THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Bioaccumulation of Heavy Metals in an Estuarine Fish *Liza parsia* of Ashtamudi Lake-Southwest Coast of Kerala, India

Razeena Karim L.
Biotechnology Unit, Department of Zoology
Fatima Mata National College, Kollam, Kerala, India
Dr. Sherly Williams E.
Biotechnology Unit, Department of Zoology
Fatima Mata National College, Kollam, Kerala, India

Abstract:
Monthly concentration of four Heavy metals (Iron, Copper, Zinc, Lead) were determined in liver, ovary and muscles of fish Liza parsia from three sites of Ashtamudi lake during December 2010 to November 2011.The results were expressed as µg/gm dry weight. Fish living in polluted waters tend to accumulate heavy metals in their tissues. Generally, accumulation depends on metal concentration, time of exposure, environmental conditions and intrinsic factors. Various metals show different affinity to fish tissues. Most of them mainly accumulate in liver followed by ovary. Comparing to the other tissues, fish muscles usually contain the lowest level of metals. The heavy metal accumulation in various tissues is in the order of Iron>copper>Zinc> Lead. ANOVA showed that the three stations showed significant difference in the accumulation of heavy metals.

Key words*: Ashtamudi Lake, Heavy metals, Liza parsia, Bioaccumulation*

1. 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 (Goodwin *et al*., 2003). 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). Heavy Metals cause the mutation of fish inner organs, disturb immune reactions, change blood parameters, reduce an organism's adaptation qualities, vitality, resistance to diseases. Loss of fry and degeneration of valuable varieties of fish are observed as a result of Heavy Metal pollution (Blasco *et al*,1999). Therefore, in order to maintain the quality of food it is important to regularly monitor and evaluate the pollution levels in fish. The aim of this work was to determine the concentrations of Lead, Copper, Zinc and Iron, in muscle, liver, and ovary of an estuarine fish *Liza parsia* from three different sites of Ashtamudi Lake. Three tissues were examined for heavy metal contamination: (1) Muscle—the final metal contamination site and the main link to human contamination by fish consumption; 2) Gonads—to test the eventual transference to next generations through reproductive process (3) Liver- the detoxification organ in the fish body.

2. Materials and Methods

2.1. Study Area

The Kollam district is situated in 80º 50' North latitude and 76º35' East longitude and is 72 km north of Thiruvananthapuram , Kerala. Ashtamudi wetland is an estuary, which lies in the Kollam district. Three sites from the Ashtamudi Lake was selected for the present study and each site is about 10-12 km away from the bar mouth (Needakkara). The Ist site (Perumon), where anthropogenic influx is less and found to be comparatively less polluted. The site II (Kureepuzha), which is adjacent to the waste dumping site of Kollam district, is considered to be one of the most polluted sites of Ashtamudi wetland. The site III, Kavanadu, is located near the Neendakara fishing harbour and Oil spillage from mechanised boat is a major source of pollution in this site.

2.2. Sample Preparation

Samples were collected from three sites of Ashtamudi lake (Figure-1) during December 2010 to November 2011. Tissues of the *Liza parsia* were carefully taken, for the analysis of Heavy Metals, and placed in separately pre-weighed acid cleaned flasks, dried at 80° C using an oven, digested on a hot plate using HNO_3 and perchloric acid in the ratio 2:1, completely digested samples were filtered through an acid resistant filter paper and filtrate made up to known volume (20ml) with distilled water. The content of heavy metal is estimated using Atomic Absortion Spectrophotometer (AAS).

