Bioaccumulation of Zn, Pb and Cd in *Scylla serrata* and *Portunus pelagicus* from Uran Coast

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Abstract

Rapid industrialization and urbanization have contaminated the riverine and estuarine ecosystems to a great extent. To evaluate such kind of contamination, the project was undertaken to determine the concentrations of zinc, lead and cadmium in carapace, and muscle tissue of commonly edible crab *Scylla serrata* and *Portunus pelagicus* collected from the Uran Coast. The heavy metals in tissue samples were estimated using an Inductively Coupled Plasma Atomic absorption spectrophotometer. Zn, Cd, and Pb in the carapace are not detected whereas only Zn is detected in the muscle tissue of both the species. Zn was found to be 224.16±26.55 ppm and 121.18±35.33 ppm in muscle samples of *S. serrata* and *P. pelagicus* respectively. All the metal concentrations were found below their acceptable limits.

Key words: *Scylla serrata, Portunus pelagicus*, Heavy metals, Inductively Coupled Plasma Atomic absorption spectrophotometer

Introduction:

Coastal belts are highly populated and urbanized with industries. Industrial activities such as mining, electroplating, tanning, metallurgical operations, emissions from vehicular traffic gas exhausts, Crude Oil and Hydrocarbon exploration and exploitation, energy and fuel production, downwash from power lines, intensive agriculture and sludge dumping and manufacturing have led to the release of toxic heavy metals into the environment (Samara, 2006; Alo and Olanipekun, 2006; Reddy et al., 2007)). These metals may have devastating effects on the ecological balance of the recipient's environment and diversity of aquatic organisms (Ashray 2005; Vosyliene and Jankaite, 2006).

Aquatic biota and water samples are often used for monitoring pollution. The relevance of the direct analysis of water is limited, as varying concentrations are often below the detection limits in water and hence cannot reveal the contamination history or the bioavailability of the amounts taken up by aquatic organisms (Muncaste et al, 1990, Rayment and Barry, 2000). The living organisms should be used to monitor environmental contamination, as they can better reflect the contamination history of a sample location through their exposure to contaminants that they accumulate in their lifetime (Linde *et al*., 1998; Mora *et al*., 2004). Furthermore, the revelations of biota dosimetry are truer than those of water dosimetry in the evaluation of a contaminant's status (Phillips and Rainbow, 1993; Rainbow, 1995).

Marine food such as fish, prawns, crabs and mussels are delicacies and form an important staple part of daily food and therefore, numerous studies have been carried out on metal accumulation in different species (Kucuksezgin *et al*., 2001; Lewis *et al*., 2002, Farkas *et al*., 2003; Mansour and Sidky, 2002). Crabs are sedentary and do not migrate, they are widely distributed, abundant in the study area and easy to collect throughout the year and are requisites of an ideal monitor (Phillips and Rainbow, 1993). Therefore, the crabs are excellent candidates for serving as monitors. However, the information on the bioaccumulation of this species is scanty, especially in the area under investigation. This study is the first attempt to investigate heavy metal, zinc (Zn), lead (Pb) and cadmium (Cd), concentrations in the crabs, *Scylla serrata* and *Portunus pelagicus*, from the Uran coast, Panvel, Raigad, Maharashtra. The result of this study will be helpful in assessing the public health risks and also it will set the preliminary baseline data for the future study.

Materials and Methods:

20 individuals of *S. serrata* and *P. pelagicus* were collected from the Uren coast in the month of September. The collected samples were stored in plastic containers, preserved in crushed ice and brought to the laboratory for further analysis. Specimens having almost the same size and weight were selected for the determination of the metal concentrations in the carapace and muscle tissue. Carapace and muscle tissue were excised carefully, dried at 70°c until a constant weight was obtained. The dried samples were put in a clean and dry mortar and were ground to fine particles and then sieved using a sieve of particle size 0.02 mm. 0.5 g of sample was placed in a clean dry beaker (100 ml), and was digested in 5 ml of aqua regia [HCl and HNO_3 (3:1)]. Few drops of H_2O_2were

then added to clear the solution to pale yellow. The samples were allowed to be evenly distributed in the acid by stirring with a glass rod and then the beaker was placed on the heater. The digested samples were filtered through Whatman filter paper No-40 into a graduated cylinder and the filtrate was diluted to 50 ml using distilled water. A reagent blank was also run simultaneously. Inductively Coupled Plasma Atomic absorption spectrophotometer model was used to analyse the concentration (ppm) of Zn, Cd, and Pd in the samples of the animals under investigation.

