"Effect of Heavy Metals from Dyeing Mills Effluents on the Fresh Water Fish Labeo Rohita and Toxic Effects on Fish Metabolism"

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ABSTRACT

An attempt has been made to study the waste water which are coming from varies industries and hospitals, rural areas that directly affect the aquatic animals and human beings who consume the same. Usually, all aquatic animals bear only certain number of heavy metals when this goes beyond the limit this cause harmful effect directly to aquatic animals and indirectly to human beings of them consume regularly. Certainly, heavy metal levels reached unacceptable levels for human consumption. Because high metal concentrations in tissue can have toxic effects on fish metabolism, it is important to consider the biological effects of contamination on fish health in the river.

Key Word: Dyeing mills and Tannery effluent, Fresh Water Fish, Heavy Metals, Fish metabolism

INTRODUCTION

Metals are elements found naturally in aquatic ecosystems due to various processes such as weathering and erosion. According to Mason (1991), there are five major types of toxic pollutants known to man: i) Metals arising from industrial processes and some agricultural applications (lead, copper, nickel and zinc) ii) Organic compounds, originating from industrial, agricultural and some domestic sources (herbicides, PCB's, organ chloride pesticides, chlorinated aliphatic hydrocarbons, organ metallic compounds and phenols) iii) Gases (ammonia and chlorine) iv) Anions (cyanides, fluorides, sulphides and sulphites) Acids and alkalis amongst the pollutants contaminating water bodies, metals play an important role (Witeska et al., 1995). As mentioned in chapter one, answers are always sought, in practice, to the problems raised by water pollution, especially when it comes to metal pollution (Nussey, (1998).Metals are present in very low concentrations in natural aquatic ecosystems (Nussey, 1998), usually at the nanogram to microgram per liter level, but recently the occurrence of especially heavy metals in excess of natural loads, has become an increasing concern (Biney et al., 1994; Bennet-Chambers wr al., 1999) for aquatic ecosystem 'health'. Heavy metals are part of a group of elements, whose hydro chemical cycles have been accelerated to a great extent by man (Viljoen, 1999). The most important heavy metals in water pollution are zinc, copper, lead, cadmium, mercury, nickel and chromium (Abel, 1989; Seymore, 1994; Viljoen, 1999) Heavy metals are often present at elevated concentrations in aquatic ecosystems, due to 1) The rapid growth in population (Biney et al., 1994: Seymore, 1994).2) An increase in industrialization (Biney et al., 1994: Pelgrom et al., 1994)3) The increase of urbanization and socio-economic activities, exploration and exploitation of natural resources. 4) Extension of irrigation and other modern agricultural practices, as well as 5) The lack of environmental regulations (Biney et al., 1994). Consequently, aquatic organisms are exposed to the elevated levels of metals (Pelgrom et al., 1995a) levels not previously encountered (Nussey, 1998), posing a great threat to aquatic organisms in particular and to the whole ecosystem in general (Zou and Bu, 1994; Zou, 1997).

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Materials And Methods

Mesh net catch adult Labeo rohita (21.1+1.9 cm and 138.4+23.3g). Ten fish from each station were used for analysis. The sizes and weights of the animals did not vary significantly from station to station (P>0.07). Station I Mettur Dam is a relatively clean area of the river system because it is north of industrial and agricultural areas and is therefore relatively less affected from contaminated effluents. The other stations, however, receive many industrial and domestic effluents from Mettur Dam and surrounding areas. Station 2 is located at the site of a small dam built for field irrigation and receive effluents from domestic sources, hospitals and other sources. The other stations are from normal flowing parts of the river (water runs faster in those areas), but they also receive additional inputs from sewage waters. In the same day of capture the Animals were brought to the laboratory as soon as they were caught and dissected with clean instruments. The tissues of ten fish of the same species from the same station were pooled to make 3 subsamples. Gill, liver, Muscle and kidney was put in Petri dishes to dry at 120 C until reaching a constant weight. Dry gill (0.423+0.165 mg), liver (0.307+0.088 mg) and muscle (0.682+0.144 mg) tissue was put into digestion flasks and 4ml perchloric acid and 8 ml nitric acid (Merck) were added. The digestion flasks were then put on a hot plate set to 130 C (gradually increased) until all materials were dissolved. Digesters were diluted with distilled water appropriately in the range of the standards, which were prepared from the stock standard solution of the metals (Merck). Metal concentrations in the samples were measured using a Perkin Elmer as 3100 atomic absorption spectrophotometer and given as mg metal/g dry weight. Statistical Analysis of data was carried out with SPSS statistical package programs. Kruskall-Wallis one way ANOVA was used to compare data among stations.

