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HEAVY METALS (Fe, Mn, Pb, Cd, AND Cr) CONCENTRATIONS IN MUSCLES, LIVER, KIDNEYS AND GILLS OF TORPEDO SCAD [*MEGALASPIS CORDYLA* (LINNAEUS, 1758)] FROM KARACHI WATERS OF PAKISTAN

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ABSTRACT

The samples of fish, *Megalaspis cordyla* (Linnaeus) collected in Pre-monsoon (January to May), Monsoon (June to August) and Post-monsoon (September to December) seasons of 2010 from coastal waters of Karachi were measured for their size and heavy metals (Fe, Mn, Cd, Pb and Cr) in their muscles, liver, kidneys and gills were analyzed. The fish samples studied varied little in size - from 3.39 to 4.65% in length and 10.13 to 10.75% in weight. It was obvious from three-way ANOVA that different metals accumulated in different concentrations in the fish ($F = 365.57$, $p < 0.0001$), the concentration of metals was significantly influenced by the seasonal variation ($F = 15.81$, $p < 0.0001$) and also significantly varied with the organ type of the fish ($F = 614.02$, $p < 0.0001$). Seasons, organs and metal types, all interacted significantly ($F = 10.85$, $p < 0.001$). Fe was the predominant metal amongst all and was found to be significantly high in concentration than that of the other metals. The concentration of other metals (Mn, Cd, Pb and Cr) didn't differ significantly from each other. Metals accumulated predominantly in liver. Muscles, kidneys and gills were not significantly different from each other in metals contents. Heavy metal contents of local *M. cordyla* were compared with the published reports on *M. cordyla* from South and Southeast Asian countries.

Key-words: Heavy metals (Fe, Mn, Pb, Cd, Cr), *Megalaspis cordyla*, Karachi Coastal Water.

INTRODUCTION

Fishes form an excellent source of digestible proteins, vitamins, minerals and polyunsaturated fatty acids (Daviglus *et al.*, 2002) but are also the source of heavy metals. Some of the metals found in the fish might be fundamental as they play vital role in biological system of the fish as well as in human beings but some of them may however, be toxic and may cause serious damage to the human health if present in excess to the permitted limits. The common heavy metals that are found in fish may include Cu, Fe, Zn, Ni, Mn, Hg, Pb, Cd, etc. from Pakistan waters or elsewhere (Connell, 1984, Rizvi *et al.*, 1988; Tariq *et al.*, 1991, 1998; Nair et al., 1997; Zehra *et al.*, 2003; Agusa et al., 2005, 2007; Dalman *et al.*, 2006; Naidu et al., 2008; Tabinda *et al.*, 2010; Kumar *et al.*, 2012; Shivakumar *et al.*, 2014; El-Moselhy *et al.*, 2014). Ambedkar and Muniyan (2011) found Cr in maximum concentration followed by Cd > Cu > Pb > Zn in the fishes of Vellar River, Tamil Nadu (India) including *Megalaspis cordyla* and four other fishes caught during January to June, 2010. It has been recognized for many years that the concentrations of metals found in coastal areas, whether they are in the dissolved or particulate phase are derived from a variety of anthropogenic and natural sources (Burridge *et al.*, 1999). The major part of the anthropogenic metal load in the sea and sea bed sediments and organisms has a terrestrial source from mining and intensive aquaculture and municipal wastewaters, untreated effluents, harbor activities, urban and agricultural runoff along major rivers and estuaries and bays. Heavy metals have the tendency to accumulate in various organs of marine organisms, especially fish, which in turn may enter into the human metabolism through consumption causing serious health hazards (Puel *et al*., 1987). Iron, copper, zinc and manganese are essential (physiological) metals while, mercury, lead and cadmium are xenobiotic toxic metals (Kennish, 1992).

