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Heavy metals Bioaccumulation in different tissues of three bivalve species from Godavari River at Paithan (MS), India

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Abstract: The aim of present study is to determine the heavy metal pollution (Zn, Pb, Cu, Cd, As) in Godavari river at Paithan. Heavy metal concentrations in surface water, soil sediment and different soft body tissues (mantle, gills, digestive glands and whole soft body tissue) of freshwater bivalve, *Lamellidens corrianus*, *Lamellidens marginalis* and *Indonaia caeruleus* were investigated in samples collected from Godavari river at Paithan. In the present study heavy metal concentrations in different soft body tissues of bivalves was highest than heavy metal concentrations in surface water and soil sediment. The digestive gland accumulated highest concentrations of heavy metals as compared to other studied organs in three bivalve species. The bioaccumulation of heavy metals in different soft tissues of bivalve can be used for the detection of polluted area.

Key words: Heavy metals, Godavari river, bivalves, bioaccumulation.

Introduction

The water quality has great importance because water is usually consumed by living organisms. The health of aquatic ecosystem is depends on pollutants from both point and non-point sources, which are related to activities caused by humans. The environmental pollutants can accumulate in the aquatic organisms, because of their poor biodegradability or chemical stability (Sanders, 1997). Several pesticides containing heavy metals are used to control pest of fruit crops, grains and vegetables which are the important source of heavy metal pollution of soil (Verkleji, 1993; Ross, 1994). Human activities like traffic emission and industrial discharge may increase heavy metals into aquatic ecosystems (Nriagu and Pacyna, 1988; Mukherjee, 1989).

Heavy metals cannot degrade like organic pollutants they accumulate mostly in the soil sediment. It has been observed that aquatic sediment accumulate toxic chemicals many times higher than water (Linnik and Zubenko, 2000; Casper et al., 2004). Heavy metals accumulated in sediment can affect on heavy metal concentrations in the aquatic organisms (Pourang, 1996; Yap et al., 2002; Kim and Kim, 2006).

Biomonitoring is defined as regular and systematic use of living organisms to evaluate changes in water quality by assessing biological effect, bioaccumulation, health and integrity of ecosystem (Oost et al., 2003).

Level of pollutants accumulated in tissues of aquatic organisms is used for evaluating the level of pollutants in that ecosystem (Abdallah and Moustafa, 2002). Bioaccumulation of metals into the cell of organism is mainly depends on their ability to pass through the cell membrane (Connell et al., 1999). According to Chapman (1997) bioaccumulation is described as one of the possible tool to be used in biomonitoring. Tissue metal concentrations in mollusc can reveal contamination of aquatic ecosystem and may therefore be used as sensitive biomonitors of pollutant (Hendozko et al., 2010).

Knowledge on accumulation of heavy metals in different soft body tissues of bivalves may help us to understand the process involved in the accumulation of heavy metals by different organs. Szefer et al., (1997) studied distribution of trace metals in soft body tissues of *Mytilus edulis* from the east coast of Kyushu Island, Japan. Cd, Cu and Zn concentration in bivalves, *L. fortunei* and *C. Fluminea* was determined to assess their utilization as bioindicators of metal pollution. The digestive glands, residuals and the adductor muscles of *Modiolus modiolus* was used for monitoring of metal pollution (Chou et al., 2003). The studies on assessment of heavy metal pollution in the straits of Johore by using transplanted caged mussel, *Perna viridis* was carried out by Eugene et al., (2013).

The aim of present study is to determine the concentrations of heavy metals in surface water, soil sediment and different tissues of three freshwater bivalve species, *Lamellidens corrianus*, *Lamellidens marginalis* and *Indonaia caerulus*. The study also determines the potential biomonitoring organ in these bivalve species.

Materials and Methods

Godavari river is one of the largest river in India originates from Trimbakeshwar (Nashik district of Maharashtra) and ultimately empties into the Bay of Bengal. It is also called as Dakshina Ganga. Surface water, soil sediment and bivalve species (*Lamellidens corrianus*, *Lamellidens marginalis* and *Indonaia caerulus*) were collected from Godavari river at Paithan in Aurangabad district of Maharashtra state, India. The surface water sample is filtered and mixed with HNO_3 and preserved in refrigerator at 4^0C until analysis. Soil sediment was collected from 5cm depth and air dried in laboratory, 5gm oven dried sieved (mesh size 0.5mm) powder sample of soil sediment was taken in conical flask. Then about 20ml of concentrated HCL was added in sample. The sample digestion was carried out in laboratory on hot plate by placing watch glass on conical flask for about 1 hour and evaporated to about dryness, the digested sample was ready for heavy metal analysis (Ahmed et al., 2002). Medium sized 10 specimens were selected from *Lamellidens corrianus* and *Lamellidens marginalis* and 20 specimens were selected from *Indonaia caerulus.* The bivalves from three species were dissected within 12 hours of collection and their mantle, gills, digestive glands and whole soft body tissues were removed, washed in distilled water and dried separately at about 70^0-80^0C in oven. After complete drying the tissues were powdered and stored separately by labeling the specimen with species and tissue name. The analysis of heavy metal concentrations in surface water, soil sediment and body tissue of bivalves (mantle, gills, digestive glands and whole soft body tissues) was carried out by Atomic Absorption Spectrophotometer.