Results

The concentrations and associated standard deviations of cadmium, lead, copper, chromium and nickel in the gill, liver, muscle, kidney of (Carp) from 2 stations in the Mettur Dam are shown in Tables 1 & 2 e, along with the results of statistical comparisons of tissue metal concentrations. Figure I show sampling stations in the Cadmium concentrations varied significantly (P<0.05) from station to station except in the muscle of Labeo rohita (Table I a). (Station 2 generally showed the highest cadmium concentrations. Lead concentrations varied significantly from station to station, except (P>0.05) in the gill of Labeo rohita (Table I b). The highest lead concentrations were found in samples from station 2, except in the muscles. Copper concentrations varied from station to station only in the gill and liver of Labeo rohita (Table 1 c). None of the stations consistently showed the highest copper concentrations. Mean copper concentrations were higher in the gill of Labeo rohita Variations in chromium concentrations were significant only in the gill and liver of Labeo rohita.) (Table 1 d). station 2 showed the highest chromium concentrations in the tissues except in the muscle and gill of Labeo rohita. Nickel concentrations varied significantly from station to station in the gill tissue of all fish species (Tanle 1 e). Station 2 showed the highest nickel concentrations. Mean nickel concentrations were highest in the gill and liver tissue of Labeo rohita

Table – 1a mean concentration (mg metal/g d.w) associated standard deviation of cadmium in the Gill, Liver, Kidney and Muscle tissue of Labeo rohita caught at five stations in the kaveri River.

Station	Gill	Liver	Muscle	Kidney
1	2.30+0.20	1.37+0.35	1.23+0.35	1.15+0.25
2	2.14+0.41	2.62+1.04	0.83+0.35	0.82+0.11
3	1.80+0.05	1.30+0.43	0.96+0.12	0.88+0.10
4	2.16+0.21	0.95+0.14	0.87+0.20	0.65+0.15
5	1.46+0.32	1.11+0.48	0.64+0.15	0.93+0.17
Mean	1.97+0.38	1.50+0.80	0.92+0.20	0.92+0.25
P Value	<0.07	<0.07	<0.07	NS

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Table – 1b mean concentration (mg metal/g d.w) associated standard deviation of Lead in the Gill, Liver, Kidney and Muscle tissue of Labeo rohita caught at five stations in the kaveri River.

Station	Gill	Liver	Muscle	Kidney
1	15.50+1.63	7.93+2.51	10.21+3.20	9.22-3.10
2	17.13+3.73	15.92+3.63	7.12+0.90	5.13-0.80
3	11.22+0.69	7.90+3.86	6.87+1.42	6.66-1.40
4	14.26+1.83	6.75+0.64	6.64+1.89	6.65-1.79
5	13.14+4.37	7.83+3.20	4.33+0.75	4.12-0.65
Mean	14.22+3.17	9.43+4.39	7.07+1.93	7,04-1.53
P Value	NS	<0.07	<0.07	<0.07

Table – 1c mean concentration (mg metal/g d.w) associated standard deviation of Copper in the Gill, Liver, Kidney and Muscle tissue of Labeo rohita caught at five stations in the kaveri River.