Megalaspis cordyla (Linnaeus, 1758) syn. *Scomber cordyla* Linnaeus 1758 is a migratory pelagic fish abundant in inshore water of continental shelf and also in offshore oceanic waters. It is commonly known by various names Torpedo scad, finny scad, cordyla scad, hardtail scad, fin-letted mackerel, torpedo trevally, etc. It is broadly distributed throughout Western Indian Ocean and elsewhere in the Western Pacific Ocean from Japan to Australia. In Pakistan, it is commonly called Kauwa Machh (Ahmad *et al.*, 2013). *M. cordyla* inhabits water up to 60m depth (Quddus and Shafi, 1983) or 20-100m depth (hppp"//www.fishwise.co.za/……). It is fast swimmer and predator species which feeds mainly on smaller fishes (13.23%), cephalopods (8.73%) and crustaceans (4.20%) – fish being the main item preferred (Jadhav and Mohite, 2013). It measures around 30-40 cm (maximally 80 cm) in length. It is economically important and its large catches are reported from Thailand, and Malaysia (Fischer and Bianchi, 1984). It is exploited as by-catch or incidental catches in gillnet, bottom trawl and shrimp trawl in Pakistan (Ahmad *et al.*, 2013). The main aim of the present work was to determine the concentration of heavy metals (Fe, Mn, Pb, Cd, and

Cr) in muscles, liver, kidney and gills of this species collected from Karachi waters (Northern Arabian Sea) during January 2010 - December 2010.

MATERIAL AND METHODS

Samples of fish *Megalaspis cordyla* were collected in Pre-monsoon (January to May), Monsoon (June to August) and Post-monsoon (September to December) seasons from coastal water of Karachi (Latitude: 24°50'49.56" and Longitude: 66°59'8.16") (Fig. 1A and B). The length (L) of the fish was measured from the tip of the mouth to the caudal fin (cm). Fish weight was measured after drying with a piece of clean towel. Total length (TL) and body weight (W) were measured with fresh samples to the nearest 0.1 cm and 0.01 g, respectively. Samples were collected for the analysis of heavy metals. Fishes were dissected using steel Scissors and scalpels to remove approximately 5 g dorsal muscles, entire liver, 2 rakers of gills and entire kidneys. They were washed with deionized water and weighed after blotting excess surface water. Samples were ground and calcinated at 500^{o}C for 3 hours until it turned to white or grey ash and reweighed.

The ashes were dissolved with 0.1 M HCl according to the method of (Gutierrez *et al*., 1978). The ashes were dissolved in 10 ml (HCl) in beaker and after which the dissolved ash residue was filtered with Whatman filter paper. One ml filtered solution was diluted with 25 ml distilled water for elemental analyses. The standards were prepared from 1000 ppm stock solution to 2 ppm, 4 ppm, 6 ppm, etc. Elemental analysis was made with atomic absorption spectrophotometer (Analyst 700) in the Centralized laboratories of University of Karachi. The concentration of metals was expressed as µg per g dry weight. The data was analyzed with SPSS version 12.

The contents of selected heavy metals in Karachi seawater are presented in Table 1.

Figure 1A: Coastal area of Karachi – fish collection area in North Arabian Sea.

Figure 1B. An individual of *Megalaspis cordyla* from Karachi Coast, Pakistan. Source: Hamid Badar Osmany. (hamid61612002@yahoo.com) www.fishbase.us /photos

RESULTS AND DISCUSSION

Thirty six fish samples of marketable-sized *Megalaspis cordyla* were collected from Karachi fish harbour during (Pre-monsoon, Monsoon, Post-monsoon) season in (January 2010-December 2010). The fish samples studied for metallic contents varied little in size - from 3.39 to 4.65% in length and 10.13 to 10.75% in weight. The length (25.47 ± 0.34cm) and weight (160.2 ± 4.59 g) were found to be the highest in Monsoon season and the lowest length (22.67 ± 0.2277cm) and weight (114.9 ± 3.63 g) were measured in Post-monsoon season. There was direct relationship between length and weight (Table 2).

Comparing the concentrations of metals in various parts of the fish with that of the seawater (Table 1) it is clear that multi-fold bioaccumulation of metals has taken place in fish at different rates in different organs. The accumulation is also the function of seasonality.

The heavy metal concentration (Fe, Mn, Pb, Cd and Cr) were measured in Muscles, Liver, Kidney and Gills of the fish *M. cordyla* during pre-monsoon, monsoon and post-monsoon seasons (Table 3, 4 and 5). The highest level of Fe (553.61 ± 28.29 µg/g) concentration was recorded in liver during monsoon season. Also the maximum mean concentrations of Mn (11.84 ± 0.97 µg/g), Pb (2.17 ± 0.23 µg/g), Cd (2.43 ± 0.51 µg/g), and Cr (2.62 ± 0.23 µg/g) were measured in liver, kidney and gills, respectively during Post-monsoon season.

