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Determination of (Fe, Mn, Cd, Pb, Cr) Concentration in *Sardinella melanura* (Cuvier, 1829) from Balochistan coast, Pakistan

Quratulan AHMED[1], Mustafa TÜRKMEN[2], Naeema ELAHI[3]

[1]The Marine Reference Collection and Resource Centre, University of Karachi, PAKISTAN
[2]Department of Biology, Faculty of Science & Arts, University of Giresun, Giresun, TURKEY
[3]Department of Zoology, University of Karachi, PAKISTAN

Sorumlu Yazar: quratulanahmed_ku@yahoo.com

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Abstract

Total (36) samples of *Sardinella melanura* fish were collected from Balochistan coast during Pre-monsoon, Mon-soon, and Post-monsson (from January 2006 to December 2006). The highest Fe (456), Mn (5.95), Cd (1.24), Pb (1.49), Cr (1.38) were found in liver of fish in µg/g. Although muscles showed the lowest metal levels, livers showed the higher metal levels in all season of the year.
Keywords: Heavy metals, *Sardinella melanura*, Balochistan coast, Pakistan

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; Matyar *et al.,* 2010, Akkan *et al.,* 2013). 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). Currently, fish is considered one of the most important foods to humans and is used in a variety of diets; it is a good source of digestible protein, vitamins, minerals, and polyunsaturated fatty acids (Carvalho *et al.,* 2005) which support healthy living (Ikem and Egiebor, 2005). However, fishes are good indicators of heavy metal contamination in aquatic systems because they occupy different tropic levels and are of different sizes and ages (Burger *et al.*, 2002).

The heavy metal intakes by fish in a polluted aquatic environment vary depending on ecological requirements, metabolisms, and other factors, such as salinity, water pollution level, food, and sediments. Fish accumulates metals in its tissues through absorption, and humans can be exposed to these metals via the food web. The consumption of contaminated fish causes acute and chronic effects to humans (Nord *et al.,* 2004).

The aim of this study to determine heavy metal (Fe, Mn, Cd, Pb, Cr) Concentration in *Sardinella melanura* tissues from Balochistan coast, Pakistan during January 2006-December 2006.

MATERIAL AND METHOD

The data reported in this study were collected on a seasonally (Pre-monsoon, Mon-soon, Post-monsoon) basis between (from January 2006 to December 2006) from Gawadar, Balochistan coast. Specimens were caught by Gill net (length-19m, width-3m and mesh size-33mm). All fishes obtained from the station were measured and weighed separately. Total (36) fish collected in this study for metal analysis. Approximately 5 g of samples muscle (edible parts), entire liver, entire kidney were dissected, with the help of scalpels and scissors wash with de-ionized water, and take fresh weighted. Samples were ground and calcinated at 500 ^{o}C for 3 hrs until made up white or grey ash. The ashes were dissolved in 10 ml (HCl) in beaker and after which the dissolved ash residue was filtered with whatman filter paper, 1 ml filtered solution diluted with 25 ml distilled water and make standards for elemental analysis. 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 (Fe, Mn, Cd, Pb, Cr) by AAnalyst 700 Atomic Absorption spectrophotometer. All metal results were expressed as ug/g^{-1} dry weight.

RESULT AND DISCUSSION

Total (36) sample of *Sardinella melanura* fish were collected from Balochistan coast from January 2006 to December 2006. The study area map was shown in Figure 1. Length (cm) and weight (gm) of fish shown in (Table 1). The highest Fe (456), Mn (5.95), Cd (1.24), Pb (1.49), Cr (1.38) in µg/g were found in fish livers. Kidney showed second highest metal levels. The highest metal levels in kidney in µg/g were Fe (36.5), Mn (2.83), Cd (0.67), Pb (0.64), Cr (0.71). Muscles showed the lowest levels in all season of the year. The highest Fe (10.2), Mn (0.56), Cd (0.33), Pb (0.19), Cr (0.29) were measured in muscles in µg/g (Table 2). Similar situations were reported by many researches (Türkmen & Ciminli 2007; Tepe et al. 2008, Türkmen et al. 2010; Türkmen et al., 2013).