Results and Discussion:

The result of the analyses shows the concentration of heavy metals present in carapace and muscle tissue of the two species of crab, *S. serrata* and *P. pelagicus* (Table 1). Zn, Pb and Cd were not detected in the carapace samples of both the species. Pb and Cd were also not detected in the muscle tissue but Zn concentration was, 224.16±26.55 ppm and 121.18±35.33 ppm in the muscle samples of *S. serrata* and *P. pelagicus* respectively.

Heavy Metals	*Scylla serrata*		*Portunus pelagicus*	
	CS	MS	CS	MS
Zinc (Zn)	ND	224.16±26.55	ND	121.18±35.33
Cadmium (Cd)	ND	ND	ND	ND
Lead (Pb)	ND	ND	ND	ND

ND= Not detected, CS= Carapace sample, MS= muscle tissue sample

The levels obtained were significantly lower than the WHO 2.00ìg/g permissible level for Lead and Cadmium in food. The concentrations of the heavy metals were below the recommended values. According to FAO (1983), Kakulu *et al.,* (1987) and Federal Environmental Protection Agency - FEPA (1991), the WHO recommended quantities permissible, safe level for human consumption are Cd-2.00ìg/g; Pb-2.00ìg/g; Zn-1000ìg/g. The result is in conformity with the observation of (Lawal-Are, 2001) that, the metal concentrations were much lower in the crabs during the wet season. This may have resulted from the high dilution of the estuary water from the heavy rains that occur in monsoon season.

In the present study, bioaccumulation of metals is in order Zn>Pd=Cd which is in the line with some of the earlier reports (Dumalagan and Gonzales, 2010).Of the three metals studied, Zn is essential elements while Pb and Cd are non-essential elements for most of the living organisms. Zn and Cu are recognized as essential elements, required by a wide variety of enzymes and other cell components having vital functions in all living beings. The concentrations of zinc (table 1) in all the samples were higher, compared to the concentrations of other metals in same crab samples. Elevated zinc concentration in crabs may be attributed to its need for the organism. Zn is an essential element for the metabolic process; it is associated with the sulphide- transporting protein at its active site. Cadmium uptake from water by aquatic organisms is extremely variable and depends on the species and various environmental factors, such as water hardness, salinity, temperature, pH, and organic matter content. Increasing temperature increases the uptake and toxic impact, whereas increasing salinity or water hardness decreases them. Acute lethal effects on marine organisms have been noted as low as 16 $\mu g\, l^{-1}$ (WHO 1992). Zinc increases the toxicity of cadmium to aquatic invertebrates. Pb is a toxic heavy metal, which finds its way in coastal waters through the discharge of industrial waste waters, such as from painting, dyeing, battery manufacturing units and oil refineries *etc*. In aquatic invertebrate communities, some populations are more sensitive than others and community structure may be adversely affected by lead contamination. However, invertebrate populations from polluted areas can show more tolerance to lead than those from non-polluted areas. In other aquatic invertebrates, adaptation to hypoxic conditions can be hindered by high lead concentrations (WHO 1995).

Hsiao-Chien *et al* (2008) have reported that, crab is a potential biomonitor of Pb and Ni pollution in aquatic ecosystems. Therefore, it can be deduced that crabs are one of the aquatic biota show bioaccumulation and serves as bioindicator of toxic metals or contaminants in aquatic environments. This result would serve as an indicator of heavy metal contents in the crabs from the Uran coast. The concentrations observed were within the maximum permissible limit set by WHO 2.00ìg/g in food for Pb and Cd. From the results obtained in the present investigation, it can be concluded that, the two species of crabs, viz *Scylla serrata* and *Portunus pelagicus* from the Uran coast are safe for human consumption.

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