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Investigate of accumulation the heavy metals Cd, Pb, and Zn in liver and muscle tissues *Capoeta trutta* fish from Dez River, southwest Iran

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Abstract

Cd, Pb and Zn concentrations were determined in muscle and liver of *Capoeta trutta* collected from northern Khuzestan province from Dez River (southwest of Iran) during March, 2012. Heavy metal concentrations varied significantly depending on the type of the tissue. Generally, showed the lowest levels of Cd and Pb and Zn metals in muscle tissues. Significant differences were observed in the concentrations of Pb and Zn, but nosignificant differences were observed between the concentration of Cd in muscle tissue and the liver. It was concluded that the level of Zn heavy metals in muscles and liver of the fish were within acceptable limits by WHO standards but concentration of Cd and Pb higher than acceptable limits by WHO standard. The main reason for pollution entering the agricultural and domestic effluents to the river.

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Introduction

Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, mutagenic and carcinogenic effects in animals (More *et al.*, 2003). Aquatic organisms have the ability to accumulate heavy metals from various sources including sediments, soil erosion and runoff, air depositions of dust and aerosol, and discharges of waste water (Labonne *et al.*, 2001; Goodwin *et al.*, 2003). The contamination of freshwaters with a wide range of pollutants has become a matter of great concern over the last few decades. Heavy metals are natural trace components of the aquatic environment, but their levels have increased due to domestic, industrial, mining and agricultural activities (Leland *et al.,* 1978; Mance, 1987; Kalay and Canli, 2000). Discharge of heavy metals into river or any aquatic environment can change both aquatic species diversity and ecosystems, due to their toxicity and accumulative behavior (Heath, 1987). Aquatic organisms such as fish and shell fish accumulate metals to concentrations many times higher than present in water or sediment (Olaifa *et al,* 2004, Gumgum *et al.,* 1994). They can take up metals concentrated at different levels in their different body organs (Khaled, 2004). Therefore, accumulation of heavy metals in aquatic organisms can pose a long lasting effect on biogeochemical cycling in the ecosphere. Heavy metals can also adversely affect the growth rate in major carps (Hayat *et al.*, 2007).

Fish are often at the top of aquatic food chain and may concentrate large amounts of some metals from the water (Mansour and Sidky, 2002). Metal bioaccumulation is largely attributed to differences in uptake and depuration period for various metals in different fish species (Tawari-Fufeyin and Ekaye, 2007). Multiple factors including season, physical and chemical properties of water (Kargin, 1996) can play a significant role in metal accumulation in different fish tissues. The gills are directly in contact with water. Therefore, the concentration of metals in gills reflects their concentration in water where the fish lives, whereas the concentrations in liver represent storage of metals in the water (Romeo *et al.*, 1999).

In most parts of Iran, water resources are scarce and insufficient to meet the growing demands of a rapidly increasing population. As a consequence, the water resources situation is now precarious and of great concern to the Government. All water bodies are looked upon as a source of exploitation for urban, agricultural and industrial uses. Many water bodies are affected by increasing salinity, pollution and eutrophication due to intensive agricultural practices. This study was undertaken to investigate the levels of heavy metal in two tissues in *Capoeta trutta* collected from Dez River, north Khuzestan province in southwest Iran.

Materials and methods

39 fish were collected from Dez River in March 2012. Fish samples were labeled, stored on ice box and the same day transported to the laboratory for further treatment and analysis. Total length and total weight of the fishes were measured. The gills, livers and muscles were separated. These tissues were dried at 90°C for 12 hrs in oven. The lyophilized fish tissues were homogenized by manual grinding in a ceramic mortar. 1gr of dried tissues from each tissue was weighed and placed in acid washed digestion tubes. A total of 10 mL of concentrated nitric acid (MERCK70%) was added to the digestion tube. All the digestion tubes were placed in a digestion block at 40°C for 1 hour and the samples were then fully digested at 140°C for 3 hrs (Yap *et al.,* 2002). After being cooled, the content of each tube was diluted to 40 mL with double de-ionized water (Yap *et al.,* 2002). The digested samples were then filtered through Whatman No.1 (filter speed: medium) filter papers in funnels into acid-washed pill boxes. For determination of trace elements using a GBC (Savant AA Sigma) flame atomic absorption spectrometer (AAS).

Data analysis

The descriptive statistics (mean, standard deviation), one-way analysis of variance (ANOVA) and Pearson correlation test were conducted using SPSS (Version 16). A one-way ANOVA statistical procedure was

employed in the assessment of variation in trace elements concentrations among stations and tissues.

Results and discussion

According to the Fig. 1 and 2, the results of measurements of heavy metals cadmium and lead in fish tissue, muscle and liver is shown. In this study, the mean heavy metals Cd, Pb, and Zn in fish muscle, 1.22, 1.42 and 3 mg/kg respectively, mean heavy metals in fish liver, 1.41, 1.66 and 12.5 mg/kg respectively ($p<0.05$). Significant differences were observed in the concentrations of Pb and Zn, but nosignificant differences were observed between the concentration of Cd in muscle tissue and the liver ($p<0.05$). Accumulation of heavy metals was higher in liver rather than muscle. In this study, muscle and liver tissues were selected as target organs, because the liver is the main organ in the body's metabolism and muscle has an important role in human nutrition and the need to ensure its safety for consumption (dadolahi sohrab *et al.,* 2008). This is in agreement with the literature (El-Nemr, 2003; Khaled, 2004; Van Aardt and Mwashot, 2003) which reported that Cd is stored in the body in various tissues, but the main site of accumulation in aquatic organisms is in the kidney and liver, beside other tissues, notably the gills, bone and exoskeleton. Average cadmium in muscle tissue of two species sturgeon in different areas of the southern Caspian Sea showed no significant difference.