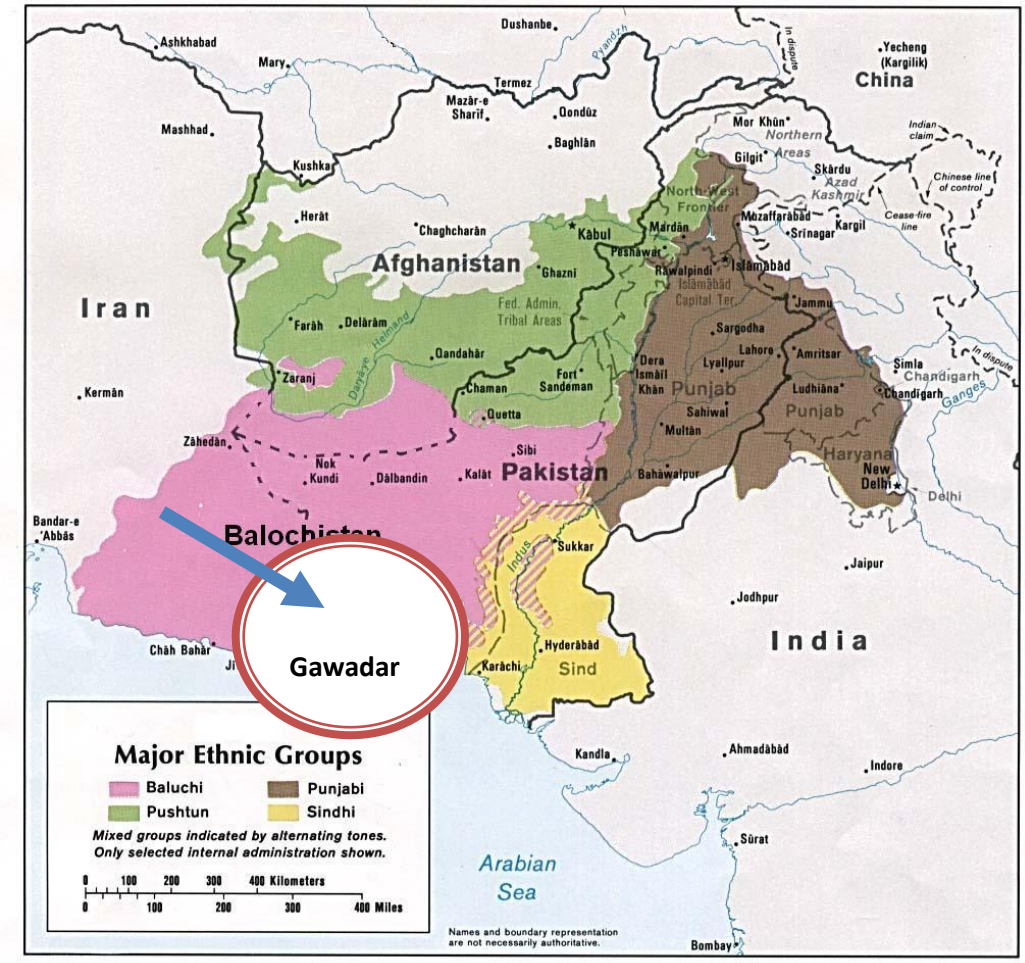

Figure 1. Study Area Map

Table 1. Mean length (cm) and weight (gm) of *Sardinella melanura* (Cuvier, 1829) during different seasons of the year (January 2006-December 2006) from Balochistan coast

Seasons	n*	Length (cm)	Weight (g)
Pre-monsoon	12	15.6± 1.90	26.5± 6.18
Mon-soon	12	18.6± 1.65	39.5± 5.26
Post-monsoon	12	17.9± 2.23	35.5± 7.42
Total	36	17.5± 2.41	35.5± 8.73

Post-Monsoon season showed the highest Fe, Mn and Cd levels in all tissues, the highest Cr in liver and muscle. On the other hand, Pre-monsoon season showed the highest Pb levels in liver and kidney, Monsoon season had the highest Pb in muscles and Cr in kidneys (Table 2). The differences among different seasons in the same tissue were significant for Mn and Cd in livers and for Fe, Mn, Pb and Cr in kidneys ($p<0.05$). On the other hand, the differences among different tissues of the same season were significant for all tissues in all seasons except Cd for Monsoon season ($p<0.05$).