3. Results

The average Concentration of heavy metals in different tissues of *Liza parsia* from three sites of Ashtamudi lake was shown in Fig 2. Highest concentrations of accumulated heavy metals were noted in liver followed by ovary and muscle. The most dominant heavy metal accumulated was found to be Iron, followed by Zinc, Copper and Lead. All the metals are found to be accumulated more in the liver in all the three sites. In the case of copper the highest value (59.4µg/g) was shown by station 2 in the Liver of the fish *Liza parsia* in the month of June where as the lowest value (5.6µg/g) was seen in the muscle from station1 during the September. Accumulation of Zinc was found to be greater (432.7µg/g) in the liver of fish from station 2 and lowest value (17.9µg/g) was in the muscle of fish from station 1.Highest value (743µg/g) of iron was shown by the liver of fishes from station 2.and the lowest value (43.2µg/g) was seen in the muscle of *Liza parsia* from station1. In the case of lead the highest Value (24.7µg/g) was shown by ovary of the fish in station 2 whereas the lowest value (0.8 µg/g) was shown by station 1 in muscle of fish. It was noted that the second site namely Kureepuzha showed a higher concentration of all the heavy metals in all tissues examined throughout the study period. Station 3 kavanad also showed higher values for iron in the muscle and Liver. Station 1 also showed the accumulation of heavy metals but it was found to be lesser comparable to accumulation in other two stations. From the study it was clear that Ashtamudi lake as a whole was getting polluted and so the biomonitoring of heavy metals in potentially contaminated estuaries could serve as useful tool for awareness of environmental health. Among the tissues examined, liver was found to be more sensitive to all heavy metals and Muscle was found to be least sensitive. ANOVA (Table-1) showed that there were significant differences between the Mean concentrations of copper, iron, lead and zinc of the tissues of fish from three stations. The highest significance ($F=122.42$ $P<0.05$) was shown by the accumulation of Lead in the ovary of three Stations and the lowest significant difference was shown by the accumulation of Zinc in the liver of three stations ($F=4.65$ $P>0.05$).

4. Discussion

Fish samples from site 2 (Kureepuzha) displayed the highest metal concentrations in their tissues followed by site 3 (Kavanadu). This confirms the effect of waste dumping in the banks of Ashtamudi lake since the site receives huge amounts of sewage, industrial and agricultural wastes, were as the site 3 receives waste from the mechanised boat and other domestic wastes. Many authors demonstrated that fish surviving at highly polluted areas accumulate higher levels of heavy metals than those surviving in less polluted areas of the same lake. (Khalil and Faragallah, 2008).

The highest level of iron was found in all the tissues of *Liza parsia* and it may be due to the presence of various organic and inorganic compounds present in the water body. Fish also get the iron from the prey and get biomagnified in their tissues. Iron may not be considered as an harmful metal as it help in the transport of oxygen, but the higher value (743µg/gm) in the liver of *Liza parsia* in site 2 may interfere with the normal metabolism.

Next to the iron Zinc was found to be accumulated more in the tissues of *Liza parsia* of Ashtamudi lake. It is also an essential element and plays an important role in biological metabolism at very low concentrations, but the excess level disturbs the biochemical function in both animals and human. Higher level of accumulation was seen in the tissue of *Liza parsia* of site 2 and site 3, this may be due to the sewage and other domestic waste that finds its way to the ambient medium through the leachate. Zinc is also the source of antifouling paints which are used in fishing trawlers in order to protect them from biofoulers and this may contribute to excess accumulation of zinc in site 3.

Higher concentration of copper was observed in the liver of *Liza parsia* from three sites and higher concentration (59.4µg/gm) in the month of June in site 2 may be due to the influence of domestic waste. Coal tar used in the fishing trawlers may also contribute to the accumulation of copper in the tissues of fish. Copper is found to be toxic even at low concentrations. The same was reported by Mathana (2012) on bioaccumulation of heavy metals from fishes of Kanyakumari district.

Lead which is considered as a non essential element found to be accumulated in animals and human tissues and is harmful. The present study showed that the lead was found to be accumulated in the tissues of *Liza parsia* in all the three sites and it was found that it in the muscle it was within the permissible limit of 2µg/gm (WHO,1989). Anthropogenic activities may be the reason for the accumulation of lead in the tissues of the *Liza parsia*. Consumption of fish with high amount of lead is a major root of human exposure to lead. Lead was found to be accumulated higher in the ovary of *Liza parsia* from site 2. ANOVA of lead accumulation in ovary of three stations also showed high significant differences ($F= 122.426$).Accumulation of lead in the ovary may lead to significant atresia in ovary (Adeyemo, 2008; Doaa *et al*,2013).

