Mercury in Finfishes and Shellfishes Inhabiting Ennore Estuary, Madras

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The concentration of mercury in some commercially important finfishes and shellfishes from Ennore estuary which receives effluent from a chlor-alkali plant, has been measured. The concentration registered in finfishes (*Chanos chanos* and *Liza macrolepis*), prawn (*Penaeus indicus*) and edible oyster (*Crassostrea madrasensis*) do not pose an imminent threat to the human consumers or to the biota themselves. The distribution of mercury load exhibited seasonality, the higher values being observed during monsoon period in all the organisms. The mercury level observed in the biota is oyster > prawn > finfishes. The results indicate the suitability of the oyster, *C. madrasensis* as a sentinel organism for monitoring mercury contamination in estuaries.

The Ennore estuary (lat.13°14'E; long. 80°15'E) situated in the northern side of Madras city, receives effluents from more than 17 industrial installations. Heavy metals, such as Hg, are among the waste products of some of these industries which include a chlor-alkali plant (Joseph, 1989). Hg discharged in the water and sediment may eventually find its way into the aquatic biota which thrive in the estuary. The present investigation was taken up to assess the level of accumulation of Hg in muscle tissues of commercially important prawn (*Penaeus indicus*), finfishes such as milkfish (*Chanos chanos*) and estuarine mullet (*Liza macrolepis*), and oyster (*Crassostrea madrasensis*) inhabiting this estuary.

Materials and Methods

Samples of water, fish, prawn and oyster were collected from Ennore estuary at quarterly intervals during 1984-85. Samples of water for hydrochemical characteristics were analysed following standard methods (APHA, 1976; Strickland & Parsons, 1975). Hg in water was determined by cold varpour atomic absorption spectroscopy (Hatch & Ott, 1968) using a Varian Techtron model AA 6 atomic absorption spectrophotometer. The edible muscle tissues of fish, prawn and oyster were wet digested in Bethge apparatus using HNO_3 and H_2O_2 mixture (Dalziel & Baker, 1983). The digested samples were analysed for total Hg by cold vapour atomic absorption technique. Analyses were done in triplicate for all samples.

The accuracy of the analytical procedure was checked using standard reference materials and recovery of Hg from the sample was 94%.

Results and Discussion

Results of hydrochemical analysis are given in Table 1. Low level of pollution

Table 1. *Range of physico-chemical features of Ennore estuarine water*

Parameters	Range
Water temperature, °C	29.1-31.8
Dissolved oxygen, mg l^{-1}	5.2-5.9
Total alkalinity, mg l^{-1}	156.0-196.0
pH	7.4-8.1
Salinity, X 10^{-3}	19.7-31.2
COD, mg l^{-1}	9.0-19.6
BOD_5, mg l^{-1}	5.7-17.3

COD : Chemical oxygen demand;
BOD5 : 5-day biochemical oxygen demand

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Table 2. *Concentration of Hg in water (μg.ml^{-1}) and in finfishes and shellfishes ((μg. g^{-1}, wet weight) inhabiting Ennore estuary*

Month & year of collection	Water	Milkfish *(C.chanos)*	Mullet *(L. macro-lepis)*	Prawn *(P.indicus)*	Oyster *(C.madra-sensis)*
Feb. 1984	BDL	0.006	0.010	0.056	0.26
May 1984	BDL	0.004	0.008	0.058	0.20
Aug. 1984	0.001	0.009	0.016	0.056	0.21
Nov. 1984	0.002	0.012	0.021	0.060	0.31
Feb. 1985	BDL	0.006	0.014	0.042	0.26
May 1985	BDL	0.005	0.012	0.041	0.20
Aug. 1985	BDL	0.006	0.018	0.052	0.29
Nov. 1985	0.001	0.014	0.024	0.060	0.36
Mean	0.0004	0.008	0.015	0.053	0.26

BDL = Below detection limit

was indicated by the existing chemical oxygen demand (BOD) test results.

