SHORT COMMUNICATION

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ACUTE TOXICITY STUDIES OF HEXAVALENT CHROMIUM IN THE COMMON CARP, *CYPRINUS CARPIO*

Abstract: The effect of hexavalent chromium [Cr (VI)] on the static bioassay of *Cyprinus carpio* (500±9.5g body weight) was assessed by exposing randomly selected 70 breeders to 50, 100, 150, 200, 250, 300 and 350mg/l Cr (VI) dosage for 96 hours in cemented tanks (250 rgm size) @ 10 breeders/tank under optimal conditions to find out the lethal concentration at which fifty percent mortality (LC_{50}) has occurred. Control group containing 10 breeders / tank was also maintained for the same period. Results showed LC_{50} value of 191mg/l by Finney's probit analysis. It was further observed that toxicity of Cr (VI) increased in *C. carpio* with the increase in time and concentration of Cr (VI) as compared to control.

Key words: Acute toxicity, LC_{50}, Cr^{6+}, fish, *Cyprinus carpio,* metal toxicity.

INTRODUCTION

Fish is an important protein source in our country however, its habitats is being contaminated alarmingly through a number of heavy metals, among them chromium is the most harmful pollutant for fish (AL-Akel, 1996). It exists in two valence states in nature *i.e.* Cr (VI) and Cr (III). Debasis *et al.* (2002) and Laura *et al.* (2006) in their studies demonstrated that Cr (VI) is 700 times more toxic than Cr (III) due to its readily soluble nature. Acute toxicity bioassays (LC_{50}) are conventional tools and very extensively used to assess the potency/toxicity of physiologically active heavy metals and also to evaluate the ful potential of metal contamination on commercially and ecologically important species (Samina and Muzammal, 1999). Some heavy metals have no nutrition at value while others are required in trace amounts for biological activitiy like chromium, zinc etc., (Guerrin *et al.,* 1990).

The 96-hr LC_{50} trials on fish were conducted, Isaac *et al*. (2000), Gulfraz *et al.* (2001), Jaffri *et al.* (2003), Kevin (2003), Diagomanolin *et al.* (2004), Naskar *et al*. (2006) and Madoni and Maria, (2006) to measure the susceptibility and surviving potential of fish to particular toxic substances such as heavy metals.

In order to establish the discharge standards for pollution in the environment, it is important to study their toxicity on common flora and fauna of the area. The present study was carried out to determine the LC_{50} of Cr (VI) in *Cyprinus carpio* because very few reports are available to describe the impact of chromium on acute static bioassay of

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C. carpio in Pakistan, which is prerequisite to determine the degree of damage produced by Cr (VI) from industrial effluents to our fresh water biota.

MATERIAL AND METHODS

Cyprinus carpio breeders (80) of (500±9.5g weight and 25.60±2.6cm length) were acclimatized in cemented tanks for one month. They were provided with 30% protein and 8% lipid rich feed @ 7% of wet body weight twice a day. For the estimation of LC_{50} (1) breeders were divided in to eight groups. Each group including control contained 10-breeders/tank (4.5' × 8.5' × 6.5'). Seven groups (70 breeders) were exposed to gradually increasing concentration of Cr (VI) as potassium chromate 50-350mg/l with the interval of 50mg *i.e.,* simultaneously. Experimental period for each concentration was 96 hours. Mortality of fish was recorded, till all fish died. LC_{50} value was calculated by following Finne'y probit analysis (1964). Aeration was provided with automatic compressor. Unconsumed food was removed on every alternate day.

RESULTS

The experimental fish exposed to Cr (VI) (50-350mg/l; with an interval of 50mg/l) showed abrupt changes before death. Initially, the fish showed restlessness, abnormal swimming movement and secretion of mucus that was followed by loss of balance. Most of the time fish remained in upper column, though it was not *C. carpio'*s biological habit. With the passage of time fish showed rapid jerky movement with open mouth which showed oxygen deficiency due to Cr (VI) stress in fish. LC_{50} 96 hr of chromium was found to be 191mg/l in *C. carpio*. Table 1 showed the mortality response of fish to different doses of Cr (VI), mortality and percent mortality in terms of empirical probit. Probit analysis significantly increased with the increase in treatment level, from 50mg/l onward, as calculated values for differences were greater than the LSD value at 1% significance level. Figure 1 showed regression line between % mortality (converted to probit) and log dose (mg/l) as well as 96 hr. LC_{5O}. Regression analysis indicated that dissolved Cr (VI), significantly contributed to mortality of *C. carpio*.