Table 1. Contents of heavy metals in sediments and Seawater of Karachi in ppm.

Location	Fe	Mn	Cd	Pb	Cr	Reference
Karachi mangroves *	-	-	0.064 ± 0.16	0.77 ± 0.16	-	Ismaili *et al* (2014)
Miani Hor	-	-	0.057	0.04	-	
Keti Bunder to Giddani ****	0.531 ± 0.11** (35.9 ± 27.9) ***	0.302 ± 0.154 (N= 13)	0.0133 ± 0.003 (N = 11)	0.159 ± 0.0046 (N = 13)	0.885 ± 0.472 (N =12)	Mumtaz (2002)
Standard unpolluted Seawater	0.0034	0.0004	0.00011	0.00003	0.0002	Turekian (1968)

*, mean of six sites; **, mean excluding Bin Qasim sample (312 ppm) and Giddani sample (148 ppm) - heavily Fe-polluted sites; ***, Mean including Port Qasim and Giddani sites; ****, mean for thirteen 13 sites calculated from the data of Mumtaz (2002).

Table 2. Mean length and weight of *Megalaspis cordyla* collected from Coastal water of Karachi.

Seasons	N	Length (cm) (Mean ± SE)	CV (%) (Length)	Weight (g) (Mean ± SE	CV (%) (Weight)
Pre-monsoon	12	23.83 ± 0.44	4.64	138.5 ± 5.63	14.13
Monsoon	12	25.47 ± 0.34	4.65	160.2 ± 4.594	10.23
Post-monsoon	12	22.67 ± 0.22	3.39	114.9 ± 3.63	10.75

Linear Length-Weight Relationship (N = 36)

$W = -233.6001 + 15.4865 L \pm 5.743$

t = -15.40 t = 24.54

$p < 0.0001$ $p < 0.0001$

$r = 0.9729$, $r^2 = 0.9466$, Adj. $r^2 = 0.9449$; $F = 602.06$ ($p < 0.0001$)

Table 3. Mean concentration of heavy metals in various organs of *Megalaspis* during Pre-monsoon season. N = 12.

Organs	Fe (µg/g) (Mean ± SE)	Mn (µg/g) (Mean ± SE)	Pb (µg/g) (Mean ± SE)	Cd (µg/g) (Mean ± SE)	Cr (µg/g) (Mean ± SE)
Muscles	37.10 ± 5.21	2.73 ± 0.36	0.22 ± 0.06	0.51± 0.09	0.17± 0.04
Liver	298.76 ±25.16	7.38 ± 0.52	1.52 ± 0.33	1.64 ± 0.20	1.77± 0.21
Kidney	21.12 ± 3.21	3.82 ± 0.58	1.47 ± 0.19	1.58 ± 0.18	1.57± 0.53
Gills	27.37± 3.70	6.21± 0.62	1.27± 0.15	1.48 ± 0.25	1.72 ± 0.23

Table 4. Mean concentration of heavy metals in various organs of *Megalaspis* during monsoon season. N = 12.

Organs	Fe (µg/g) (Mean ± SE)	Mn (µg/g) (Mean ± SE)	Pb (µg/g) (Mean ± SE)	Cd (µg/g) (Mean ± SE)	Cr (µg/g) (Mean ± SE)
Muscles	48.398 ± 7.79	2.47±.37	0.51± 0.09	0.54 ± 0.06	0.46 ± 0.09
Liver	553.61 ± 28.29	7.54 ± 0.52	1.89 ± 0.20	1.72 ± 0.25	1.82 ± 0.28
Kidney	40.48 ± 5.717	4.17± 0.66	1.47± 0.19	1.48 ± 0.15	1.41 ± 0.12
Gills	38.49 ± 5.56	2.92 ± 0.59	1.68 ± 0.19	1.64 ± 0.13	0.39 ± 0.16

Table 5. Mean concentration of heavy metals in various organs of *Megalaspis* during Post-monsoon season (N = 12)

