

On exposure to LC-50 of cadmium chloride, *Ophiocephalus punctatus* alters the physicochemical parameters of water

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ABSTRACT:

Cadmium is highly toxic to aquatic biota and severely alters the biochemical, physiological and histopathological aspects of organisms. It also induces the change in physico-chemical parameters of water. It is observed that the Cadmium chloride gradually increases the pH, conductivity, free carbon dioxide and total alkalinity of water from 24 hrs to 48 hrs of exposure to *Ophiocephalus punctatus*. However the temperature and dissolved oxygen showed no appreciable changes as to our expectation. It has been concluded that the increase in pH, conductivity could be due to excretion of negatively charged ions by the fish. Increase in free carbon dioxide might be due to high metabolic rate, total alkalinity as calcium carbonate could be the result of calcium excretion and formation of calcium carbonate after complex chemical reaction.

Keywords:

Cadmium, Physico-chemical parameter, fish.

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INTRODUCTION:

Heavy metals from industries disturb the aquatic environment and leads to environmental health hazards (Shukla et al., 2007; Gupta and Srivastava, 2006; Agtas et al., 2007; Yoon et al., 2008). Among the heavy metals, cadmium is considered as a major aquatic pollutant in many parts of the world and has been reported to exert deleterious effects in terms of nephrotoxic, cytotoxic, genotoxic, immunotoxic and carcinogenic (AMAP. 1998; Lippmann. 2000 and Rissode-faverney, 2001).

There are many studies concern with the toxicity of cadmium on vertebrates and invertebrates (Rasmussen and Andersen, 2000, Adami *et al.*, 2002 and Filiovic and Raspor, 2003). Fish exposed to high concentration of cadmium quickly develop lack of calcium and low blood hemoglobin. Microorganisms may suffer growth inhibition at cadmium concentration of 0.25 mg/l (Roberts, 2003). Biochemical and physiological biomarkers are frequently used for detecting or diagnosing sublethal effects in fish exposed to different toxic substances (Theodorakis *et al.*, 1992).

Although many aspects relevant to cadmium toxicity on variety of animals were carried out (Zellokof *et al.*, 1995; Woodling *et al.*, 2001; Arockiaraj and Haniffia, 2004; Maheshwaran *et al.*, 2008 and Vesey, 2010) but still very insufficient work has been done to evaluate the change induced by heavy metals in physicochemical parameters of water in relation to fish. In the present study the attempt was made to correlate the effect of cadmium on *Ophiocephalus puctatus* in

relation to alternation in physicochemical characteristics of water.

MATERIALS AND METHODS

Healthy fingerlings of *Ophiocephalus puctatus* measuring the size 12-15cm were purchased from fisherman of Mulchera (District-Gadchiroli). It was carried to the laboratory in hygienic condition and acclimatized for fifteen days. During this period of acclimatization fish were fed with boiled eggs and rice bran. Cadmium LC-50 for 96 was carried out thrice to confirm exact dose of LC-50. Then the fish were divided into six groups. Each group was contained twenty fish each. Later all these fish were exposed to lethal concentration of cadmium for 24, 48, 72 and 96 hrs. The estimation of water was carried out at the interval of 24 hrs after real start time. All the physicochemical parameters were tested according to APHA (1989). Values were calculation by using software orgin-50 and figures were prepared with the help of Microsoft Excel and Adobe Photoshop-7.

RESULTS:

Cadmium a non-essential toxic heavy metal induces the behavioral changes and alters the physicochemical properties of water (**Table-1**)

Ophiocephalus puctatus exhibited sudden change in its behavior after exposure to lethal concentration of Cadmium. It became more active and started to moving fast, taking jump. Opercular movement was increased. Vertical movement at angle of 60° was most striking

Table-1. Effect of Cadmium (LC-50) on Physicochemical Parameters of Water

Sr. No.	Parameters	24-Hrs	48-Hrs	72-Hrs	96Hrs.
1	Ambient Temp.	25.5°C	25°C	25°C	25°C
2	Water Temp.	23.8°C	23.9°C	24.1°C	23°C
3	pH	6.17 ± 0.008	6.24 ± 0.004	6.28 ± 0.006	6.61 ± 0.008
4	Conductivity	0.249 ± 0.002	0.311 ± 0.003	0.352 ± 0.004	0.361 ± 0.002
5	Free CO ₂	10.01 ± 0.040	12.36 ± 0.13	13.44 ± 0.069	15.54 ± 0.15
6	Dissolved O ₂	0.73 ± 0.021	0.27 ± 0.033	0.43 ± 0.033	0.47 ± 0.021
7	Total Alkalinity	15.5 ± 0.34	21.5 ± 0.5	23.83 ± 0.40	28.33 ± 0.61

behavior amongst these fish. But after one and half hour they became acclimated and started showing normal behavior.

Temperature of water increased from 24 to 72 hrs. The lowest temperature (23°C) was noticed at the end of 96 hrs. Ambient temperature was slightly high at the first 24 hours and later it was constant (**Fig. 1**).

Negative logarithmic hydrogen ion concentration increased continuously from 24 to 96 hours of exposure (**Fig. 2**). Maximum pH (6.61 ± 0.008) was noticed on fourth day (96 hrs) of exposure and minimum (6.17 ± 0.008) on first day (24 hrs). Similarly, the conductivity (**Fig. 3**) of water was increased from 24 to 96 hrs, the maximum conductivity (0.361 ± 0.002) was observed at 96 hrs. and lowest at 24 hrs (0.249 ± 0.002).

