KFBD

Karadeniz Fen Bilimleri Dergisi / The Black Sea Journal of Sciences 3(8):105-111, 2013
ISSN: 1309-4726 *http://kfbd.giresun.edu.tr*

Heavy metal contents in largehead hairtail (*Trichiurus lepturus*) from the coast of Karachi

Farzana YOUSUF[1], Quratulan AHMED[1], Mustafa TÜRKMEN[2*], Sadaf TABUSSUM[1]

[1]Department of Zoology, University of Karachi, Karachi, PAKISTAN
[2]Department of Biology, Faculty of Science & Arts, University of Giresun, Giresun, TURKEY

Sorumlu Yazar: aquratulan_ku@yahoo.com

Geliş Tarihi: 06.11.2012
Kabul Tarihi: 12.01.2013

Abstract
The concentrations of heavy metal (Fe, Zn, Cu Mn) were recorded in liver and muscles of (72) specimens of *Trichiurus lepturus* from the coast of Karachi fish harbour from August 2011 to July 2012. Our results indicated that the concentration of heavy metals was found to be generally higher in liver than muscles of fish. The highest mean concentration of Fe (591 ug/g) were recorded in fish liver and also the highest mean concentration of Fe (42.6 ug/g) were recorded in muscles. The lowest mean concentration of Mn (13.6 ug/g) in were recorded in liver of fish and lowest mean concentration of Mn (0.94 ug/g) were also recorded in muscles. Metal concentration significantly varied in different months of the year.
Keywords: Heavy metal, *Trichiurus lepturus*, Karachi coast, Pakistan

INTRODUCTION

The seas and oceans, which cover 70% of the world's surface, are one of the man's great hopes for future food supplies. As human populations multiply and industrialization increases, the problems of environmental pollution become more critical (Jerome & Williams, 1979). Heavy metals enter the aquatic environment naturally through weathering of the earth's crust. In addition to geological weathering, human activities have also introduced large quantities of metals to local water bodies, thereby disturbing the natural balance in the ecosystem (Forstner & Wittmann, 1983). Fishes are major part of the human diet and it is therefore not surprising that numerous studies have been carried out on metal pollution in different species of edible fish (Unlu *et al*., 1996; Prudente *et al*., 1997; Tepe *et al.,* 2008; Türkmen *et al.,* 2010; Mutlu *et al.,* 2012).

Low levels of copper and zinc in fish muscles appear to be due to low levels of binding proteins in the muscles (Allen-Gill & Martynov, 1995). The danger of zinc is aggravated by its almost indefinite persistence in the environment because it cannot be destroyed biologically but are only transformed from oxidation state or organic complex to another. Zinc is a potential toxicant to fish (Everall *et al.*,1989), which causes disturbances of acid-base and ionoregulation, disruption of gill tissue and hypoxia (Hogstrand *et al*., 1994).

The essential elements play vital biochemical and physiological functions in fish. Zinc, for example, is regulated to maintain a certain homeostatic status in fish (Chen & Chen, 1999), while both Fe and Cu are components of the enzyme cytochrome oxidase which is involved in energy metabolism (NAS, 1976). Toxicity of iron, for example, may lead to heamochromatosis and, in severe cases, to thalassaemia (Hovinga *et al.,* 1993).

Among the various toxic pollutants, heavy metals are particularly severe in their action due to tendency of bio-magnification in the food chain. The global heavy metal pollution of water is a major environmental problem. With the advent of agricultural and industrial revolution, most of the water sources are becoming contaminated (Khare & Singh, 2002)

The objective of this study was to determinate the concentration of heavy metals (Fe, Zn, Cu, Mn) in fish from the coast of Karachi by the Atomic Absorption Spectrophotometer dry ash method.

MATERIAL and METHOD

Totally seventy two fishes collected monthly from the coast of Karachi (Figure 1). Six fish samples collected each month from August 2011 to July 2012 were transported to the laboratory in a bucket box with ice on the same day in each study period.

