Bioaccumulation of Heavy Metalsin Fish Species of Ratnagiri Coast, Maharashtra

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ABSTRACT *The presence of heavy metals in our environment has been of great concern because of theirtoxicity when their concentration is more than the permissible level. Exposing human beings to these heavy metals directly through the food chain causes potential danger to human health. In present study the level of heavy metals, namely Zn, Cu, Hg, Pb and Cd in different fish species were evaluatedusing Atomic Absorption Spectrophotometer. The samples were collected between October 2012 to May 2013 form Ratnagiri coast.The metal concentrations in different body parts(Gill, Intestine, Liver, Kidney, and Muscle) were analyzed.The means of the amounts of heavy metals were estimated follows the order Zn> Cu> Cd> Pb> Hg. Heavy metals accumulated in higher concentration in intestine and low in muscles. The concentrations of metals in all samples were within permissible range set by World Health Organization.*

Introduction:

Metals generally enter the aquatic environment through atmospheric deposition, erosion of geological matrix or due to anthropogenic activities caused by industrial effluents, domestic sewage and mining wastes (Reddy et al., 2007).In the aquatic ecosystems, fishesare considered the important indicators of heavy metal enrichment of the aquatic ecosystems (Gernhoferet al., 2001). In an aquatic ecosystem, metals are transferred to the fish through foodchain that could ultimately affect the health of people consuming this fish. Heavy metals are known for their persistent toxicity and tendency to bio-accumulate in aquatic ecosystems (Miller et al., 2002). Therefore, metals eco-toxicity of the aquatic ecosystems has become a major health concern over the years (Mendilet al., 2010).

Biomonitoring of heavy metal pollution has been given ever-increasing attention due to the ability of various aquatic organisms to accumulate these heavy metals. Most of the salts of heavy metals and pesticides produce toxic effect on fish through physical accumulation (Tilaket al.,2005).The worldwide reports indicate relatively wide variations in metal concentrations in sea water and sediment and fishes from different oceanic areas (Chester et al, 1974). Domestic sewage and industrial effluents are discharged in the water sources in and around India in untreated or partially treated form. These, add a variety of pollutants, which include certain toxic heavy metals (Sankpal and Naikwade, 2012).The heavy metals are accumulated in the marine environment then transfer to the marine organisms e.g. fishes by different ways. When their concentrations exceed the required levels, they become toxic and cause several health problems (Goldstein, 1994;Malik, 2004).

Material and Methods:

Ratnagiri district is one of the most important maritime districts of the state with the coastal belt extending to about 200 Km. Ratnagiri is an important coastal area of Maharashtra with average rainfall about 2500 mm. Most of the activities in this area are connected with sea. Recently several chemicals, pharmaceuticals companies and some power plants are grown up along the coastal region. Developmental activities like Konkan Railway Project, Enron electricity project, proposed marine highway, Cargo Ports are attracting more tourism industries in this region, which directly or indirectly causes environmental pollution. The marine area is presently receiving water with a variety of effluents, which may be potentially contaminating, including elevated levels of pollut-

ants (Agardet al., 1988). Very little work is carried outon the distribution of heavy metals in fish samples of Ratnagiri coast.

Fish samples were collected form selected sites of Ratnagiri coast with the help of local fisherman during the period October 2012 to May 2013.Fish samples were transported to the laboratory in a thermos flask with ice on the same day. All fish samples were kept at -4°C until analysis. Sample preparation and analysis were conducted according to the procedure described by Bernhard (1976).Before analysis, muscle, liver, gill, intestine, and kidneywere removed. Fish samples were homogenized in a blender and one gram of homogenate was digested. A microwave digestion system was used to prepare samples for analysis. Atomic Absorption spectrophotometer (Shimadzu AAS-680) was used for the analysis of metal.

Table.1 Accumulation of heavy metals in different tissues of fish

Fish Species Name		Concentration (ppm wet weight) in different body parts				
		Zn	Cu	Hg	Pb	Cd
Sardinellalongiceps	Gill	19.36	12.86	0.060	0.798	0.218
	Intestine	29.57	6.30	0.030	0.522	0.336
	Liver	10.10	4.77	0.064	0.065	0.389
	Kidney	8.18	1.91	0.015	0.028	0.912
	Muscles	2.19	3.83	0.040	0.370	0.078
	Mean	13.88	5.93	0.042	0.357	0.387
Lepturacanthussvala	Gill	15.29	17.69	0.056	1.20	0.182
	Intestine	33.49	11.29	0.042	0.892	0.298
	Liver	12.29	6.29	0.097	0.098	0.287
	Kidney	9.27	2.01	0.018	0.032	0.998
	Muscles	2.39	4.39	0.045	0.283	0.876
	Mean	14.18	7.02	0.046	0.422	0.451

Lactariuslactarius	Gill	27.30	6.90	0.087	0.92	0.211
	Intestine	31.49	10.34	0.035	1.29	0.322
	Liver	16.26	7.28	0.102	0.096	0.267
	Kidney	11.93	1.92	0.019	0.029	0.987
	Muscles	3.36	5.39	0.039	0.321	0.987
	Mean	15.33	6.83	0.049	0.454	0.482

Result and Discussion:
The difference in the levels of accumulation in different organs of a fish can primarily be attributed to the differences in the physiological role of each organ. Other factors such as regulatory ability, behavior and feeding habits may play a significant role in the accumulation differences in the different organs (Marzouk, 1994).Also the chemical nature of the metals ionic strength and pH tends to be a master variable in the accumulation process.

The mean concentrations of heavy metals in the Gill, Intestine, Liver, Kidney and Muscle of selected fishsamples are given in Table 1. The pattern of bioaccumulation of metals follows the order order Zn> Cu> Cd> Pb> Hg.The lower concentrations of copper, zinc, mercury, cadmiumand lead were usually recorded in muscles rather than the other organs while the higher values were recorded in the intestine for all samples.The intestine has a tendency to accumulate heavy metalsin high values in fishes.The order of bioaccumulation is as follows: Intestine> Gill> Liver> Kidney > Muscle. While comparing different fish species studied, it was observed that Lactariuslactarius showed highest concentrations of Zn, Hg, Pb and Cd. However Cu concentration was highest inLepturacanthussavala.

Wastewater discharge from sewage and industries are major component of water pollution in Ratnagiri coast (Naikwadeet al. 2012).The impact of waste from industries also plays an important role in seawater pollution (Govindrajuet. al., 2011).

The study clearly indicated significant accumulation of heavy metals in the organs of the fish species from Ratnagiri coast. Results revealed that heavy metal like Zn was more concentrated in the intestine, Cd and Pb weremore concentrated in kidney and muscles. When compared with international standards results showed that metal concentrations did not exceed WHO (World Health Organization, 1993) limit.Proper precautions should be taken by pollution controlling authority to avoid further pollution of Ratnagiri coast. Appropriate management strategies are needed to ensure the sustainable development and management of coastal areas and their resources.

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