Organs	Fe (µg/g) (Mean ± SE)	Mn (µg/g) (Mean ± SE)	Pb (µg/g) (Mean ± SE)	Cd (µg/g) (Mean ± SE)	Cr (µg/g) (Mean ± SE)
Muscles	38.20 ± 7.219	2.29 ± 0.50	0.4 9 ± 0.06	0.29 ± 0.06	0.26 ± 0.06
Liver	473.46 ± 28.24	11.84 ± 0.92	1.44 ± 0.20	2.23 ± 0.31	2.11 ± 0.19
Kidney	32.92 ± 4.420	2.01 ± 0.20	2.17 ± 0.23	2.36 ± 0.13	2.62 ± 0.23
Gills	27.79 ± 4.10	4.07 ± 0.60	2.16 ± 0.22	2.43 ± 0.15	1.88 ± 0.16

Table 6: Mean concentration of heavy metals in various organs of *Megalaspis* (data of all seasons pooled).

Organs	Fe (µg/g) (Mean ± SE)	Mn (µg/g) (Mean ± SE)	Pb (µg/g) (Mean ± SE)	Cd (µg/g) (Mean ± SE)	Cr (µg/g) (Mean ± SE)
Muscles	41.23 ± 3.92 a *	2.50 ± 0.23 a	0.41 ± 0.04 a	0.44 ± 0.04 a	0.29 ± 0.04 a
Liver	441.94 ± 27.17 b	8.92 ± 0.52 b	1.61 ± 0.14 a	1.86 ± 0.14 a	1.90 ± 0.14 a
Kidney	31.59 ±2.89 b	3.31 ± 0.33 c	1.71 ± 0.12 a	1.80 ± 0.11 a	1.87 ± 0.13 b
Gills	31.22 ±2.70 b	4.40 ± 0.41 c	1.70 ± 0.12 b	1.89 ± 0.12 b	1.33 ± 0.15 c
F (p)	8.39 (P < 0.0001)	54.9(p < 0.0001)	30.6 (p < 0.0001)	37.9 (p < 0.0001)	38.5 (p < 0.0001)
$LSD_{0.05}$	290.5069	1.0803	0.3209	0.3159	0.3380

*, Figures provided with similar letter are not significantly different as given by Duncan multiple range test at $p < 0.05$. N = 36.

Table 7. ANOVA for heavy metals data in various organs of fish *Megalaspis cordyla* captured in various seasons from the coastal water of Karachi.

Source	SS	df	MS	F	p
Seasons	26736.396	2	13368.19	15.81	0.0001
organs	2076829.78	4	519207.45	614.02	0.0001
Metals	927347.41	3	309115.80	365.57	0.0001
Seasons x Metals	108439.16	8	13554.89	16.03	0.0001
Seasons x Organs	56718.79	6	9453.13	11.18	0.0001
Metals x Organs	3554994.97	12	296249.58	350.35	0.0001
Seasons x organs x metals	220155.0	24	9173.13	10.85	0.0001
Error	558084.99	660	845.58	-	-
Total	7529306.51	719	-	-	-

Metals			Organs			Seasons		
Rank	Metals	Mean	Rank	Organs	Mean	Rank	Seasons	Mean
1	Fe	136.47 a	1	Liver	91.25 a	1	Monsoon	35.65 a
2	Mn	4.78 b	*2*	Muscles	8.98 b	2	Post-Monsoon	30.65 a
3	Cd	1.49 b	3	Kidney	8.09 b	3	Pre-Monsoon	20.97 b
4	Pb	1.36 b	4	Gills	8.04 b	$LSD_{0.05}$: 5.212		
5	Cr	1.35 b						
$LSD_{0.05}$: 6.73			$LSD_{0.05}$: 6.019					

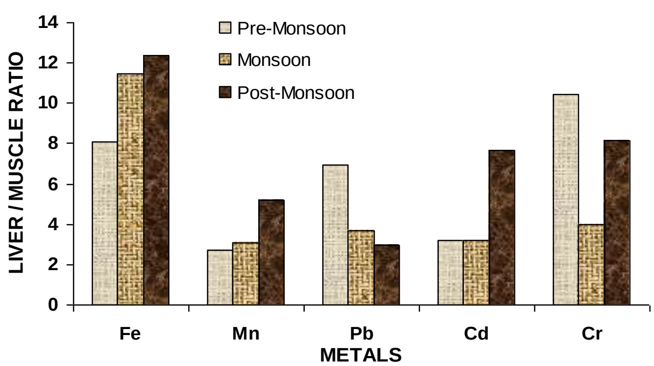

Fig.2. Comparison of seasonal values of liver: muscle ratio of heavy metals in *M. cordyla* captured from Karachi waters, Pakistan.