Figure 1. Study area from Karachi fish horbour, Karachi coast

The fish samples measured the length in cm and weight in g. The measured mean lengths of the samples ranged from 560 to 950 mm and mean weights from 245 to 450 g. Then samples were washed with deionized water and wrapped separately in polyethylene bag and stored frozen at -20°C until analysis. Fish samples were de-scaled and rinsed with ultrapure water before dissection for the isolation of the internal organ for test samples liver and flesh muscles. Cares were taken during dissection of the internal organ (liver) to prevent any injuries and metal contaminations of the organ samples by using stainless steel dissecting kits. The isolated organs (liver and flesh muscles) were manually cut into small pieces with stainless-steel scissor and weighed accurately to (3.00±0.05 g) (wet weight basis) into individual sanitized porcelain crucibles and subsequently subjected to keep a muffle furnace at 500 ^{0}C for 3 hours. Samples were ground and calcinated at until made up white or grey ash. Weighted dry ash were dissolved in 10 ml HCl (conc) and then filtered and brought to final volume (50 ml) with distilled water. Sample blanks were prepared in the laboratory in a similar manner to the field samples.

Calibration standards were prepared from multi element standard. All samples were analyzed for iron, zinc, copper and manganese by AAnalyst 700 Atomic Absorption spectrophotometer. All metal results were expressed as ug/g dry weight. One way ANOVA and Duncan's multiple range test were performed to test the differences of the metal levels among months ($p<0.05$).

RESULT and DISCUSSION

A total (72) fish sample of *Trichiurus lepturus* were collected from fish harbour of Karachi coast for metal analysis on monthly basis. Iron showed the highest concentrations in both tissues of examined fish in all months (Table 1). Second highest metal was zinc after iron. As reported by many researchers, liver metal levels in this study were higher than muscle metal levels (Çoğun et al., 2005; Uluözlü et al., 2007; Tepe et al. 2008; Türkmen et al. 2008; Türkmen et al., 2012). There were differences among the levels of same tissues according to months ($p<0.05$).

In muscles, the lowest metal levels in ug/g d.w were found as 18.1 (Fe), 1.74 (Cu) in February 2012, 4.87 (Zn) in December 2011 and 0.94 (Mn) in August 2011. On the other hand, the highest metal levels in ug/g d.w were found as 42.6 (Fe), 16.8 (Zn), 3.31 (Mn) and 6.56 (Cu) in July 2012. Metal levels for fish muscles in literature were reported as 0.84-1.83 (Cu), 68.6-163 (Fe), 1.28-6.54 (Mn) and 35.4-106 (Zn) for fish species from Black and Aegean seas (Uluözlü et al., 2007), 2.37-3.73 (Cu), 20.9-55.8 (Fe), 1.63-5.96 (Mn) and 18.1-43.9 (Zn) for fish species from Mediterranean Sea (Abdallah & Abdallah, 2008), 0.80-7.05 (Cu), 9.18-99.0 (Fe), 0.18-2.78 (Mn) and 3.51-53.5 (Zn) for fish species from Aegean and Mediterranean seas (Türkmen et al., 2009), <0.001-4.92 (Cu), 11.6-287 (Fe), 0.255-9.717 (Mn) and 2.116-54.95 (Zn) for fish species from İstanbul fish market (Ozden et al., 2010), 0.48-1.30 (Cu), 19.3-52.3 (Fe), 0.19-0.86 (Mn) and 3.41-11.2 (Zn) for fish species from Akyatan Lagoon, Mediterranean (Türkmen et al., 2012).

In livers, the lowest metal levels in ug/g d.w were found as 401 (Fe), 13.4 (Cu) in February 2012, 27.3 (Zn) in August 2011 and 13.6 (Mn) in November 2011. On the other hand, the highest metal levels in ug/g d.w were found as 598 (Fe) in November 2011 and 43.2 (Cu) in August 2011, 75.0 (Zn) and 53.3 (Mn) in June 2012.

