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Determination of 96-hr LC_{50} value of cadmium for a fish, Labeo rohita

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Abstract
This paper emphasizes on the determination of 96hr LC_{50} value of Cadmium sulphate for the fish, *Labeo rohita*. The test was performed according to the standard methods in APHA and the value was calculated by probit analysis. The fish specimens were acclimatized in the laboratory conditions for 25 days. The stock solution of Cadmium sulphate was prepared and the fish were treated with various concentrations for 96 hours. The results showed that the median lethal concentration (LC_{50}) of Lead Nitrate for the fish, *Labeo rohita* is 24 mg/l. The susceptibility of *Labeo rohita* to the lethal effect of Cadmium sulphate was dependent on duration as well as on concentration. The mortality of the fishes is directly proportional to the concentration.

Keywords: 96-Hr LC_{50}, Cadmium, *Labeo rohita*

1. Introduction
Water pollution with heavy metals affects various physiological processes in fishes including breeding and development. The effects of waterborne metals on fishes are related to their uptake and accumulation by the organism, resulting in metal-induced disturbances in the structure and function of various tissues and organs [1]. Pollution of the biosphere with heavy metals has become a serious anxiety in the developing world. The discharge of these metals in the environment has significantly increased as a result of anthropic activities mainly linked to burning of fossil fuels, mining and smelting of metalliferous ores, municipal wastes, fertilizers, pesticides, and urban sewage. The production processes approved out at high temperature introduce in the atmosphere metals both as vapors and dust particles that finally lay down on soil and in sea [2]. The heavy metals are accumulated in living organisms when they are taken up, and stored faster than they are broken down or excreted. They enter into the water supply by industrial and consumer materials, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers and groundwater. The three most pollutant/environmental heavy metals have been reported include Pb, Hg and Cd, but some other heavy metals can also badly affect the environment. *'Heavy metals toxicity'* has been reported to be caused by different means; e.g., from contamination of drinking-water (Pb pipes), high ambient air concentrations near emission sources, or from food chain. The heavy metals are poisonous due to their bioaccumulation. The *'bioaccumulation'* means an increase in the level of a chemical/toxicant in a biological organism over time, compared to chemical/toxicant level in the environment [3].
In fish, cadmium can cause a number of structural and pathomorphological changes in various organs. The highest cadmium levels were detected in the kidneys and liver of fish [4].
The dominant form of Cd in sediments was a carbonate. Levels of Cd in water varied over time and between sites, but usually ranged from 0.5 to 2.5 ppb. It is possible that significant amounts of cadmium are transferred from the sediments into rooted aquatic macrophytes and later released into the water after macrophyte death (natural or herbicide-induced), particularly in heavily contaminated systems. In Palestine Lake, Cd levels in pondweed, a rooted aquatic macrophyte, were about 90 ppm dry weights; a maximum burden of 1.5 kg was retained by the population of *P. crispus* in the lake [5]. Release of the total amount could raise water concentrations by a maximum of 1 ppb. This amount was considered negligible in terms of the overall lake Cd budgets; however, it might have limited local effects.

As judged by these and other complexities regarding Cd bioavailability, it appears that the organism remains the ultimate arbiter of its environment, regardless of the source of cadmium and its geophysical surroundings Background levels of cadmium in uncontaminated, no biological compartments extended over several orders of magnitude [6, 7]. The aim of the research work was to determine the 96 h LC_{50} and lethal concentration of *Labeo rohita* against cadmium.