Table 2. Mean metal concentrations in tissues and seasons of fish samples

Tissues	Seasons	Fe	Mn	Cd	Pb	Cr
Muscle	Pre-monsoon	9.56 ± 1.20^{ax}	0.52 ± 0.04^{ax}	0.20 ± 0.03^{ax}	0.17 ± 0.03^{ax}	0.13 ± 0.03^{ax}
	Mon-soon	7.11 ± 0.87^{ax}	0.40 ± 0.04^{ax}	0.24 ± 0.04^{ax}	0.19 ± 0.04^{ax}	0.28 ± 0.05^{ax}
	Post-monsoon	10.2 ± 1.13^{ax}	0.56 ± 0.10^{ax}	0.33 ± 0.08^{ax}	0.18 ± 0.04^{ax}	0.29 ± 0.07^{ax}
Liver	Pre-monsoon	430 ± 26.0^{ay}	4.24 ± 0.28^{ay}	0.53 ± 0.05^{ay}	1.49 ± 0.13^{ay}	0.95 ± 0.15^{ay}
	Mon-soon	421 ± 23.7^{ay}	4.80 ± 0.53^{aby}	1.15 ± 0.15^{bx}	1.39 ± 0.08^{ay}	1.26 ± 0.23^{ay}
	Post-monsoon	456 ± 24.7^{ay}	5.95 ± 0.55^{by}	1.24 ± 0.19^{by}	1.37 ± 0.10^{ay}	1.38 ± 0.17^{ay}
Kidney	Pre-monsoon	22.2 ± 3.77^{ax}	1.73 ± 0.23^{az}	0.35 ± 0.03^{az}	0.64 ± 0.04^{az}	0.44 ± 0.06^{ax}
	Mon-soon	27.1 ± 2.79^{abx}	2.55 ± 0.23^{abz}	0.60 ± 0.11^{ax}	0.41 ± 0.05^{bz}	0.71 ± 0.10^{bx}
	Post-monsoon	36.5 ± 3.56^{bx}	2.83 ± 0.31^{bz}	0.67 ± 0.14^{ax}	0.60 ± 0.04^{az}	0.61 ± 0.05^{abx}

*Vertically, letters *a* and *b* show differences among different seasons in the same tissue, and *x* and *y* differences among different tissues of the same season ($p<0.05$).

In muscles, the mean metal levels in mg kg^{-1} were found as 0.20-0.33 (Cd), 7.11-10.2 (Fe), 0.13-0.29 (Cr), 0.40-0.56 (Mn) and 0.17-0.19 (Pb). Metal levels in mg kg^{-1} for fish muscles in literature were reported as <0.30-8.33 (Cd), <0.01-0.54 (Cr), 1.0-

89.8 (Fe), <0.02-1.04 (Mn), <0.05-2.77 (Pb) (Carvalho et al., 2000); 0.002-0.029 (Cd), 3.30-16.6 (Cr), 5.67-54.49 (Fe) and 0.273-0.986 (Mn) (Company et al., 2010); 0.02-0.37 (Cd), 0.04-1.75 (Cr), 7.46-40.1 (Fe), 0.10-0.99 (Mn) and 0.33-0.86 (Pb) (Türkmen et al. 2008); 0.07-0.38 (Cd), 0.42-1.87 (Cr), 13.4-23.7 (Fe), 0.44-0.85 (Mn) and 0.62-0.81 (Pb) (Türkmen et al, 2009); and 0.10-0.47 (Cd), 0.17-0.72 (Cr), 28.9-52.3 (Fe), 0.75-0.96 (Mn) and 0.19-0.47 (Pb) (Türkmen et al. 2010) (Table 3).

The present study provides valuable preliminary information on metal contents in different tissues of fish in different seasons from the study site, and indirectly indicates the environmental contamination of the coast. Moreover, the results showed that muscle tissue of fish was not heavily burdened with metals, as concentrations were below the legal values for fish and fishery products proposed by Nauen (1983). Comparison of our data with the Turkish acceptable limits (TKB, 2002) showed that our values were also lower than national guidelines except Cd (Table 4). However, these results should be confirmed occasionally by running more detailed studies in the coast to update our knowledge of heavy metal contaminants in fish.

Table 3. Comparison of heavy metal concentration ranges in edible muscle tissue of fish from this study with other studies and guidelines for maximum allowable concentrations

Studies/ Guidelines	Metals and concentrations (mg kg^{-1})				
	Cd	Cr	Fe	Mn	Pb
This study	0.20-0.33	0.13-0.29	7.11-10.2	0.40-0.56	0.17-0.19
Türkmen et al. 2008	0.02-0.37	0.04-1.75	7.46-40.1	0.10-0.99	0.33-0.86
Türkmen et al. 2009	0.07-0.38	0.42-1.87	13.4-23.7	0.44-0.85	0.62-0.81
Türkmen et al. 2010	0.10-0.47	0.17-0.72	28.9-52.3	0.75-0.96	0.19-0.47
Carvalho et al., 2000	<0.30-8.33	<0.01-0.54	1.0-89.8	<0.02-1.04	<0.05-2.77
Company et al., 2010	0.002-0.029	3.3-16.6	5.67-54.5	0.27-0.99	--
TKB, 2002	**0.1**	**-**	**-**	**-**	**1.0**
Nauen, 1983	**0.05-5.5**	**1.0**	**-**	**-**	**0.5-6.0**

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