Determination of Acute Mercury Toxicity to Developing Stages of *Cyprinus carpio* and *Cirrhinus mrigala*

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Toxicity of inorganic mercury to different life history stages of fresh water fishes, *Cyprinus carpio* and *Cirrhinus mrigala* were demonstrated by static bioassays. 48 and 94% of egg hatching occurred in controls at 72 and 24 h of experimentation in *C. carpio* and *C. mrigala* respectively. While fish eggs in water containing mercuric chloride showed delayed development as compared to the control. LC_{50}, LC_{100} and safe concentrations of hatchling, fry and fingerling were calculated. Hatchling and fry were observed to be more susceptible as compared to fingerlings of *C. carpio* and *C. mrigala*.

The acute toxicity of mercury compounds on a number of fish have been reported by Boetius (1960), Jackim *et al.* (1970), Portman (1972), Wobeser (1975), Menezes & Qasim (1983), and Dhanekar *et al.* (1985). Despite these works there is paucity of information on the mortality response of early developmental stages (ELS) of fresh water fishes exposed to mercury compounds. The objective of the present study was to observe the toxicity levels of mercury to eggs, hatchlings, fry and fingerlings of *C. carpio* and *C. mrigala*.

Materials and Methods

Eggs, hatchlings, fry and fingerlings of fresh water fishes *Cyprinus carpio* and *Cirrhinus mrigala* were collected from Madhya Pradesh Government Fisheries Department, Ujjain. The test fish stages were kept in different concentrations of mercuric chloride to study the effect of mercury toxicity. 50 eggs of *C. carpio* and *C. mrigala* were kept in each aquarium in replicates for each toxicant concentrations. After few hours the dead eggs which became opaque and subsequently developed fungal growth were removed from the aquaria. ELS mortality was observed at 4 hour intervals upto 96 hours of experimentation. LC_{50}, LC_{100} and safe concentration limits were determined by the methods of Litchfield and Wilcoxon (1949) and Hart *et al.* (1945). The test fish was considered dead when there was no respiratory or other movement and lack of response to mechanical stimulii. The effect of toxicant on fish activity was also recorded during the test period. Activity indications of fry and fingerling of *C. carpio* and *C. mrigala* were recorded by counting their opercular movement per minute.

Experiments as per details described above were set up in stored tap water. The physico-chemical characteristics of this water was analysed before the experimentation as per the procedures given in APHA (1975); water temperatue 25°C, pH 8.4, dissolved oxygen 8 mg/1, carbonate alkalinity 12 mg/1, chloride 51 mg/1, calcium 17 mg/1 and hardness 166.0 mg/1.

Results and Discussion

In controls 48 and 94% of egg hatching occurred at 72 and 24 h experimentations in *C. carpio* and *C. mrigala* respectively. Table 1 shows a reduction in the percentage of *C. carpio* egg hatchlings from 48% in the control to 2% in 1 p.p.m. concentration of $HgCl_2$. In *C. mrigala* the percentage of hatchlings ranged between 94% in control to 30% in 1 p.p.m. $HgCl_2$ concentration (Table 1).

Mercury exposed eggs were observed to have delayed development in both the fish species. Hatchlings which hatched in 0.5 and 1.0 p.p.m. of mercuric chloride showed abnormalities in swimming. Their nervous control of post branchial region have been

Table 1. *Details of hatching effects due to mercury toxicity to C. carpio and C. mrigala*

Fish species	Concentration of $HgCl_2$ p.p.m	Hatching percentage
C. carpio 72 h	0.00	48
	0.05	28
	0.10	22
	0.50	8
	1.00	2
	2.00	Nil
C. mrigala 24 h	0.00	94
	0.05	60
	0.10	54
	0.50	44
	1.00	30
	2.00	Nil

impaired due to which partial paralysis occurred. The paralytic symptoms were observed by loss of balance and jerky movements. Finally they sank to the bottom before death occurred. Fry and fingerlings within a short period of their introduction in the experimental tank, exhibited signs of distress, gulping of air by hanging on the surface. This was however, not at all seen in the control tanks.

