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Determination of heavy metals in *Acanthopagrus latus* (Yellowfin seabream) from the Bushehr seaport (coastal of Persian Gulf), Iran

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Abstract: In this study, bioaccumulation of lead, copper, cadmium, zinc and mercury in gill, liver and muscle of *Acanthopagrus latus* (Yellowfin seabream) was quantified. The concentrations of heavy metals were determined by using differential pulse anodic stripping voltammetry (DPASV) after wet digestion method. The result comprise of concentration level of Cu^{2+}, Cd^{2+}, Zn^{2+}, Pb^{2+} and Hg^{2+} in ten different samples of fish. Cu^{2+} and Zn^{2+} concentrations show that there is no significant variation with weight and length, but Cd^{2+}, Pb^{2+} and Hg^{2+} concentration increases gradually as weight and length increases. Concentrations of metals in gill, liver and muscle were significantly different ($p< 0.05$). Muscle, generally, accumulated the lowest levels of metals and highest levels of metal concentrations were observed in the liver and gills. These results suggest that higher accumulation of heavy metals in liver and gills can be good environmental indicators of metal stress in *Acanthopagrus latus*.

Keywords: ***Acanthopagrus latus*, heavy metals, anodic stripping voltammetry, Persian Gulf**

Introduction

Fish, apart of being a good source of digestible protein vitamins, minerals and polyunsaturated fatty acids (PUFA), are also an important source of heavy metals. Some of the metals found in the fish might be essential as they play important role in biological system of the fish as well as in human being, some of them may also be toxic as might cause a serious damage in human health even in trace amount at a certain limit. The common heavy metals that are found in fish include copper, iron, copper, zinc and manganese, mercury, lead and cadmium (Connell, 1984).

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 metals while, mercury, lead and cadmium are toxic metals (Kennish, 1992). The seriousness of heavy metals leads the marine environmental pollution to be recognized as a serious matter to human health concern. Industrial and agricultural activities were 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).

Since, fish are highly consumed by human being and may accumulate large amounts of some metals from the water, it is important to determine the concentration of heavy metals in commercial fish in order to evaluate the possible risk of fish consumption for human health (Cid *et al*., 2001). This study was conducted to determine the distribution of several types of heavy metals (Cu, Cd, Zn, Pb and Hg) in marine *Acanthopagrus Latus* (Yellowfin Seabream) caught in Bushehr Seaport which is located in the north western Persian Gulf Coast of Iran (N 50 ° 51', E 28 ° 59'). This species is a benthic economical fish in Persian Gulf. Along the coast of Bushehr Seaport, there are aquaculture farms and industrial plants. Due to heavy aquaculture and industrial activities in the region, coast of Bushehr Seaport is probably infected. As this area has important for local fisheries, this research was carried out for first time in Bushehr Seaport.

Materials and Methods

Marine fish (Yellowfin Seabream) samples were obtained from the site (Bushehr beach) and transported daily to the labratory. Total length and weight was recorded for all specimens. All fishes were stored in plastic bags and freezed until dissection. Each sample was dissected for its muscle, gill and liver tissues (N=10, digested by concentrated nitric acid and perchloric acid (2:1 v/v) (Merck) at 60°C

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and all samples were diluted to 25 ml with double distilled water. Metal concentrations in muscle, gill and liver tissues were measured by differential pulse anodic stripping voltammetry. Statistical analysis were carried out using the SPSS sttastical package program. Metal tissues concentrations were also compared by one-way analysis variance (Tukey test). The significance level (α) was set at 0.05.

Results and Discussion

The variation of weight and length is shown in Table 1, and Figure 1 and 2. From the graph, no idea can be made about the correlation of weight and length because no proper order is followed viza viz these two variables. Change in length has not been found to be proportionate with weight. For a very small change in length, corresponding change in weight is very large i.e. at 23.8 cm length, weight was 842 g and in case of 18.6 cm length, weight was 575 g.