Table 1. Comparison of heavy metal concentrations (ug/g d.w) in muscles and liver of fish *Trichiurus lepturus* from the cost of Karachi*

Sampling months	**Tissues**	**Iron**	**Zinc**	**Manganese**	**Copper**
August 2011	Muscle	20.1 ± 2.83^{a}	6.53 ± 0.42^{ab}	0.94 ± 0.21^{a}	1.93 ± 0.24^{ab}
	Liver	455 ± 38.9^{12}	27.3 ± 2.16^{1}	14.8 ± 0.64^{1}	43.2 ± 5.19^{2}
September 2011	Muscle	20.7 ± 2.04^{a}	7.14 ± 0.30^{abc}	1.79 ± 0.27^{abcd}	2.19 ± 0.44^{ab}
	Liver	409 ± 44.9^{1}	34.4 ± 4.60^{123}	15.4 ± 0.59^{1}	42.02 ± 4.82^{2}
October 2011	Muscle	26.5 ± 4.71^{ab}	10.2 ± 0.76^{bcde}	2.06 ± 0.44^{abcd}	1.82 ± 0.40^{a}
	Liver	448 ± 39.7^{12}	32.4 ± 3.34^{12}	21.7 ± 3.90^{12}	15.7 ± 1.56^{1}
November 2011	Muscle	28.1 ± 3.26^{ab}	10.7 ± 0.79^{cde}	1.26 ± 0.17^{ab}	2.48 ± 0.31^{abc}
	Liver	598 ± 49.6^{2}	45.2 ± 3.09^{2345}	13.6 ± 1.20^{1}	15.5 ± 1.56^{1}
December 2011	Muscle	19.0 ± 1.56^{a}	4.87 ± 0.24^{a}	1.29 ± 0.21^{ab}	2.21 ± 0.26^{ab}
	Liver	418 ± 23.7^{1}	42.1 ± 3.43^{2345}	26.5 ± 3.49^{12}	37.7 ± 6.01^{2}
January 2012	Muscle	26.5 ± 4.90^{ab}	8.41 ± 0.36^{abcd}	1.62 ± 0.28^{abc}	2.61 ± 0.16^{abcd}
	Liver	537 ± 59.3^{12}	35.7 ± 3.30^{123}	20.4 ± 2.99^{12}	15.1 ± 1.24^{1}
February 2012	Muscle	18.1 ± 1.89^{a}	9.55 ± 0.98^{bcde}	1.72 ± 0.20^{abcd}	1.74 ± 0.22^{a}
	Liver	401 ± 27.8^{1}	53.0 ± 3.21^{45}	26.2 ± 3.29^{12}	13.4 ± 0.74^{1}
March 2012	Muscle	35.6 ± 2.23^{bcd}	9.62 ± 0.99^{bcde}	2.45 ± 0.45^{bcde}	3.18 ± 0.60^{abcd}
	Liver	555 ± 47.4^{12}	44.0 ± 4.13^{2345}	22.5 ± 1.27^{12}	34.4 ± 6.05^{2}
April 2012	Muscle	26.7 ± 3.11^{ab}	9.16 ± 0.74^{bcd}	2.68 ± 0.69^{cde}	4.32 ± 1.10^{bcde}
	Liver	500 ± 34.5^{12}	39.3 ± 5.47^{1234}	26.0 ± 3.40^{12}	42.4 ± 7.84^{2}
May 2012	Muscle	29.7 ± 6.62^{abc}	13.4 ± 1.22^{ef}	2.47 ± 0.35^{bcde}	4.93 ± 1.31^{de}
	Liver	498 ± 35.6^{12}	55.1 ± 4.58^{5}	33.4 ± 3.40^{2}	35.9 ± 8.40^{2}
June 2012	Muscle	41.1 ± 6.04^{cd}	11.8 ± 1.31^{de}	2.86 ± 0.23^{de}	4.79 ± 1.34^{cde}
	Liver	536 ± 65.5^{12}	75.0 ± 7.61^{6}	53.3 ± 7.68^{3}	39.3 ± 6.20^{2}
July 2012	Muscle	42.6 ± 4.07^{d}	16.8 ± 3.22^{f}	3.31 ± 0.53^{e}	6.56 ± 0.92^{e}
	Liver	581 ± 82.3^{2}	48.2 ± 6.04^{345}	54.0 ± 9.47^{3}	41.3 ± 6.27^{2}
Total	**Muscle**	**27.9±1.40**	**9.86±0.49**	**2.04±0.13**	**3.23±0.26**
	Liver	**495±15.0**	**44.3±1.88**	**27.3±1.92**	**31.3±1.99**

*Vertically, letters *a* and *b* show differences among levels in muscles according to months, *1* and *2* differences among levels in livers according to months, and levels sharing the same letters were not significantly different from one another.

