EFFECT OF ZINC CHLORIDE ON BEHAVIOURAL RESPONSES IN *OPHIOCEPHALUS PUNCTATUS*

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Abstract- **Zinc is an essential trace element for all living organisms. It causes significant and detrimental effects on fish behaviour and physiology. There are various sources by which zinc enters the water and cause hazardous effect on increasing concentration beyond limit. In the present study, we estimatedZnCl₂ LC-50 for 96 hours which was 42.50 mg/L. Over the period of toxicological exposure of ZnCl₂ LC-50 for 96 hours we observed some behavioral changes in *Ophiocephalus punctatus* that include shedding of scales, aggregation at one side due to fearing and redness of caudal peduncle. These behavioral changes in *Ophiocephalus punctatus* could be due to response to excess amount of Zn than that needed for biological functions.**

Index Terms- **Zinc chloride, Toxicity, Behavior, Ophiocephalus punctatus etc.**

I. INTRODUCTION

Zinc is an inevitable trace element that contributes to the structure of several proteins that involve in reproduction, development and growth of fish (Watanabe et al., 1997; Celik et al., 2013). However in high concentrations zinc may prove toxic to fish and may results in death (Malik, et al., 1998). It is evident that similar to other metals, zinc toxicity may alter with respective to environmental conditions such as temperature, dissolved oxygen, pH, water hardness, and other organic and inorganic substances (Hellawell, 1986; Khan et al., 2022).

Aquatic ecosystem receives zinc by the weathering and erosion of rock and through industrial and agricultural activities (Shuillebhain, et al., 2002), municipal wastewater discharges, coal burning power plants (Pertsemli and Vousta, 2007; Dong et al., 2012).

Due to solublizing property of Zinc it can be easily transported into the tissues of fishes through the gills, intestines and lining of rectum. However there are reports of accumulation of zinc in the vital organs like liver, kidneys, gills, intestine and muscle (Mackey et al., 1975; Murugan et al., 2008 and Madhusudan et al., 2003; Bawuro et al., 2018) and also excreted out (Firat and Kargın, 2010). In addition, some workers have reported effects of zincon the growth, reproduction and sexual maturity in*Poecilia reticulate* and *Levistes reticulates* (Crandall and Goodnight 1962; Uviovo and Beatty 1979; Pierson 1981), mucus secretion over the gills, anorexia and increased fin movement in *P. reticulate* (Khuyakari et. al. 2001).

II. MATERIALS AND METHODS

Ophiocephalus punctatus is a bottom dwelling fish present in fresh water. All the experimental fingerlings *O. punctatus* selected for present study were procured from local fish market of Rajura, District-Chandrapur (M.S.), India. Fish were brought to the laboratory were separated according their size and weight. Fish selected for the experiment had an average length 25±4 cm and weight 80±5 gm.Prior to acclimatization, fish were bathed in 0.01% potassium permanganate ($KMnO_4$) solution for 15 minutes for two consecutive days to neutralize possible external infectious pathogenic microorganisms. Fish were stocked in big aquarium containing 1000 lit. of water and acclimatized for fifteen days. During this period, fish were fed with boiled eggs and rice bran at least once in a day in an alternated fashion. Physiochemical parameters like pH, temperature, dissolved oxygen, conductivity; free carbon dioxide and total alkalinity of aquaria water were monitored.

Determination Zinc LC-50 for 96 Hours

For static bioassays of another heavy metal, zinc chloride ($ZnCl_2$) was selected and solution was prepared in tap water. The test organisms (fingerling of *O. punctatus)* were randomly distributed in small aquaria (20 liter capacity) filled with different concentrations of zinc chloride solution i.e. 10, 20, 30, 40 and 50 mg/l and mortality was recorded at 24, 48, 72 and

96 h. Ten fishes were used per concentration and the experiment was conducted in triplicate. The aquaria were not aerated during experimentation. For calculating the exact death rate on exposure to zinc chloride, the comparison was made with death of fish occurred in controlled aquarium since the beginning of exposure. All experiments were carried out for a period of 96 h. The number of dead fish was counted every 12 h and removed immediately from the aquaria.

Percent mortality was calculated and the values were transformed into probit scale and analyzed as per Finney, 1971. Regression lines of probit against logarithmic transformation of concentrations were obtained. Slope function (S) was calculated (Figure-1).

III. RESULT AND DISCUSSION

There are several works have been done on the lethal concentration of heavy metals including LC-50 of Zinc. Murugan *et al.,* (2011) have reported 96 hrs LC-50 concentration of zinc at 48.68 mg/l of water for *C. punctatus.* LC-50 (96 hrs) for zinc in African catfish, *Clarias gariepinus* was reported 37.7 mg/l (Ololade and Ogini, 2009), in Nile tilapia, *Oreochromis niloticus,* 63.984mg/l (Abdel-Tawwab *et al.,* 2012), Srivastava and Srivastava(2008) did work on this fish, but not took into consideration LC-50 value they directly exposed fish to different concentration of zinc and observed the consequences.