Station	Gill	Liver	Muscle	Kidney
1	7.53-0.03	51.61-31.0	6.54-5.25	6.50-3.25
2	7.42-1.75	62.23-27.7	3.43-1.20	3.47-1.13
3	6.21-1.01	11.82-8.24	6.22-0.16	6.23-0.12
4	6.21-0.75	11.4-6.97	4.54-0.67	3.58-0.42
5	7.40-1.35	14.32-7.50	4.77-0.48	4.79-0.48
Mean	7.02-1.07	32.19-27.6	5.13-2.37	5.12-2.17
P Value	NS	<0.07	<0.07	NS

Table – 1d mean concentration (mg metal/g d.w) associated standard deviation of Chromium in the Gill, Liver, Kidney and Muscle tissue of Labeo rohita caught at five stations in the kaveri River.

Station	Gill	Liver	Muscle	Kidney
1	1.81-0.31	0.23-0.35	0.54-0.90	0.36-0.82
2	6.10-3.09	2.30-0.87	0.82-0.31	0.83-0.20
3	2.39-0.63	1.20-0.40	0.77-0.40	0.58-0.04
4	2.65-1.43	O.62-0.56	0.57-0.17	0.38-0.15
5	5.75-1.56	0.53-0.37	0.35-0.08	0.36-0.08
Mean	3.75-2.36	1.03-0.90	0.60-0.43	0.62-0.22
P Value	<0.07	<0.07	<0.01	NS

Table – 1e mean concentration (mg metal/g d.w) associated standard deviation of Nickel in the Gill, Liver, Kidney and Muscle tissue of Labeo rohita caught at five stations in the kaveri River.

Station	Gill	Liver	Muscle	Kidney
1	9.50-0.82	4.86-1.50	5.43-1.43	3.45-1.22
2	14.83-6.42	11.10-3.40	6,10-0.70	3.11-0.52

3	8.93-1.08	6.95-3.00	5.50-0.50	3.58-0.30
4	9.70-0.59	5.70-1.47	6.20-3.07	5.21-3.08
5	7.68-1.52	5.30-2.51	2.57-0.57	1.58-0.58
Mean	10.36-3.90	5.18-1.90	5.18-1.94	5.19-1.83
P Value	<0.07	<0.01	NS	NS

Mean concentration (mg metal/g d.w.) and associated standard deviations of cadmium (1a), lead (1b), copper (1c), chromium (1d) and nickel (1e) in the Gill, Liver and muscles tissue of **Labeo rohita** caught at five stations in the Mettur Dam. Results of statistical differences (P value) from station to station are indicated and the total mean concentration of metals in each tissue for each fish species are also given. NA=not significant (P.0.07), NA=not available.

DISCUSSION

Initially we expected that metal concentrations in the tissue of fish from Stations 4 and 5 would be highest as they are in the south of Mettur Dam. Which receives more untreated waste water from the river and surrounding environment. However, fish species from Station 2 displayed the highest metal concentrations in their tissues. An investigation was carried out to determine the source of high metal input to this station and the results showed that several hospitals as well as domestic sources discharge untreated effluents in the vicinity of station 2. The results of this study indicate that fish can accumulate heavy metals efficiently in areas where direct inputs occur, the literature states that metal uptake from sediment (Goyer, 1991). The fact that fish from Stations 3-5 displayed lower metal concentrations than those from Stations 2 suggests that metals discharged in the vicinity of Station 2 are perhaps precipitated or adsorbed onto sediments due to interaction with some other compounds, so that fish at stations 3-5 are not exposed to the metals in water to the same degree as fish living at Station 2. From the results of this study, Station 1 (**Mettur Dam**) appears to be the cleanest part of the river system, probably because it does not receive many pollutants from industrial and domestic sources.

SUMMARY AND CONCLUSION

In this present study it is clear that depending upon the pollutant water which are coming from various dyeing mills industries and hospitals, rural areas that directly affect the aquatic animals and human beings who consume the same. Usually, all aquatic animals bear only certain number of heavy metals when this goes beyond the limit this cause harmful effect directly to aquatic animals and indirectly to human beings. Certain heavy metal levels reached unacceptable levels for human consumption. Because high metal concentrations I tissue can have toxic effects on fish metabolism, it is important to consider the biological effects of contamination of fish health in the river.

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