The lowest mean concentration of Fe was recoded to be 21.67 ± 3.21µg /g in kidney and that of Pb 0.22 ± 0.06 µg/g and Cr 0.17± 0.04 µg/g) in muscles were during Pre-monsoon season (Table 3). Also Mn (2.01 ± 0.20 µg/g) and Cd (0.29 ± 0.06 µg/g) were determined to be the lowest in muscles during Post-monsoon season (Table 5). Irrespective of the seasons (data for various seasons pooled), the mean concentration of metals of *M. cordyla* in present studies are presented in Table 6. Following trends of metal concentrations were approximated the metals concentration in various organs:

Muscles: Fe > Mn > Cd ≈ Pb > Cr
Liver: Fe > Mn > Cr ≈ Cd ≈ Pb
Kidney: Fe > Mn > Cr ≈ Cd ≈ Pb
Gills: Fe > Mn > Cd > Pb > Cr

Table 8. Heavy metals contents in *M. cordyla* reported from various Asian countries. Values in µg .g^{-1} dry weight (mean ± SD).

#	Species (Organ)	Fe	Mn	Pb	Cd	Cr	Reference & Locality
1.	*M. cordyla* Gills	-	-	0.14 ± 0.01	0.12 ± 0.01	-	Fadi *et al.* (2013) Mersing, Malaysia.
	Liver	-	-	0.62 ± 0.04	6.14 ± 0.20	-	
	Muscle	-	-	0.13 ± 0.01	0.13 ± 0.01	-	
2.	*M. cordyla* Gills	347.82 ± 0.22	17.75 ± 2.11	-	-	-	Nair et al. (1997) Cochin, India
	Alim. Canal	833.3 ± 178.0	2.73 ± 0.50	-	-	-	
	Muscle	362.32 ± 70.0	1.36 ± 0.22	-	-	-	
3.	*M. cordyla* Muscle	-	-	0.70 ± 0.40	1.10 ± 0.49	1.28 ± 0.69	Ambedkar & Muniyan (2011) Tamil Nadu, India
4.	*M. cordyla* Muscle	41.23 ± 23.54	2.49 ± 1.38	0.41 ± 0.28	0.45 ± 0.26	0.32 ± 0.27	Present Study – Karachi Coast, Pakistan
	Liver	439.17 ± 161.7	8.92 ± 3.09	1.62 ± 0.87	1.86 ± 0.87	1.90 ± 0.79	
	Kidney	31.51 ± 17.34	3.31 ± 1.99	1.72 ± 0.74	1.81 ± 0.68	1.90 ± 0.80	
	Gills	31.12 ± 16.11	4.40 ± 2.46	1.71 ± 0.73	1.84 ± 0.75	1.33 ± 0.88	
Agusa *et al.* (2007) have presented data on 20 metals of several species for fish including *M. cordyla* from Southeastern countries. Their data expressed as geometric mean present problem of comparison.							

An order of heavy metals concentrations (Fe > Zn > Cu > Mn > As > Hg > Cd) with Fe being the predominant metal in the fishes of Northeast coast of India has also been reported by Kumar *et al.* (2012). Shivakumar *et al* (2014) have also given Fe- dominated metallic accumulation sequences in some Indian fishes as follows:

Etrophus maculates: Fe > Zn > Cu > Pb > Ni > Cd
Cirrhinus reba: Fe > Cu > Zn > Pb > Ni > Cd
Ompok bimaculatus: Fe > Zn > Cu > Pb > Ni > Cd