Results and Discussion

Heavy metal concentrations were analysed in surface water of Godavari river at Paithan are given in table 1. In the present study heavy metals were observed in surface water of Godavari river at Paithan, this might be due to different sources of contaminant. Agricultural, domestic and industrial waste matter acts as major source of heavy metal pollution (Rashed, 2001; Ravera, 2004, Aksoy et al., 2005). The area of Godavari river basin is known for growing sugarcane, fruits, vegetables and other crops, hence several pesticides containing heavy metals are used to control the pest and these are the source of heavy metal pollution (Verkleji, 1993). Water runoff may bring higher concentrations of metals from anthropogenic activities including industrial and municipal waste, chemical fertilizers and pesticides used in agriculture (Zacharias et al., 2002; Rajmohan and Elango, 2005).

Table 1. Heavy metal concentrations in surface water (mg/l), soil sediment (µg/g) and different tissues of freshwater bivalve, *Lamellidens corrianus*, *Lamellidens marginalis* and *Indonaia caeruleus* (µg/g) collected from Godavari river at Paithan.

Heavy metals		Zn	Pb	Cu	Cd	As
Surface water		0.1126±0.0007	0.0276±0.0004	0.0215±0.0005	0.0079±0.0003	0.0084±0.0002
Highest permitted value for drinking water IS (1991)		15	0.05	1.5	0.01	0.01
Soil Sediment		155.32±1.87	20.08±0.72	51.08±0.65	2.87±0.38	2.68±0.41
Lamellidens corrianus	Mantle	529.6±5.29	145.1±1.73	132.9±1.28	14.26±0.49	2.33±0.34
	Gills	671.9±6.08	184.3±2.68	169.1±1.47	18.42±0.62	2.97±0.57
	Digestive glands	878.2±8.15	191.5±3.15	174.2±2.14	26.03±1.12	3.35±0.85
	Whole soft body tissue	583.5±6.93	167.2±2.82	154.7±1.92	17.08±0.75	2.58±0.69
Lamellidens Marginalis	Mantle	534.7±5.39	138.4±1.38	125.4±1.35	13.15±0.44	2.46±0.40
	Gills	674.2±7.61	172.8±2.39	162.7±1.79	17.93±0.83	3.08±0.73
	Digestive glands	890.3±8.03	178.6±2.90	170.8±2.70	25.17±0.98	3.50±0.92
	Whole soft body tissue	594.6±7.20	162.7±2.26	159.2±1.93	15.20±0.51	2.72±0.71
Indonaia caeruleus	Mantle	526.8±6.42	129.6±1.61	137.3±1.56	16.21±0.68	2.25±0.64
	Gills	661.1±6.55	169.2±2.05	176.8±2.77	20.09±1.05	2.94±0.76
	Digestive glands	842.5±7.82	183.9±2.84	191.9±3.12	28.72±1.20	3.29±0.81
	Whole soft body tissue	568.4±5.89	160.4±2.17	168.5±2.62	18.79±1.02	2.63±0.54

Mean ± Standard deviation

In the present study heavy metal concentration (Zn, Pb, Cu, Cd and As) was highest in soil sediment than surface water (table 1). This indicates accumulation of heavy metals in the sediment over the years (Namminga and Wilhm, 1976). The metal concentration in sediment not only based on anthropogenic sources but also upon the textural characteristic, mineralogical composition, organic matter content and depositional environment of the sediment (Presley et al., 1980). Heavy metal concentrations in soil sediment increase with increase in organic matter content and decrease in the particle size (Halcrow et al., 1973). Many investigators reported that sediments were the main source of heavy metals in the aquatic ecosystems (Cheung et al., 2003; Ikem et al., 2003; Audry et al., 2004).

The heavy metal concentrations were determined in mantle, gills, digestive glands and whole soft body tissue of *Lamellidens corrianus*, *Lamellidens marginalis* and *Indonaia caeruleus* collected from Godavari river at Paithan and obtained results are summarized in table 1. The metal concentrations were found highest in different soft body tissues of bivalves as compared to surface water and soil sediment same results were reported by Deshmukh (2013). In the present study results indicated that different species of bivalve accumulated different concentration of heavy metals. Maha et al., (2008) reported that different species of bivalve have different capacity of heavy metal accumulation from medium into their body tissues. The interspecific difference in heavy metal accumulation is studied in different species of bivalves by Waykar and Shinde (2011) and Waykar and Deshnukh (2012).

The heavy metal concentrations were determined in different soft body tissues (mantle, gills, digestive glands and whole soft body tissue) of three bivalve species collected from Godavari river at Paithan (table 1). The digestive gland accumulated highest concentrations of heavy metals in three bivalve species as compared to other studied organs the results are in agreement with results reported by several researchers (Waykar and Deshmukh 2012, Bustamante et al., 2004, Zorita et al., 2007). Highest concentrations of Zn accumulation in hepatopancreas is reported by Lakshmanan and Nambisan (1989).

Conclusion

The present study indicates that heavy metals (Zn, Pb, Cu, Cd, As) concentrations in surface water of Godavari river at Paithan were below the permissible limits (Indian Standard 1991, 10500). Therefore this study clearly indicates that water of Godavari river at Paithan is suitable for drinking and irrigation purposes. The soil sediment accumulated higher concentration of heavy metals than surface water. The freshwater bivalves, *Lamellidens corrianus, Lamellidens marginalis* and *Indonaia caeruleus* is being proposed as sentinel organism for monitoring of heavy metal pollution and used as bioindicator of heavy metal pollution in Godavari river at Paithan. The digestive gland accumulated highest concentrations of heavy metals as compared to other organs, this indicated that digestive gland is potential biomonitoring organ in these bivalve species.

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