In the present study, Zn toxicity was noticed by fish mortality. Shetty *et al*. (2007) reported that the determination of acute toxicity is usually an initial screening step in the assessment and evaluation of the toxic characteristics of all compounds. Likewise, De DeSchamphelaere and Janssen (2004) reported that fish mortality might be a more sensitive endpoint for assessing effect of Zn exposure. The LC-50 (96 hrs) of zinc chloride for *O. punctatus* was found 42.50 mg/l of tap water. It is observed that the toxicity of any chemical is determined by supporting factors like pH, temperature and alkalinity, otherwise the little amount of xenobiotic substance alone exert the effect lately. Thus, this factor helps the toxic substance to accelerate the effect on target organ or tissue or animal as a whole.

Bengeri and Patil (1986) have suggested that, 65.0 mg/l of zinc causes the 50% mortality of *Labeorohita*upto 96 hrs of exposure. Hilmy*et al*. (1987) were reported 13.0 and 26.0 mg/l of zinc for *Tilapia zillii* and *Clarias lazera*. The variation in LC-50 values among the different studies may be due to the variations in kinetic variables of water and environment that may play a role in explaining these differences. Weatherley *et al.,* (1980) and Wood (2001) stated that zinc bioavailability and toxicity to aquatic organisms are affected by pH, alkalinity, dissolved oxygen, and temperatures. Alabaster and Lloyd (1982) and Everall *et al.,* (1989) stated that zinc toxicity to fish can be greatly influenced by the pH.Hilmy*et al.* (1987) found that 96 hrs LC-50 for both fishes increased with the decrease in water temperature. Eisler (1993) reported that the acute 96 hrs LC-50 values for fish were between 66 and 40,900 µg zinc/l depending on many factors including pH, alkalinity, dissolved oxygen, and temperatures.

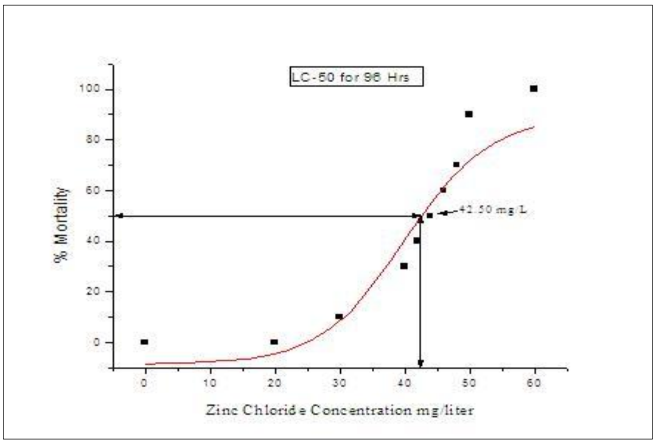

Fig-1: Showing Zinc chloride Lethal Concentration-50 (LC-50) in *O. punctatus*

In aquatic ecosystems, the zinc (II) ion is toxic to fish and other aquatic organism at relatively low concentrations. Zinc is generally regarded as one of the less hazardous metals (Duffus, 1980 and Robinson, 1996). Zinc frequently occurs in nature together with other metals of which iron and cadmium is the most common (Dallas and Day, 1993).

Fig. 2. Fish showing fearing behavior coupled with aggregation at one place onexposure to $ZnCl_2$ LC-50

Fig.3: Fish showed excessive secretion of mucous and shading of scales on exposure to $ZnCl_2$ LC-50

Fig.4: Redness of caudal peduncle on exposure to $ZnCl_2$ LC-50

The zinc is a prevalent component of industrial and mining effluents which are often discharged into aquatic environments. Alabaster and Lloyd (1982) reported that zinc salts precipitated the mucus on the gills of fish, causing them to die from suffocation or hypoxia. Bengtsson, (1974) stated that the exposure of zinc results in hyperexcitation and changes in activity of minnows. Al-Akel and Shamsi (1988) have studied the effect of mercuric chloride and zinc sulphate on the behaviour of fish. Al-Kahem *et al.,* (1999) reported the effect of sub-lethal concentration of zinc on the behavior of *Oreochromis niloticus*. The behaviour included fin flickering, partial jerk, threat and nip. The most significant effect was on respiration manifested as an increase in frequency of cough and yawn. The increase was greater in initial time of exposure compared to the later period but remained higher than the control throughout the period of investigation. Fish were found to aggregate at one side of glass panel due to fear (Fig.2). Aggressive interaction like threat and nip were increased in exposed fish. Discomfort movement (fin-flickering,partial jerk and S-jerk) were also increased in treated fish. The exposed fish secreted mucus in large quantity (Fig.3). The present investigation is also agreed with Al-Kahem et al., (1999). In the course of exposure for short term to zinc chloride LC-50 started becoming blood red (Fig.4).

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