Metal levels for fish livers in literature were reported as 20.8-260 (Cu), 236-363 (Fe) and 111-160 (Zn) for fish species from Mediterranean Sea (Çoğun et al., 2005), 1.11-46.2 (Cu), 49.9-889 (Fe), 0.72-7.33 (Mn) and 9.83-195 (Zn) for fish species from Turkish seas (Tepe et al., 2008), 2.61-7.25 (Cu), 92.8-137 (Fe), 1.29-4.10 (Mn) and 15.3-25.5 (Zn) for fish species from

Yelkoma Lagoon, Mediterranean (Türkmen et al., 2010), 3.36-29.7 (Cu), 92.9-176 (Fe), 1.06-2.56 (Mn) and 16.9-26.8 (Zn) for fish species from coastal waters of Turkey (Mutlu et al., 2012), 1.31-20.5 (Cu), 76.7-308 (Fe), 0.46-2.11 (Mn) and 16.0-37.9 (Zn) for fish species from Akyatan Lagoon, Mediterranean (Türkmen et al., 2012). Studies have also indicated that fish are able to accumulate and retain heavy metals from their environment and that accumulation of metals in tissues of fish is dependent upon exposure concentration and duration as well as other factors such as salinity, temperature hardness and metabolism of the animals (Cusimano *et al.,* 1986; Heath, 1987; Allen, 1995; Karthikeyan *et al.,* 2007).

The results of the present study supply valuable information about metal contents in muscle and liver of *Trichiurus lepturus* from the cost of Karachi and indirectly indicate the environmental contamination of the environment. Moreover, these results can also be used to understand the chemical quality of fish and to evaluate the possible risk associated with their consumption. Statistically significant differences were observed in the mean metal values from different months their tissues ($p<0.05$). According to Nauen (1983) the maximum permissible copper and zinc levels are 10-100 and 30-100 mg kg^{-1} for fish respectively. Since the levels of copper and zinc both muscle and liver of the examined fishes in this study were lower than maximum permissible levels, it may be concluded that consumption of this species from the cost of Karachi is not a problem on human health.

REFERENCES

Abdallah, M.A.M., Abdallah, A.M.A. 2008. Biomonitoring study of heavy metals in biota and sediments from the southern coast of the Mediterranean Sea, Egypt. Environmental Monitoring and Assessment, 146: 139-145.

Allen, P. 1995. Chronic accumulation of cadmium in the edible tissues of *Oreochromis aureus* (Steindachner): Modification by mercury and lead. Arch. *Environ. Contam. Toxicol.,* 29: 8-14.

Allen-Gill, S. M., Martynov V.G. 1995. Heavy metals burdens in nine species of freshwater and anadromous fish from the Pechora River, Northern Russia. *Sci. Total Environ.,* 160-161: 653-659.

Chen, M.H., Chen, C.Y. 1999. Bioaccumulation of sediment-bound heavy metals in grey mullet, *Liza macrolepis*. *Mar. Pollut. Bull.* 39: 239-244.

Cusimano, R.F., Brakke, D.F., Chapman, G.A. 1986. Effects of pH on the Toxicities of Cadmium, Copper and Zinc to Steelhead trout *(Salmo gairdneri). Can. J. Fish Aquat. Sci.,* 43: 1497-1503.

Çoğun, H., Yüzereroğlu, T.A., Kargin, F., Firat., Ö. 2005. Seasonal Variation and Tissue Distribution of Heavy Metals in Shrimp and Fish Species from the Yumurtalik Coast of Iskenderun Gulf, Mediterranean. Bulletin of Environmental Contamination and Toxicology, 75: 707-715.