It is obvious from three-way ANOVA (Table 7) that different metals accumulated in different concentrations in the fish ($F = 365.57$, $p < 0.0001$), the concentration of metals was significantly influenced by the seasonal variation ($F = 15.81$, $p < 0.0001$) and also significantly varied with the organ type of the fish ($F = 614.02$, $p < 0.0001$). Seasons, organs and metals type, all interacted significantly ($F = 10.85$, $p < 0.001$). Fe was the dominant metal amongst all and was found to be significantly high in concentration than that of the other metals. The concentration of other metals (Mn, Cd, Pb and Cr) didn't differ significantly from each other. Metals accumulated predominantly in liver. Muscles, kidneys and gills were not significantly difference from each other in metals content. The metals concentration varied significantly with seasons. It was maximum in monsoon season and minimum on pre-monsoon season. The concentration of metals in fish organs are determined primarily by the level of pollution in their environment, in water and food (Farkas *et al.,* 2003). The concentration in muscles and gills reflect the concentrations of metals in the water (Fathi *et al.,* 2013). The maximum mean concentrations of heavy metals were found in liver in all seasons. Liver has also been reported to be the target organ for Cu, Zn and Fe accumulation by El-Moselhy *et al.,* 2014). Pb and Mn were found in higher concentration in the gills by El-Moselhy *et al.* (2014). Highly increased concentrations of metals in general and iron in particular in liver may represent storage of sequestrated products in this organ (Hamilton and Mehrle, 1986). Iron is physiologically (reversibly) stored in liver as ferritin and hemosiderin (Ahmad, J, < www.fda.gov.ph/...annex% 20J%20....>). Ferritin has the capacity of about 4500 iron (III) ions per protein molecule. This is the major form of iron storage (< *http://library.med.utah.edu/ NetBiochem/hi.htm*>). The metallic accumulation may depend on seasonal variations also (Deram *et al.,* 2006).

It is evident from Table 8 that Cr in muscles of our samples was lower in concentration than that of *M. cordyla* samples of Tamil Nadu (India) (Ambedkar and Muniyan, 2011). Cd contents were larger in concentration in all organs of our samples (0.45 - 1.86 µg/g) except in the liver which was higher in Mersing samples (6.14 ± 0.20 µg/g) of Malaysia. Our samples had higher Pb contents than Malaysian *M. cordyla* (Fadi *et al.*, 2013). Our samples had higher Mn concentration than that of Cochin (India) except gills wherein it was 7.13 times higher in Indian specimens (Nair *et al.,* 1997). Fe content was also quite higher in Cochin samples of *M. cordyla* as compared to that of our samples. This pattern of variation obviously should be due to differential degree of metallic pollution of various waters of the above countries. *M. cordyla* from Vile Parle market of Mumbai contained Mn 0.254, Fe 16.82, Pb 0.036, and Cd 0.007 ppm. Similar to our samples Fe was the dominant element in Vile Parle M. cordyla (Zodape *et al.,* 2011).

The liver / muscles ratio of metals varied seasonally and were always higher than one – maximally around 10-12 in case of Fe, 4-10 in case of Cr, 2.5 to 4.5 for Mn, 3-7 for Pb and ≤ 4 to 8 in case of Cd. . The ratios for Fe, Mn and Cd were the maximum in post-monsoon season and those for Pb and Cr were the maximum in pre-monsoon season (Fig. 2). Agusa *et al.* (2007) have reported Cd to be 100 times in Southeast Asian fishes. Such ratios for Mn, Pb and Cr were reported by them to be 7.9, 6.3 and 3.16, respectively. Such ratios obviously depend on not only metallic concentrations in water but also on intrinsic metabolic characteristics related to their bioaccumulation in various organs. Our ratios for metals other than Cd are roughly comparable to that of Agusa *et al.* (2007).

