In Situ PARTITIONING AND BIOMAGNIFICATION OF MERCURY IN INDUSTRIALLY POLLUTED HUSAINSAGAR LAKE, HYDERABAD, INDIA

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Abstract. The distribution of Hg in water, sediment, plankton and fish along with the in situ biomagnification of the metal in Husainsagar Lake, India were measured. The concentration of Hg in the water was 10 μg L⁻¹ and exceeded the water quality criteria standards. Sediments of the lake at different sites had Hg concentrations several thousand fold more than that of the overlying water column and showed relationship with the water content of the wet sediment. Sediments in the lake acted as a 'sink' for the metal. The concentrations of Hg increased from nanoplanckton → phytoplankton → zooplankton. Fish, an end organism in the food chain, had Hg concentrations higher than that of nanoplanckton and lower than those of phytoplankton and zooplankton. This trend did not illustrate the expected pattern of food chain enrichment in the classical sense as noted for chlorinated hydrocarbons (DDT).

1. Introduction

Concern about Hg contamination in the environment are well documented (D'Itri and D'Itri, 1977). After hazardous Hg contamination in the aquatic environment found in Japan, Scandinavia, and North America (Minamata Disease Study Group, 1969; Lofroth, 1969; D'Itri, 1971), investigations on the levels of Hg in the components of aquatic system were initiated and comprehensive analytical surveys of Hg content in fish from many parts of the world have been made (Krenkel, 1973). The toxicity of Hg is well known, and its presence in natural waters has been recognized as a public health hazard in many countries (D'Itri, 1972). Recorded concentrations of Hg in fish from numerous waters provide evidence of bioaccumulation and the rate of bioaccumulation differs among different lake ecosystems with or without Hg sources (Fimreite and Reynolds, 1973; Fagerstrom et al., 1974; Smith et al., 1975; McFarlane and Franzin, 1980; MacCrimmon et al., 1983). Despite these examples of Hg levels in fish, Biddinger and Gloss (1984) opine that there is still a lack of data as to the roles the food chain and biomagnification have played in the accumulation of Hg in fish.

Recently, with the deterioration of the water quality of Husainsagar Lake, Hyderabad, India, contamination of lake water with heavy metals have been reported (Seenayya et al., 1985; Prahalad, 1987). The in situ partitioning and biomagnification of Cu, Cd, Cr, and Mn had been shown by Prahalad and Seenayya (1986) and Seenayya and Prahalad (1987).

In the present study a multicompartmental approach to examine the intercompart-
mental interactions and in situ biomagnification of Hg in Husainsagar Lake water, sediment, planktonic organisms, and fish has been reported.

2. Materials and Methods

2.1. Study site

Husainsagar Lake is an hypereutrophic polluted lake situated in the heart of Hyderabad metropolis. Its physical features are described elsewhere (Prahalad and Seenayya, 1986). The main source of water to the lake is the Kukatpally channel, which passes through the industrial belt (Figure 1). More than 250 industries which manufacture chemicals, drugs, paints, and machine tools are located on its banks (Simhachalam, 1975). The sources of heavy metal pollution is from leakage and overloading of the sewer line of the industrial belt, dumping their untreated and partially treated effluents directly into the stream.

2.2. Sampling sites

Four sampling sites were fixed based on the morphology and bathymetric characteristics, covering major inflow points and deeper central region of the lake (Figure 1). Site 1 is situated in the shallow region of the lake towards receiving point of the main inflow channel; the depth range from 1.8 to 3.7 m. Site 2 is located on the southern side of the lake, depth ranged from 2.4 to 6.4 m. Site 3 is located at the central deeper region of the lake; the depth varied between 8.5 to 10.7 m, and Site 4 located in the northern segment of the lake; the depth ranged from 2.7 to 5.8 m. The water, plankton and fish were sampled for total Hg only from Site 1, since this site is more vulnerable to the entry of industrial effluents down from the Kukatpally channel. The analysis of total Hg and water content of surficial sediment were made for all the four sites, since the data on sediment pollution will provide a valuable ecological information for identifying the hot spot of Hg contamination through risk analysis studies which are in progress.

2.3. Samples collection

Surface water samples and sediment from Husainsagar Lake were collected as described by Prahalad and Seenayya (1986) and Seenayya and Prahalad (1987). Water samples were brought to the laboratory in properly washed polyethylene bottles rinsed with HNO₃ to avoid adsorption of Hg on the walls of the container. Samples were filtered using 0.45 µm membrane filter and subjected to acid digestion to measure total dissolved concentration of Hg. Random collections of samples of particulate matter (living and non-living) were made with nets of steel frames using warranted genuine quality bolting cloth (Dufourba, U.S.A.) of three different pore sizes (≥ 50, ≥ 100, and ≥ 600 µm) from Site 1 of the lake. Samples were sorted according to pore size of nets and arbitrarily designated as nanoplankton, phytoplankton and zooplankton, respectively (Prahalad and Seenayya, 1986; Seenayya and Prahalad, 1987), since each can be contaminated to a different degree under in situ conditions. Five fish of different body weights were