The concentration of Hg in Ennore estuarine water (Table 2) ranged from below detection limit (<0.0001 μg. ml^{-1}) to 0.002 μg. ml^{-1}. It is reported (Hasselerot, 1968) that the Hg levels in water may be close to the analytical detection limit even when fishes are grossly contaminated. The observed concentration of the metal in water indicates a contaminant source in this ecosystem. The Ennore estuary receives city sewage, agricultural land run-off, effluents from coal fired thermal power plant and petro-chemical complex including a chlor-alkali plant, all of which can contribute to Hg loading in the ecosystem. The concentration of Hg was found to be higher during the month of November (monsoon period). Many of the industries situated nearby are not having perennial effluent channels. The waste are getting dried up in barren lands nearby and the freshets bring a heavy load of pollutants into the estuary (Joseph, 1991). This may be causing an increase in Hg loading during monsoon period. Strong winds prevailing during this period also cause the resuspension in the water of bottom sediments containing significant amounts of Hg (Joseph, 1990).

The Hg contents in tissues of fishes and shellfishes (Table 2) are slightly higher than the values reported for some of these species from Indian estuarine and coastal waters (Sanzigiri *et al.*, 1988; Kureishy *et al.*, 1979; Patel & Chandy, 1988; Krishnakumar & Pillai, 1990), but are lower than those reported from Thane Creek and Ulhas estuary, Bombay (Mahajan & Srinivasan, 1987).

The edible oyster *C. madrasensis* had higher concentration (mean 0.26 μg. g^{-1})) than prawn and fishes. Filter feeders such as *C. madrasensis* can take up Hg from the ambient water, from particulate organic matter and planktonic organisms, the concentration of the metal in such animals may be a composite function of all these factors. The sessile bivalve species filter large volumes of water and concentrate Hg from low ambient levels. The increase in Hg accumulation in oysters in the present study

can be attributed to their bio-availability and filter feeding habits which result in biomagnification of the metal. Further, the oysters sampled during the present study occupied the bed of the estuary, near the confluence of the Buckingham canal and Red Hills Surplus channel which bring industrial effluents into the estuary. This area is well within the limit of tidal amplitude. Therefore, the ratio of sediment-organism contact was very high throughout the life time of the animal. Hence the Hg load showed by this species probably indicates a combined effect of sediment and ambient water load.

Between *C. chanos and L. macrolepis*, the latter generally contained higher Hg burden. *C. chanos* is mainly a phytoplankton consumer while *L.macrolepis* has a more varied diet. Since the sediment and water hardly seem to influence the Hg burden of estuarine fish (Cuvin Aralar, 1989), it would appear that the type of food taken in by the two species affects their Hg uptake. For example, it has been shown that carnivorous fishes have significantly higher Hg load than those with herbivorous habit (Ratkowsky & Wilson, 1975) as noted in Derwent estuary of Tasmania.

Higher concentration of Hg was noted in all the biological samples collected during the month of Novmber which coincides with the peak monsoon period in this region. The increase in the availability of Hg in the ambient water, sediment and fish-food organisms may be causing accumulation of the metal in the biota.

The Hg concentration observed in the biota are found to be lower than the maximum permissible limit of Hg in sea foods for human consumption prescribed as 0.5 $\mu g. g^{-1}$ by USSR, 0.7 $\mu g. g^{-1}$ by Italy and 0.4 $\mu g. g^{-1}$ by Japan (FAO, 1983). The tissue Hg levels above 10.0 $\mu g. g^{-1}$ are considered harmful to fish (Anon, 1979). The concentrations registered in the biota do not pose an imminent threat to the human consumers or to the biota themselves. Sublethal doses of Hg may influence fertility, affect nervous and haematological responses and induce chromosomal aberrations in fishes (Cuvin Aralar, 1989). Therefore, steps should be taken to ensure that the concentration of this metal does not exceed further. To this end, a careful monitoring programme should be instituted, particularly in Ennore estuary which is a major source for several commercially important species of fish and shellfish.

The concept of monitoring heavy metal pollution through animals, especially bivalves has been fairly well accepted. The sequence of Hg levels noted in biota in the present investigation is oyster > prawn > finfishes. The edible oyster *C.madrasensis* which is widely distributed in the coastal and most of the estuarine waters of India (Nair & Nair, 1986) can be used as a suitable bioindicator (Radhakrishnan *et al.*, 1986) for detection of heavy metal contamination in such systems to make assessment of space and time trends.

The first author is grateful to Dr. K.Alagarswami, Director, Central Institute of Brackishwater Aquaculture and Late Dr. A.V. Natarajan, former Director of CICFRI for their valuable guidance. Thanks are also due to Prof. T.V. Ramakrishnan and Dr.N. Balasubramaniam, Department of Chemistry, IIT, Madras for providing facilities and help for the chemical analysis of the samples.

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