Table 1: Probit Analysis showing percent mortality in *Cyprinus carpio* due to Cr (VI) as compared to control. After 5 cycles, maximum probit change is 0.00035 with 1.6776 Chi-squared values and an LC_{50} of 190.97=191 mg/l.

Sr. No.	Dose mg/l	96 hours (dead/alive) (n=10)	Log (Dose)	Mortality %	Expected probit	Calculated Probit
1	50	1/9	3.9120	10	2.68	1.622
2	100	2/8	4.6052	20	3.77	3.369
3	150	4/6	5.0106	40	4.56	4.391
4	200	5/5	5.2983	50	4.85	5.116
5	250	7/3	5.5215	70	5.44	5.679
6	300	9/1	5.7038	90	6.23	6.138
7	350	10/0	5.8579	100	7.40	6.527

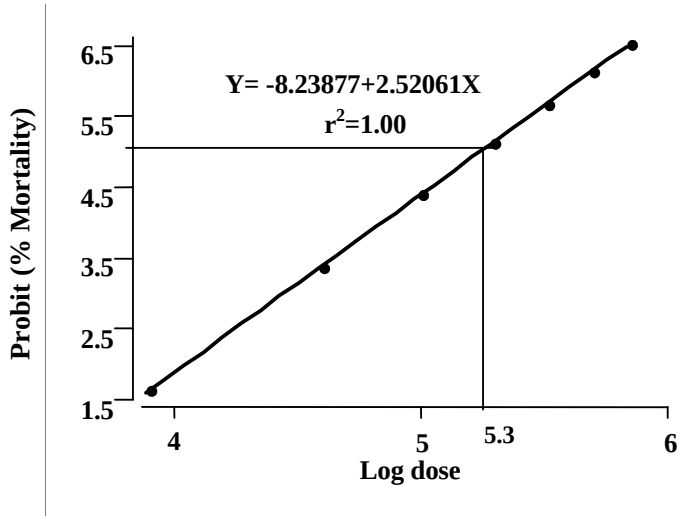

Fig 1: Regression line showing lethal concentration estimates (mg/l) for Cr (VI), the symbol indicated the real data points the full lines indicated the fitted line and square showed LC_{50} in mg/l.

DISCUSSION

Heavy metals have long been recognized as serious pollutants of the aquatic environment. They caused serious impairment in metabolic, physiological and structural system, when present in high concentration in the milieu (Smet and Blust, 2001; Laura *et al*., 2006). The concentration of heavy metals in fish is related to several factors, such as the food habit, foraging behaviour of the organisms, trophic status, source of particular metal, and distance of the organism from the contamination source, presence of other ions in the milieu, biomagnifications, food availability, metalothioneins and other metal detoxifying proteins in the body of animal. Transport of metal across the membrane, the metabolic rate of the animal and physicochemical properties of the water and the seasonal changes in the taxonomic composition of different trophic level may also affect the concentration and toxicity of heavy metal in the body of fish (Chen and Folt, 2000).

Effect of acute doses (LC_{50}) of chromium on fish has been studied in few species, such as *Salmo giardinerri* (140mg/l by Schiffman and Fromm, 1959), *Cyprinus carpio* (250mg/l by Al-Akel, 1996), *Oreochromis mossambicus* (200mg/l by Jaffri *et al*., 1999) *Labeo rohita* (142mg/l by Jaffri *et al*, 2003) and *Cyprinus wastoni*(178mg/l by Ikhtiar-ud-Din and Hafeez, 1996). LC_{50} value of hexavalent chromium in present study was found to be 191mg/l. This value is different from other reported species. Variations in values may be due to the several factors such as temperature, pH, dissolved oxygen, water hardness and synergism in addition to different fish species (Al-Akel, 1996).

Sanjay *et al*. (2006) exposed air breathing teleost fish *Channa marulius* to Cr (VI) for 96 hours. LC_{50} as well as safe level were studied. They observed that toxicity of metal is dose and time dependent *i.e.*, with the increase in metal concentration and time, the mortality was also increased, which is according to present findings where Cr (VI) toxicity was noted to be increased with concentration and time.

In present study hyper- excitation and fast jerking movements were noted in fish before death. Too much behavioral changes (cough and yawn) at higher concentration might be due to manifestation of the disturbances in the physiological mechanism which is supposed to initiate, maintain and terminate the behavior. Ahmet (2005) stated that increased cough and yawn is due to the increased secretion of mucous which deposited on the gills to combat the toxicity produced by heavy metals. It also reduced the gaseous diffusion causing less supply of oxygen, causing immediate fish death.

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