The phenomenon that different metals are accumulated at different concentrations in various organs and tissues of fish was observed in the present study. In the present study liver was found to be accumulated more heavy metals and this was supported by earlier studies (Altindag and Yigit, 2005;Karadede *et al.*, 2004). Muscles, in the present study, showed lowest levels of heavy metals. Many authors agreed with this result, namely, the muscle is not an active tissue in accumulating heavy metal (Yilmaz, 2005 and Chouba *et al.*, 2007).

5. Conclusion

The study confirms the presence of heavy metal load in Ashtamudi lake. The order of metal pollution in the tissues is in the order Liver>Ovary>Muscle. While considering heavy metals concentrations in the fish species, the most important aspect is their

toxicity effect on human consumption. As the values of heavy metals in the muscles of *L. parsia* were low as compared to the maximum acceptable limits, the fish from the Ashtamudi lake are considered safe for human consumption. But ovary and liver showed higher accumulation of Heavy metals and some of the values in the muscles are near to the acceptable limit. Moreover, such fish may constitute a potential risk for predatory fishes, birds and mammals feeding on contaminated fish. Bio monitoring of heavy metals in potentially contaminated estuaries could serve as a useful tool for awareness of environmental health. Efforts are needed to protect Ashtamudi lake, the Ramsar site from pollution so as to conserve the fishes which forms the major livelihood of the people inhabiting this region.

Figure 1: Map Showing The Study Areas

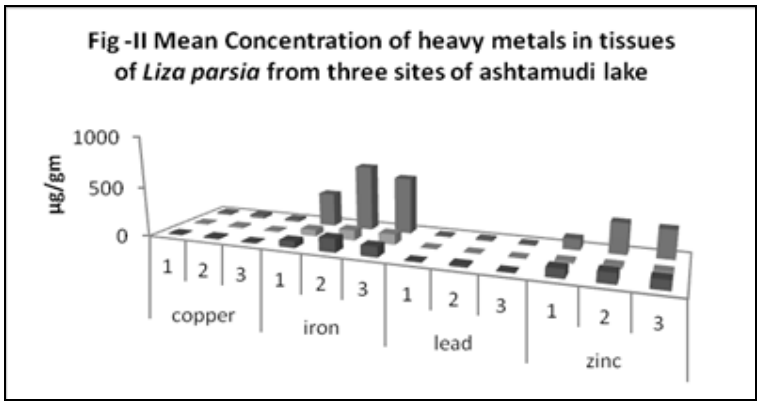

Figure 2

Heavy Metal	Mean ±SE			F-Value	Sig
	Site 1	Site 2	Site 3		
copperovary	7.8 ±1.4	15.17±3.9	8.59±2.3	15.604	.000***
coppermuscle	9.69±5.4	16.50±5.4	10.90±5.1	25.323	.000***
copperliver	18.81±5.8	31.18±9.3	22..39±7.2	8.997	.001**
Ironovary	66.47±15.0	136.45±50.0	103.63±37.8	7.797	.002**
ironmuscle	64.26±16.8	101.00±15.2	103.87±18.4	15.394	.000***
Ironliver	333.01±60.7	645.65±58.5	558.53±58.9	60.001	.000***
leadovary	2.91±1.5	19.21±3.3	3.97±2.1	122.426	.000***
leadmuscle	1.45±0.43	1.58±0.34	1.58±0.3	24.328	.000***
Leadliver	7.82±1.3	14.28±1.4	9.39±1.3	51.076	.000***
Zincovary	87.55±9.2	104.16±13.9	93.94±10.1	4.928	.013*
zincmuscle	18.42±0.3	26.35±2.6	21.41±1.4	52.372	.000***
Zincliver	108.33±14.2	304.12±72.6	281.8±59.7	4.654	.017*