Everall, N.C., MacFarlane, N.A.A., Sedgwick, R.W. 1989. The interactions of water hardness and pH with the acute toxicity of zinc to the brown trout, *Salmo trutta* L. J. Fish. Biol., 35: 27-36.

Forstner, U., Wittmann, G.T.W. 1983. Metal pollution in the aquatic environment. Berlin, Springer-Verlag., pp: 30-61.

Heath, A.G. 1987. Water Pollution and Fish Physiology. CRC Press, Florida, USA.

Hogstrand, C., Wilson, R.W., Polgar, D., Wood, C.M. 1994. Effects of zinc on the kinetics of branchial calcium uptake in freshwater rainbow trout during adaptation to waterborne zinc. *J. Exp. Biol.,* 186:55-73.

Hovinga M.E., Sowers M., Humphrey H.E. 1993. Environmental exposure and lifestyle predictors of lead, cadmium and PCB and DDT levels in Great Lakes fish eaters. *Arch. Environ. Health*, 48: 98-104.

Jerome and Williams,, 1979. Introduction to marine pollution control, John Wiley-Inter Science Publication. pp 1-50.

Karthikeyan, S., Palaniappan, P.R., Sabhanayakam, S. 2007. Influence of pH and water hardness upon nickel accumulation in edible fish *Cirrhinus mrigala. J. Environ. Biol.,* 28, 484-492.

Khare, S., Singh, S. 2002. Histopathological lessons induced by copper sulphate and lead nitrate in the gills of fresh water fish Nandus. *J. Ecotoxicol. Environ. Monit.,* 12: 105-111.

Mutlu C., Türkmen A., Türkmen M., Tepe Y., Ateş A. 2012. Comparision of the heavy metal concentrations in Atlantic Horse Mackerel, *Trachurus trachurus*, from coastal waters of Turkey. *Fresenius Environmental Bulletin*, 21: 304-307.

NAS., 1976. Food and Nutrition Board. Zinc in human nutrition. In: *Introduction to Nutrition*, Fleck, H. (Ed). 3rd Edn. Macmillan, New York.

Ozden O., Erkan N., Ulusoy S. 2010. Determination of mineral composition in three commercial fish species (*Solea solea*, *Mullus surmuletus*, and *Merlangius merlangus*). Environmental Monitoring and Assessment 170: 353-363.

Prudente, M., Kim, E. Y., Tanabe, S., Tatsukawa, R. 1997. Metal levels in some commercial fish speciesfrom Manila Bay, Phulippines. *Marine Pollution Bulletin,* 34: 671-674.

Tepe Y, Türkmen M, Türkmen A. 2008. Assessment of heavy metals in two commercial fish species of four Turkish seas. *Environmental Monitoring and Assessment*, 146: 277-284.

Türkmen, M. Türkmen, A. Tepe, Y. Ateş, A. Gökkuş, K. 2008. Determination of metal contaminations in sea foods from Marmara, Aegean and Mediterranean seas: Twelve fish species. Food Chemistry, 108: 794-800.

Türkmen, M., Türkmen, A., Tepe, Y., Töre, Y., Ateş, A. 200). Determination of Metals in Fish Species from Aegean and Mediterranean Seas. *Food Chemistry,* 113: 233-237.

Türkmen A., Türkmen M., Tepe Y., Çekiç M. 2010. Metals in tissues of fish from Yelkoma Lagoon, northeastern Mediterranean. *Environmental Monitoring and Assessment*, 168: 223-230.

Türkmen, A., Tepe, Y., Türkmen, M., Ateş, A. 2012. Investigation of Metals in Tissues of Fish Species from Akyatan Lagoon. *Fresenius Environmental Bulletin*, 21, (11c): 3562-3567.

Uluozlu, O.D., Tuzen, M., Mendil, D.,Soylak, M. 2007. Trace metal content in nine species of fish from the Black and Aegean Seas, Turkey. *Food Chemistry*, 104: 835-840.

Unlu, E., Akba, O., Sevim, S., Gumgum, B. 1996. Heavy metal levels in mullet, *Liza abu* (Heckel, 1843) (mugilidae) from the Tigris river, Turkey. *Fresenius Environmental Bulletin,* 5: 107-112.