Muscles which are the edible part of the fish showed the lowest level of concentration throughout this study. El-Moselhy *et al.* (2014) have also reported muscles of the fish to possess the lowest concentration of metals. The authors have reported quite varying concentrations of various heavy metals in fishes as a function of the species or the pollution of their environment. The metallic concentration amongst fishes of Cochin (India) varied from species to species. Cu, Zn, Fe and Mn showed increased concentration in gills and alimentary canal as compared to the muscles. The difference in heavy metal concentrations in various species were attributed to their varying feeding habit (Nair *et al.,* 1997). According to the studies of Nair *et al.* (1997) Fe was dominant element which was 362.32 ± 70 in muscles, 347.82 ± 88.4 in gills and maximally 833.33 ± 178 µg /g dry weights in alimentary canal in *M. cordyla* of Cochin.. Mn was, however much higher in concentration in gills (17.75 ± 2.11 µg /g dry weight) and comparatively quite lower in alimentary canal and muscles (2.73 ± 0.50 and 1.36 ± 0.22µg/g dry weight, respectively. ShivaKumar *et al.* (2014) also showed relatively higher accumulation of metals in intestine and gills. Tuzen (2003) reported Pb levels in the fish of Black Sea in the range of 0.22-0.85 mg/kg and Uluozlu et al., (2007) reported lead in the fish edible tissue in the range of 0.33 – 0.93 mg/kg. *Dicentrarchus labrax*, a fish of Güllük Bay (Aegean Sea, Turkey) was found to contain Pb (< 0.0042 – 0.4 mg/kg and Cd (0.01-0.04 mg/kg) – to be within permissible limit (Dalman *et al.,* 2006). Zehra *et al.* (2003) reported Cd (0.04-0.15 µg / g) and Pb (0.25-0.5 µg / g) in *Acanthopagurus berda* from Balochistan coast.

Fish has been considered good indicators for heavy metal contamination in aquatic systems because they occupy elevated trophic levels with different sizes and ages (Burger *et al.,* 2002). Meanwhile, fish are widely consumed in many parts of the world by humans, and polluted fish may endanger human health. The levels of toxic elements in fish are related to age, sex, season and habitat (Kagi and Schaffer, 1998). The ingestion of food is an obvious means of exposure to metals, not only because many metals are natural components of food stuffs, but also environmental contamination and contamination during processing (Voegborlo *et al.,* 1999). The distribution of metals varies between fish species, depending on age, development status and other physiological factors (Kagi and Schaffer, 1998). Industrial and agricultural activities have been reported to be the leading potential source of the accumulation of pollutants in the aquatic environment including the sea (Tarra-Wahlberg *et al*., 2001; Akif *et al*., 2002). Various organs of the fish, to an extent, are protected from heavy metals by their chelation in metallothioneins (MTs), a family of low molecular weight cysteine-rich proteins localized in Golgi apparatus membrane. Metallothioneins have capacity of binding physiological metals (Zn, Cu Se) and xenobiotic (Cd, Hg, As, Ag) metals through thiol group (Daryaonsu and Ismail, 2014; Sigel *et al.,* 2009). High exposure to Cd is found to increase MTs proportionally in fishes (Huang *et al.,* 2007). Seveikova *et al.* (2013), however, demonstrated no influence of Hg on MTs level in fish from Skalka and Želika reservoirs.

Some heavy metals are health damaging elements. Pb is known to induce reduced cognitive development and intellectual retardation in children and increase blood pressure and cardiovascular disease in adults (Commission of the European; 2002). It may cause learning disabilities, impaired protein and hemoglobin synthesis and shorten the lifespan of red blood cells which leads to severe anemia (hypochromic microcytic anemia) in children (Sultana and Rao, 1998). The most common toxic effects of cadmium in human is renal failure, accumulation in the bone resulting in calcium loss and malfunctioning of peripheral and central nervous system (Schroeder, 1965, Castro-Gonzalez and Méndez-Armenta 2008). Cd proves to be a risk factor for lung disease, kidney dysfunction, skeletal damage and reproductive deficiency (Nordberg, 2003). Fish consumption may be toxic to humans if fish is contaminated with heavy metals beyond permissible limits and it consumed excessively. Per capita fish consumption per year in Pakistan is the lowest in the World (c 2 kg per capita per year or 5.48g per capita per day (Government of Pakistan, Agric. Statistics, MINFAL, Islamabad (seen in Waseem, 2007) which is much lower than that of global estimate of 17 kg per capita per year and very much lower than that in southeast Asia (170 g per capita per day in Malaysia (Agusa *et al.*, 2007). Toxicity due to heavy metals by eating torpedo scad is, therefore, quite unlikely in general terms, in Pakistan but there remains great likelihood of heavy metal toxicity in Pakistan's populations due to heavy pollution of all kinds in the country. There is a great need to investigate heavy metals load in all kinds of fishes or Sea food consumed locally or exported elsewhere.

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