2. Material and Methods

The present experiments were conducted at fish seed hatchery, Department of Fisheries and aquaculture, University of Veterinary and Animal Sciences, Ravi Campus. Individuals of *Labeo rohita* were obtained from grow out ponds kept in holding tanks, supplied with flow through aerated water and acclimatized for 2 weeks, in the laboratory before conducting toxicity test. Pure compound of Lead $CdSO_4$ was dissolved in deionized water and stock solutions (1000 ppm) were prepared. Laboratory tests were conducted to determine the 96-hr LC_{50} and lethal concentrations of Cd for *Labeo rohita* at constant temperature (30 ^oC) and pH (7.5) of water in glass aquaria attached with aeration system. Glass aquaria were filled with 80-liter metal free tap water and stock solution was added on metallic ion basis to get the desired concentration of metal. To avoid stress to the fish, the desired metal concentration in each aquarium was attained within 7 hours of the start of the experiment. Twenty five individuals of experimental fish were tested against concentration of metal for the determination of both 96-hr LC_{50} and lethal concentrations. During this trial, the fish were subjected to 12-hr photo period. The fish were not fed during acute toxicity trials. The concentration of Cadmium was started from zero up to the onset of 96-hr LC_{50} and lethal concentrations. The aquarium was examined after every 2 hours for fish mortality. The dead fish were weighed individually after being lightly blotted dry at the time of mortality observations and were dissected and their body organs viz. gills, liver, skin and muscle for the determination of their respective exposure metals by following the methods of [8, 9] The mortality data were statistically analyzed by using Probit Static Bioassay test system. The 96-hr LC_{50} and lethal concentrations were determined along with 95% confidence intervals. The data obtained from present investigation were statistically analyzed by using SPSS 13.00 computer program.

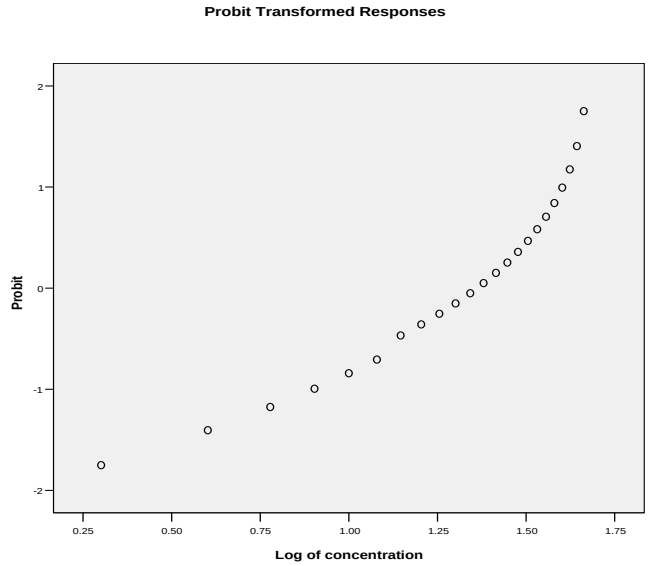
3. Results and Discussion

Twenty five individuals of *Labeo rohita* were tested against cadmium concentration for the determination of both 96-hr LC_{50} and lethal concentrations at constant temperature (30 ^oC) and pH (7.50) of water. During this study the 96-hr LC_{50} of cadmium for the fish, *Labeo rohita* was found to be almost 24 mg/l (table.1). Different species shows different results against same metals while it is also found by some scientists that same fish species may shows different behaviors against same metals due to several factors like age and the experimental conditions under which the tests are performed [7, 8].

The susceptibility of *Labeo rohita* to the toxic effect of cadmium is directly proportional to the concentration and duration of dose. If the dose increases the rate of mortality will also increase.

Table 1: Relation between concentration of cadmium sulfate and the percentage mortality of the fish

Dose Mg/l	Log of concentration	Total individuals	Mortality	Mortality %	Probit kill
0	-	25	0	0	0
2	0.3010	25	1	4	.087
4	0.6020	25	2	8	.759
6	0.7791	25	3	12	2.040
8	0.9031	25	4	16	3.653
10	1	25	5	20	5.379
12	1.0792	25	6	24	7.088
14	1.1461	25	8	32	8.711
16	1.2041	25	9	36	10.215
18	1.2552	25	10	40	11.589
20	1.3010	25	11	44	12.834
22	1.3424	25	12	48	13.956
24	1.3802	25	13	52	14.965
26	1.4149	25	14	56	15.870
28	1.4471	25	15	60	16.683
30	1.4771	25	16	64	17.412
32	1.5051	25	17	68	18.068
34	1.5314	25	18	72	18.657
36	1.5563	25	19	76	19.187
38	1.5797	25	20	80	19.665
40	1.6020	25	21	84	20.097
42	1.6232	25	22	88	.087
44	1.6434	25	23	92	.759
46	1.6627	25	24	96	2.040
48	1.6812	25	25	100	3.653



4. Conclusion

It is concluded that some organisms especially fresh water species becomes sensitive to high concentration of metals in aquatic ecosystem and it causes lethal effects on them. This article helps us to determine the permissible limits of cadmium against fresh water species and the criteria of water quality to protect aquatic life.

5. References

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