Table 1. Variation of different samples of fish (*Acanthopagrus Latus* (Yellowfin Seabream)) weight with Length

Sample No.	Lentght (cm)	Weight (g)
1	23.8	842
2	22.4	818
3	20.7	635
4	18.6	575
5	17.5	516
6	17.2	516
7	16.1	443
8	15.3	402
9	14.8	352
10	12	196

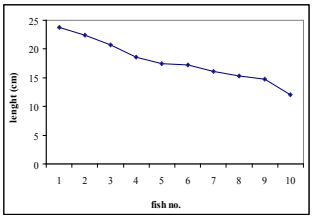

Figure 1. Variation of different sample of fish with length (g)

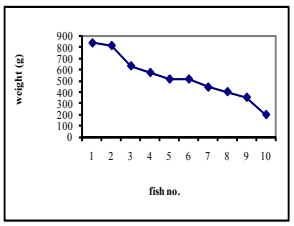

Figure 2. Variation of different sample of fish with weight (g)

Table 2 shows the change in concentration of different samples of fish with respect to weight and length. Figures 3 and 4 shows that there is no significant variation of Cu^{2+} and Zn^{2+} concentrations with weight and length ($p > 0.05$). Result shows a random data which may be due to rough sea. Figures 5-7 shows that Cd^{2+}, Pb^{2+} and Hg^{2+} concentration increases gradually as weight and length increases, on the other hand, there is significant variation of Cd^{2+}, Pb^{2+} and Hg^{2+} concentration with weight and length ($p < 0.05$). It may be due to different sites of sampling area or may be due to different depths. Concentrations of metals in gill, liver and muscle were significantly different ($p < 0.05$). Muscle, generally, accumulated the lowest levels of metals and highest levels of metal concentrations were observed in the liver and gills.

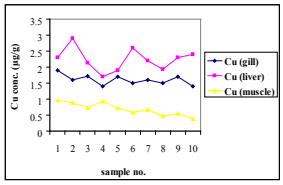

Figure 3. Concentration of Cu in different samples of fish

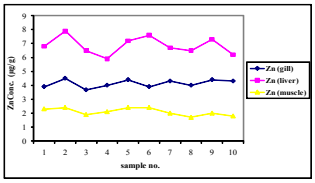

Figure 4. Concentration of Zn in different samples of fish

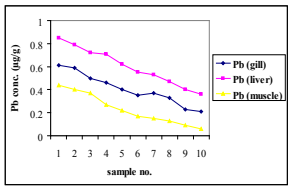

Figure 5. Concentration of Pb in different samples of fish

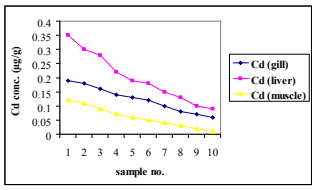

Figure .6. Concentration of Cd in different samples of fish

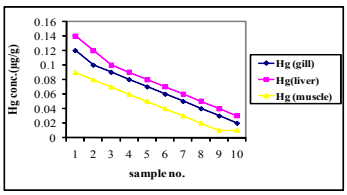

Figure 7. Concentration of Hg in different samples of fish

Many studies also indicated that different fish species from the other area contained different metal levels in their tissues (Canli *et al*., 2003; Marcovecchio, 2004; Fernandes *et al*., 2007). The metal accumulation in different fish organs depends on their physiological role, behavior and feeding habits, as well as regulatory ability (Chattopadhyay *et al*., 2002; Clearwater, 2002). Other factors, such as sex and size, may also influence metal bioaccumulation (Canli *et al*., 2003; Al-Yousuf *et al*., 2000) The concentrations of essential metals, such as Cu in organisms, tend to be highly regulated compared to nonessential. Fish can use different strategies of metal homeostasis to achieve a steady-state balance.The mechanisms of reducing metal accumulation and toxicity include uptake inhibition, increased elimination and detoxification and study showed that the highest and lowest concentration metals (Cu, Zn, Pb, Cd and Hg) were in liver and muscle result revealed that liver is involved in the metabolism of Cu, Zn, Pb, Cd and Hg. Prolonged exposure may result in impairment of the normal detoxification response for these metals, leading to liver bioaccumulation.

