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A PRELIMINARY STUDY ON CERTAIN TRACE METALS IN SOME PLANT AND ANIMAL ORGANISMS FROM MANGROVES OF SUNDARBANS, INDIA

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ABSTRACT

The distribution of some trace metals in the mangrove flora and fauna of Sundarbans have been studied. Among the metals, Zn showed higher values in all the species of plants and animals followed by Cu and Pb. The most dominant plant of the system *Avicennia marina* contained significant amount of Zn in leaves than in other plant parts. Muscles of edible fishes showed Hg content higher than the permissible limit.

Key-words: Heavy metals; organisms; mangroves; Sundarbans.

Extensive use of different chemical forms of metals by the industrial, agricultural and domestic sectors have invoked considerable interest in the aquatic environments. It has been suggested that no organic life can develop and survive without the precipitation of metal ions (Forstner and Whitman, 1979). However, various organisms are known to accumulate metals in excess of those in their environment (Stinner and Nickless, 1975; Zingde, Singbal, Moraes and Reddy, 1976). The Hooghly Matla estuarine complex supports the world's most luxurious mangrove vegetation, the Sundarbans, an area that traditionally functions as an important source of human nutrition. Hence, the study was undertaken to assess the levels of certain heavy metals like Zn, Cu, Pb, Hg and Cd in some most common organisms distributed in the mangrove environment of Sundarbans.

The study areas are around Lothian and Prentice Islands situated in Saptamukhi river complex of the Gangetic delta, extending from 88°17'30"E to 88°21'30"E and 21°32'50"N to 21°45'50" N. The mean annual precipitation is 1900 mm and mean maximum and minimum temperatures are 29.2°C and 12.5°C respectively. The type of vegetation found in these islands is mainly salt resistant mangroves (Meher-Homji, 1973) and associated with characteristic flora and fauna distributed over this mangrove ecosystem.

The samples of plants and animals (mature average sized) were collected during May 1987 and transported to the laboratory in plastic bags. All the samples were washed with demineralized water. To remove metals present on the root surface, roots were treated by a modified dithionitecitrate-bicarbonate extraction procedure

(Otte, Buijs, Riemer, Rozema and Broekman, 1987). The plant parts were then dried at 80°C for 24 hours and animal parts at 100 - 150°C to constant weight. All the dried samples were separately homogenized and 100 mg of each sample was digested with 10 ml nitric acid and perchloric acid mixture (Lithnor, 1975) till a clear solution obtained, cooled at room temperature and filtered. The filtrate was then diluted with HCl and made to 50 ml with double distilled water. Blanks were run at the same sequence of treatments. The solutions were analysed for Zn, Cu, Pb and Cd using an atomic absorption spectrophotometer (Model Varian spectra AA 20). Mercury was analysed by a Mercury analyser (Model EC-MA 58001). Precision of the each analysis was also checked from replicate samples.

In the present study Zn was found to be most abundant of the metals measured in all the species of plants and animals. In the plants, concentration of Zn varied from 28 to 80 ppm of dry weight (Table I). Among the studied plants the two dominant species, *Avicennia marina* and *Acanthus ilicifolius* showed higher values of Zn content whereas lower values of all metals were encountered in the case of *Porteresia coarctata*. The variations of Cu, Pb, Hg and Cd in different plant species were 11 to 29 ppm, 5 to 24 ppm, 0.2 to 1.8 ppm and 1.0 to 3.0 ppm respectively.

Metal distribution in different parts like pneumatophore, root, stem and leaf, of *Avicennia marina*, revealed that the accumulations of all metals except Zn, was higher

Table I Distribution of heavy metals (ppm) in organisms

Organism	Species	Zn	Cu	Pb	Hg	Cd
	Porteresia coarctata					
	Leaf	29	14	12	1.2	1.9
Plant	*Avicennia marina*					
	Leaf	78	11	5	0.2	1.0
	Stem	80	7	9	0.3	1.3
	Root	29	18	20	0.5	2.0
	Pneumatophore	28	24	26	0.8	2.0
	Acanthus ilicifolius					
	Leaf	71	18	24	1.2	2.4
	Ceriops decandra					
	Leaf	52	20	20	1.6	3.0
	Aegialitis rotundifolia					
	Leaf	58	29	20	1.8	2.0
Animal (Muscles)	*Mystus gulio*	187	43	26	0.9	43.0
	Harpodon nehanias	387	46	20	0.8	37.0
	Pelocoetes sp.	429	49	14	1.0	3.4
	Macoma birmanica	368	36	5	0.5	2.8
	Telescopium telescopium	381	47	15	–	1.5
	Nerita articulata	213	32	20	1.5	–

in pneumatophore and root portion of the plants. But the variation of Zn content was in the order of Leaf > Stem > Root > pneumatophore.

Although the studied plants and animals species reside in same habitat, the distribution of some metals was found much higher in animals than the plants. Benthic bivalves (*Macoma birmanica*), gastropods (*Telescopium telescopium*, *Nerita articulata*), nemertines and Cnidarians (*Pelocoetes* sp.) showed a significant accumulation of Zn, Cu and Cd in their muscles which ranged from 213 to 429 ppm, 32 to 49 ppm and 1.5 to 3.4 ppm respectively. Whereas Pb and Hg accumulation was more or less similar in both plant and animal species. The species like *Mystus* and *Harpodon* were distinguished by their higher content of Pb (20 - 26 ppm), Cd (37 - 43 ppm) and Hg (0.8 - 0.9 ppm).

Some of the metals like Zn, Cu, etc. have been considered as essential metals taking active part in the biological system while Pb, Cd and Hg as non-essential metals, presence of which cause deleterious effect. It is an intrinsic need of the organisms to show strong affinity for the essential elements rather than non-essential ones. The distribution of different metals in organisms thus, depends on the availability of the respective metal, the accumulation capacity of the organism and of course on the antagonistic nature of the metallic ions present in that environment (Clark, 1986). In the present study, higher values of Zn and Cu in plants and animals appear to be due to their more availability and accumulating capabilities in all the organisms. The variation of metal accumulation in plants and animals has been supported by Page, Bingham and Nelson (1972) and Zingde, Singbal, Moraes and Reddy (1976).

Mc Millan (1977) has reported that the ultrafiltration mechanism is not better developed in *Avicennia marina* and thus does not affect the accumulation of certain essential ions from the environment. The observation in the present study, that the higher concentration of Zn in the leaf than that in other plant parts, substantiated this view. It, therefore, lends support that the Zn ion is well transported from roots to leaves through folian glands and vascular hairs as pointed out by Queen and Reimold (1974). Similar type of observations have been reported by Subramanian and Venugopalan (1983) in *Avicennia marina* in respect of Fe and P content from Pitchavaram mangrove forest.

Among the animals, relatively higher values of metals were found in *Mystus gulio* and *Harpodon neharias*. It is important to note that the muscles of the edible fishes contained Hg level higher than the permissible limit (0.5 ppm) (Tejam and Haldar, 1975). Moreover, existing evidence shows that the higher concentration of Cd in animals can also cause teratogenic, mutagenic and carcinogenic effects to organisms (C.E.C., 1978). Hence, the present study indicates that the environment is not at all free from heavy metal contamination. It is therefore, felt that there is an urgent need to protect the ecosystem freeing from anthropogenic stresses by adopting legal and other regulatory measures so that the mangrove habitat can be more productive.

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