LC_{50}, LC_{100} and safe concentration of $HgCl_2$ to ELS stages of *C. carpio* and *C. mrigala* were calculated and given in Table 2. Fingerling stages of *C. carpio* and *C. mrigala* were most resistant to mercuric chloride

Table 2. *Details of acute toxicity of early developmental stages of C. carpio and C. mrigala*

Experimental fish	96 h LC_{50} p.p.m	96 h LC_{100} p.p.m	Safe concentration p.p.m
C. carpio			
Hatchling	0.05	0.25	0.0018
Fry	0.50	1.00	0.0100
Fingerling	1.50	2.00	0.0300
C. mrigala			
Hatchling	0.10	0.50	0.0030
Fry	0.10	0.80	0.0080
Fingerling	1.00	2.00	0.0160

toxicity. Next in order of susceptibility were fry and hatchling stages. The basic toxicity patterns of herbicides, fungicides and heavy metals were well explained by Anderson & Weber (1975) and McKim (1977), which shows that larger fish are tolerant than smaller fish of the same species. In the present study similar pattern was observed. There is no satisfactory explanation regarding the mode of action of different metals which cause death to fish exposed to toxicity.

Mercury toxicity resulted in hyperactivity of experimental fry and fingerling. It was observed that highest hyperactivity values were gradually attained by freshly treated fish. After the threshold value the activity gradually decreased until death (Fig. 1). In control fish, highest opercular movements were observed initially which gradually

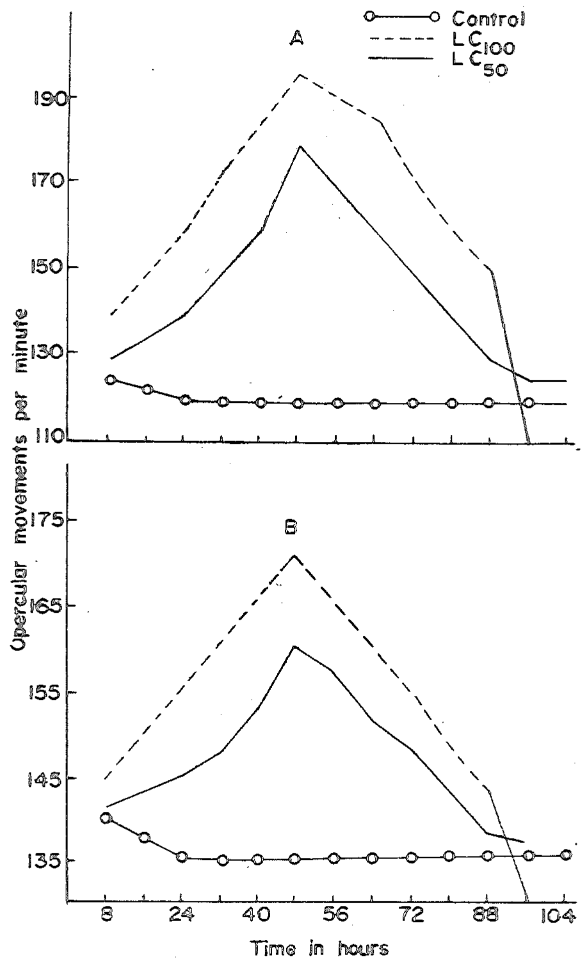

Fig. 1. Opercular movements in fry (A) and fingerlings (B) of *C. mrigala*

decreased to basal levels of activity. This indicates initial handling effect in the experimental conditions.

It was also observed that swimming activity of fish exposed to $HgCl_2$ decreased significantly. It was probable that such an increased opercular movements, associated with decreased swimming activity, compensates for the loss of efficiency in the oxygen uptake by decreasing the physiological oxygen demand and increasing the amount of oxygen passing over the branchial tissue per unit time. The gills are known to accumulate significant amount of heavy metals as compared to other organs of the exposed fish and hypertrophy of branchial epithelial cells has been reported in Hg, Cr, Cu, Cd and Zn toxicity by Wobeser (1975). Increased opercular movements as reported in the present study have been observed in fish exposed to $HgCl_2$, by Menezes and Qasim (1983) and Dhanekar *et al.* (1985).

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