Gills are the first organs to be exposed to resuspended sediment particles, so they can be significant sites of interaction with metal ions. On the other hand, the liver was a key role in basic metabolism (Moon *et al*., 1985) and is the major site of accumulation, biotransformation of contaminants

in fish (Triebskorn *et al*., 1994; Triebskorn *et al*., 1997). It is well known that a large amount of metallothionein induction, caused by contamination, occurs in liver tissues of fish (Olsvik *et al*., 2001). In contrast, the muscle tissues are not considered an active site for metal accumulation (Romeo *et al*., 1999).

The difference in concentration of these metals in fish samples can suggest to what degree a particular specie picks up the matter from the sediment and water during feeding. It is well known fact that bottom feeders are known to concentrate more metal levels than the surface feeders.

Table 2. Trace metal concentrations (µg/g) in the gill, liver, mucle tissues for various samples of fish (*Acanthopagrus Latus* (Yellowfin Seabream))

Sample No.	Tissues	Cu	Zn	Pb	Cd	Hg
1	Gill	1.90±0.20	3.90±0.31	0.61±0.02	0.19±0.03	0.12±0.02
	Liver	2.30±0.10	6.80±0.19	0.85±0.03	0.35±0.02	0.14±0.01
	Muscle	0.97±0.11	2.30±0.21	0.44±0.02	0.12±0.01	0.09±0.01
2	Gill	1.60±0.12	4.50±0.16	0.59±0.07	0.18±0.02	0.10±0.03
	Liver	2.90±0.15	7.90±0.22	0.79±0.06	0.30±0.03	0.12±0.02
	Muscle	0.89±0.10	2.40±0.23	0.40±0.05	0.11±0.03	0.08±0.01
3	Gill	1.71±0.16	3.70±0.21	0.50±0.06	0.16±0.02	0.09±0.02
	Liver	2.14±0.14	6.50±0.25	0.72±0.04	0.28±0.04	0.10±0.03
	Muscle	0.74±0.11	1.90±0.14	0.37±0.03	0.09±0.01	0.07±0.01
4	Gill	1.40±0.16	4.00±0.22	0.46±0.04	0.14±0.05	0.08±0.01
	Liver	1.70±0.13	5.90±0.23	0.71±0.07	0.22±0.04	0.09±0.02
	Muscle	0.94±0.14	2.10±0.20	0.27±0.03	0.07±0.01	0.06±0.01
5	Gill	1.70±0.17	4.40±0.19	0.40±0.02	0.13±0.02	0.07±0.01
	Liver	1.90±0.15	7.20±0.28	0.62±0.03	0.19±0.02	0.08±0.01
	Muscle	0.72±0.09	2.40±0.23	0.22±0.04	0.06±0.01	0.05±0.02
6	Gill	1.50±0.10	3.90±0.26	0.35±0.05	0.12±0.04	0.06±0.01
	Liver	2.60±0.21	7.60±0.32	0.55±0.04	0.18±0.03	0.07±0.02
	Muscle	0.59±0.08	2.40±0.19	0.17±0.02	0.05±0.01	0.04±0.01
7	Gill	1.60±0.14	4.30±0.32	0.37±0.01	0.10±0.02	0.05±0.01
	Liver	2.20±0.19	6.70±0.35	0.53±0.02	0.15±0.03	0.06±0.01
	Muscle	0.67±0.12	2.00±0.18	0.15±0.03	0.04±0.01	0.03±0.02
8	Gill	1.50±0.11	4.00±0.34	0.33±0.02	0.08±0.02	0.04±0.01
	Liver	1.94±0.10	6.50±0.29	0.47±0.02	0.13±0.01	0.05±0.03
	Muscle	0.46±0.12	1.70±0.16	0.13±0.03	0.03±0.01	0.02±0.01
9	Gill	1.70±0.11	4.40±0.38	0.23±0.09	0.07±0.01	0.03±0.01
	Liver	2.30±0.16	7.30±0.36	0.40±0.12	0.10±0.03	0.04±0.01
	Muscle	0.55±0.07	2.00±0.21	0.09±0.02	0.02±0.01	0.01±0.00
10	Gill	1.40±0.20	4.3±0.34	0.21±0.05	0.06±0.01	0.02±0.00
	Liver	2.40±0.19	6.20±0.30	0.36±0.01	0.09±0.02	0.03±0.01
	Muscle	0.39±0.08	1.80±0.20	0.06±0.01	0.01±0.01	0.01±0.00

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