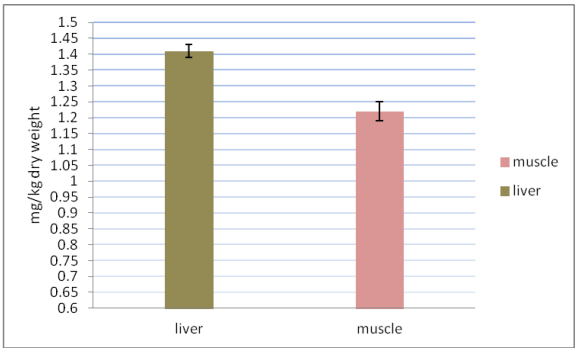

Fig. 1. Cadmium levels in muscle and liver.

Average lead in muscle tissue of the two species different significantly in away areas of the southern Caspian Sea, which is consistent with current research (Sadeghirad *et al.,* 2005). The Pb widely disseminated in the environment and high toxicity (Sari, 2001). Red blood cells, Pb enters to the body and spread to all the organs and accumulated in the liver, kidneys and skin and then accumulates in bones, teeth and spreads to the brain (Jalali Jafari and Aghazadeh. 2007)., In research on levels of cadmium on shirbot and Gatan in Dez River (Mohammadi. 2010), Biah in the river Bahmanshir and Karun (Askari sari *et al.,* 2010), six species of fish in the Mediterranean Sea (Canli and Atli., 2003) Caspian Sea golden mullet (Amini Ranjbar and Setoudeh nia., 2005) and gray mullet (Ubalua *et al.,* 2007), The results showed that the heavy metals in liver were higher than muscle and consistent with our results. the Zn concentrations measured in muscle tissue of the research results obtained by Amini Ranjbar and Setoudeh Nia in 2005, Sadeghirad *et al.,* (2005), Sabbagh Kashani (2001), Canli and Atli (2003), Javad (2004), Farkas *et al.,* (2003), Mansour and Sidkey (2002), Turkmen *et al.,* (2008), Dural *et al.,* (2010) were lower, while the results obtained by Usero *et al.,* (2003), Karadede *et al.,* (2004), Al-Yosouf *et al.,* (2000), Rashed (2001), Turkmen *et al.,* (2010), Lakshmanan *et al.,* (2009) were higher.

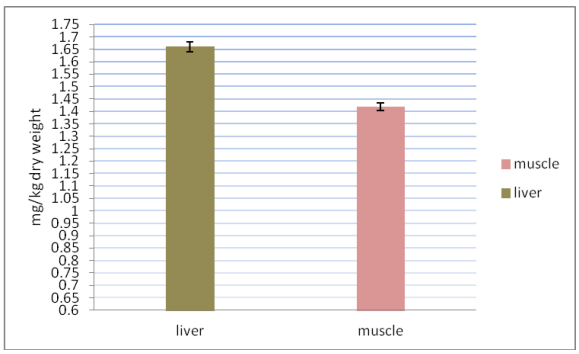

Fig. 2. Pb levels in muscle and liver

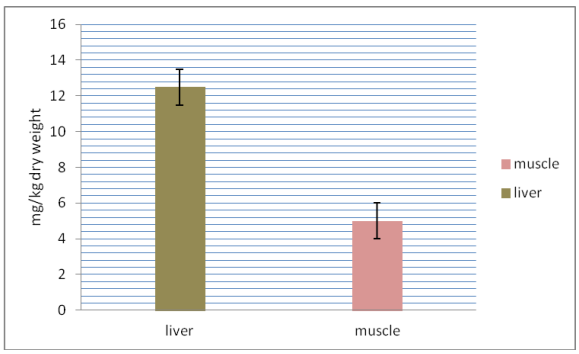

Fig. 3. Zn levels in muscle and liver.

Table 1. Maximum standard values of heavy metal in fish muscle (mg/kg).

Sources	Cd	Pb	Zn	Standard
WHO, 1985 Chen&chen, 2001	0.2	0.5	1000	WHO[1]
Colling et al., 2000	1	5	_	FDA[2]
Teodorovic et al., 2000	0.2	_	50	MAFF[3]
Darmono and Denton, 1990	0. 05	1.5	50	NHMRC[4]

1-World Health Organization, 2- U.S. Food and Drug Administration, 3- Ministry of Agriculture Fisheries, & Food (UK), 4- National Food Authority, Food Standard

Based on the measured values and comparing them to the acceptable limit based on table 1, the concentration of Pb and Cd were higher than the standard value, The Zn concentration is lower than the standard value. There are a relation between accumulation of heavy metals and different tissues of the fish species (Huang, 2003), that it may be related to dietary habits and potential bioaccumulation is any species (Farkas *et al.,* 2000). In conclusion, in this study, In accordance with table 1 and figure 1-3, it can be stated Cd and Pb concentrations in fish muscle (*Capoeta trutta*) in the Dez River is higher than the standard World Health Organization (WHO) and the Food and Drug Administration (FDA). The results of this study indicate high values of the Heavy metal in fish tissue Dez river is compared with international standards, This is due to the discharge of industrial effluents, agricultural, and urban hospitals to increase pollution of rivers and streams, especially in the downstream river of Dez achieved. Thus preventing the direct discharge of wastewater into the river Dez, and equipping of industrial wastewater treatment systems approach is essential to reduce the pollution load of the river.

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