CHAPTER:1

INTRODUCTION

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Among the various environmental pollutants, heavy metals and their salts constitute the most widely distributed group of highly toxic and long retained substances (Metaleve et.al, 1983)[1]. Metals and pesticides head the list of environmental pollutants at the moment, which poses a greater potential risk than the entrophicating nutrients and organic wastes (Katz, 1975)[2].

Metals and their compounds are greatly influencing the modern world antagonistically. On one hand, the modern development is based on metals as they have been found to be of immense use in our life. On the other hand, however, they are polluting the environment in a number of ways. The effects of metals in water bodies and waste water range from beneficial through troublesome to dangerously harmful or toxic,(APHA, 1985)[3]. The benefits and the toxicity of metals depend upon the chemical form in which they are present in relevent environs in the qualitative as well as quantitative sense.

Some of the metals have been found to be very useful due to their presence in the biological systems. Such, for example, is iron in blood and magnesium in Chlorophyll. The deleterious effects of metals/metal ions are effectively exhibited by the transfer of mercury of fertilizers and insecticides, through animals, plants and water to human systems. Similarly chromium of industrial waste affects the life and growth of fishes.

The rapid industrial development has made the extensive applications of heavy metals. Industries have been discharging the

heavy metals in their wastes, causing land and water pollution. Consequently, terrestrial and aquatic fauna and flora are affected in various baneful ways.

Excess heavy metals are often introduced into aquatic ecosystems as by-product of industrial processes and acid-mine-drainage residues. Among the heavy metals and their compounds that are harming the aquatic life, the important ones are mercury, lead, chromium, cadmium, silver, nickel, zinc, copper and iron. Blaise and Costan (1987)[4] have analysed and assessed the toxicity of 300 effluent samples collected from 160 different industrial sites including 6 industrial sectors: mining, textile, food, pulp and paper, chemical and refinery. Mercury has been found to be present as a by-product in the insecticide, paints and pharmaceutical industries. Lead has been detected in the effluent waste of batteries and paints industries. The use of lead arsenate, phenyl mercury acetate, arsenic chloride, zinc cyanide and mercuric chloride as insecticide, fungicide, herbicide and disinfectants is a common practice in agriculture. Vermillion prepared from lead chromate is very commonly used by the indian women. Nickel finds extensive use in edible oil industries in hydrogenation of fats and oils. Nickel pollutes the water through the effluents from the electroplating, paints and other chemical industries. Cadmium is obtained at considerable levels in the discharges from the industries dealing with manufacture of batteries, pigments and in electroplating. In this manner the heavy metals are getting their way to water bodies along with the effluent wastes being discharged from various industries.

The survey of the health of workers involved in mining and processing sectors has revealed that metals such as arsenic,

zinc, copper, cadmium, lead, nickel and mercury have a number of ill-effects on their health (Spehar et al 1979)[5]. Environmental pollution by heavy metals was instantly recognised with Minamata disaster in Japan (Smith 1975[6], Kastuki et.al 1957[7] and Takeuchi et al. 1962[8]), where several thousands of people suffered mercury poisoning by consuming the fish caught in Minamata Bay, which was recipient of mercury released from a vinyl chloride plant between 1953-1960. Smith and Smith (1975)[6] observed that Itai-itai disease in Japan was caused by the consumption of cadmium contaminated rice.

Singh(1984)[9] in Table 1 shows the list of heavy metals and the industrial effluents that contain them. From the point of view of the present investigations, one may find out that these heavy metals, on getting into the water bodies like ponds, lakes or rivers, affect the animal and plant life to inhibit their growth. In the ponds, lakes or rivers (the fresh water bodies), most important animal life is fish, economically. Among the freshwater fish, Carps and Catfishes form a major part of the edible variety. While growing in the polluted water (due to heavy metals), these fish are affected by the heavy metals present in it. This effect may be apparent in the form of loss of growth in length and weight, some disease or even the death of the fish, when the concentration of the metal exceeds a certain limit.

A review on the effect of pollution on fresh water fish was published by Spehar et al. (1979)[5]. The available literature deals with the toxicity of various metals and other pollutants to some fresh water fish. Since the massive outbreak of mercury

poisoning in Minamata Bay of Japan, mercury has been recognised and reported by Kastuki et al (1957)[7], Takeuchi et al. (1962)[8] as one of the most hazardous environmental pollutant. Extensive work by Handa et al. (1983)[10], Kaviraj (1983)[11], Sastry and Sunita (1984)[12], Sippel et al. (1983)[13] and Kaviraj (1983)[14] has been carried out using chromium, zinc, mercury, lead etc. on different varieties of fish. Mathis and Kavern (1975)[15] observed that mercury is highly toxic to aquatic fauna and among the aquatic fauna fish are one of the most sensitive groups. However, an extensive survey of literature reveals that there is a dearth in the studies on the effect of these heavy metals on the edible freshwater fish and hence there is need to undertake investigations to fill the gap.

The edible fish, affected by the toxic heavy metals are consumed by the human beings as food. In this way these heavy metals may pass into the human systems causing undesirable effects on the health of its consumers. Hence, the effect of presence of these metals in water sources and the fish needs thorough and careful study.

In the present work an attempt has been made to study the effect of some heavy metals such as **cadmium, mercury and nickel** on fresh water fish. The studies have been made largely with reference to the growth and physiology of the cyprinoid fish sp., **Cirrhinus** mrigala (Hamilton) and a siluroid fish sp. **Heteropneustes fossilis** (Bloch). The extent of the toxicity of the metals to the fish has been studied at varying concentrations of the metals. The median lethal concentration values of the metal salts to the fish with

varying exposure durations have been determined. Histological studies of the gills, liver and kidney have also been made to correlate the effect of these metals on these organs. Studies on the accumulation of these metals in different organs of the fish such as gill, liver and kidney have also been attempted.