Table 1: Mean concentration of heavy metal accumulation in Liza parsia from different sites of Ashtamudi lake.
(**) Significant at P>0.05% level and (***) Highly Significant at P>0.05% level
M±S.E = Mean ±Standard Error, n=12

6. References

1. Adeyemo, O K (2008) Histological alterations observed in the gills and ovaries of Clarias gariepinus exposed to environmentally relevant lead concentrations. J Environ. Health. 70 (9): 48-51.
2. Altindag A, Yigit S (2005) Assessment of heavy metal concentration in the food web of lake Beysehir, Turkey. Chemosphere .60:552-556.
3. Blasco J, Arias AM, Saenz V(1999) Heavy metals in organisms of the River Guadalquivir estuary: possible incidents of the Aznalcollar disaster. The Science of the Total Environment. 242-249.
4. Chouba L, Kraiem M, Njimi W, Tissaoui C,Thompson J,Flower R(2007) Seasonal Variation of heavy metals (Cd, Pb, and Hg) in sediments and mullet , Mugil cephalus (Mugilidae) from the Ghar EL-Melh Lagoon (Tunisia). Transitional water Bulletin, 4:45-52.
5. Doaa M. Mokhtar Hanan, H,Abd-Elhafeez (2013) Histological Changes in Selected Organs of Oreochromis niloticus Exposed to Doses of Lead Acetate. J. Life Sci. Biomed. 3(3): 256-263.
6. Goodwin T H, Young A R, Holmes M G R, Old G H, Hewitt N,Leeks GJL, Packman JC, Hamed M (1998) Distribution of trace metals in the River Nile Ecosystem, Damietta branch between Mansoura city and Damietta Province. J. Egypt. Ger. Soc. Zool. 27(A):399-415.
7. Hayat S,Javed M, Razzaq S (2007) Growth performance of metal stressed major carps viz. Catla catla, Labeo rohita and Cirrhina mrigala reared under semi-intensive culture system. Pakistan Vet. J., 27(1): 8-12.
8. Karadede H, Oymak S. A, Ünlü E (2004) Heavy metals in mullet, Liza abu, and Catfish, Silurus triostegus, from the ◌Ataturk Dam Lake (Euphrates), Turkey. Environment Internationl, 30: 183-188.
9. Khalil M, Faragallah H (2008)The distribution of some leachable and Total heavy metals in core sediments of Manzala lagoon, Egypt. Egypt. J. Aquat. Res., 34(1):1-11.
10. Mansour SA, Sidky M M (2002). Ecotoxi-cological studies. 3: Heavy metals contaminating water and fish from Fayoum Governorate, Egypt. Food Chem., 78: 15-22.
11. Mathana P, Thiravia Raj S, Radha Krishnan Nai C, Selvamohan T(2012) Bioaccumulation of some heavy metals in different tissues of commercial fish Lethrinus lentjan from Chinnamuttom Coastal area, Kanyakumari, TamilNadu. Advances in Applied Science Research, 3 (6):3703-3707
12. More T G, Rajput,R A ,Bandela N N(2003) Impact of heavy metals on DNA content in the whole body of freshwater bivalve, Lamelleiden marginalis. Environ. Sci. Pollut. Res., 22: 605-616.
13. Tawari-Fufeyin P, Ekaye S A (2007) Fish species diversity as indicator of pollution in Ikpoba river, Benin City, Nigeria. Rev. Fish Biol. Fisheries, 17: 21-30.
14. WHO (1989) Heavy metals-environmental aspects. Environment Health Criteria No. 85, World Health Organization, Geneva, Switzerland.
15. Yilmaz B A (2005) Comparison of Heavy metal levels of grey Mullet (Mugil cephalus) and sea Bream (Sparus aurata) caught in Iskenderun Bay (Turkey).Turk. J. Vet. Anim. Sci. 29:257-262

7. Acknowledgements

The authors are thankful to University Grants Commission, New Delhi, India for financial support in favour of corresponding author under the scheme of ‘Maulana Azad National Fellowship for Minority Students.