Maximum dissolved oxygen (**Fig. 5**) was observed at 24 hrs (0.73 ± 0.021 mg/l) and lowest at the second day (48 hrs, 0.27 ± 0.033 mg/l). There was no consistency in decrease was observed at 72 and 96 hrs. However, the free carbon dioxide consistently increases (**Fig. 4**) from 48 to 96 hrs. The minimum free carbon dioxide was recorded at 24 hrs (10.01 ± 0.040 mg/l) and maximum was at the end of experimentation (96 hrs, 15.54 ± 0.15 mg/l).

Total alkalinity (**Fig. 6**) as calcium carbonate was maximum on fourth day of exposure (96 hrs, 28.33 ± 0.61 mg/l) and minimum at the first day (96 hrs, 15.5 ± 0.34 mg/l). From the first day of exposure the total alkalinity gradually increased up to 96 hrs.

DISCUSSION:

The study on physicochemical characteristics of fresh water, marine water and polluted water had been done by many authors all over the world but insignificant data is available on the alternation of physicochemical characteristics of water after exposure of fish to the heavy metals. Therefore the present study was carried out to explore variation in physicochemical changes of water after exposure of *Ophiocephalus punctatus* to the Cadmium chloride.

O. punctatus is a fresh water snake head abundantly present in Wardha River and in the ponds of Chandrapur and Gadchiroli districts. It is a live fish and survives in oxygen deficit water. However the physicochemical parameters affect the survival of fishes by many aspects. In the present study the attempt had been made to explore the change in physicochemical parameter of water in response to effect of Cadmium Chloride on *O. punctatus*.

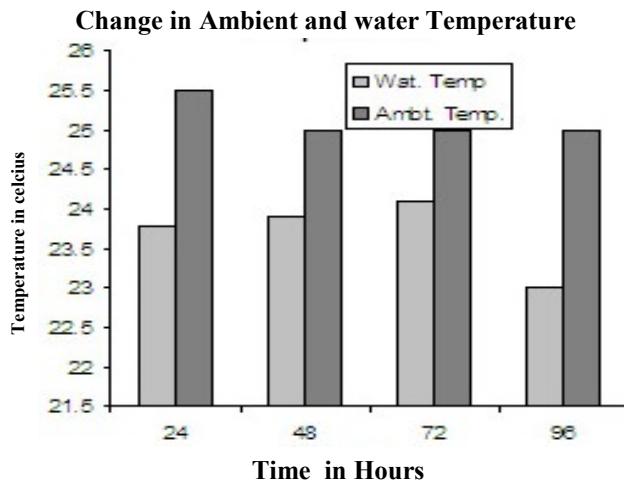


Fig. 1. Showing the difference in Ambient and Water Temperature during the experiment from 24hrs to 96hrs upon exposure of *Ophiocephalus punctatus* to Cadmium LC-50.

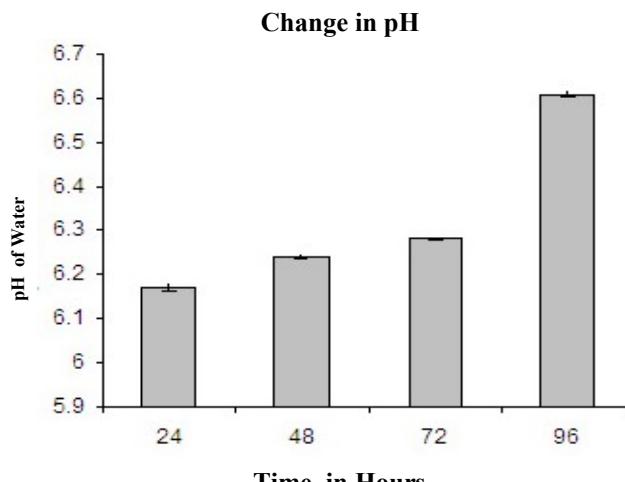


Fig. 2. Showing change in pH (logarithmic hydrogen ion concentration) during the experiment from 24hrs to 96hrs upon exposure of *Ophiocephalus punctatus* to Cadmium LC-50.

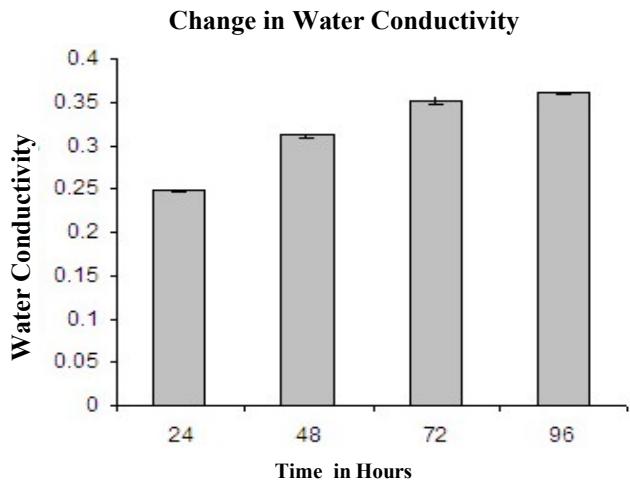


Fig. 3. Showing change in Water Conductivity from 24hrs to 96hrs upon exposure of *Ophiocephalaus punctatus* to Cadmium LC-50.

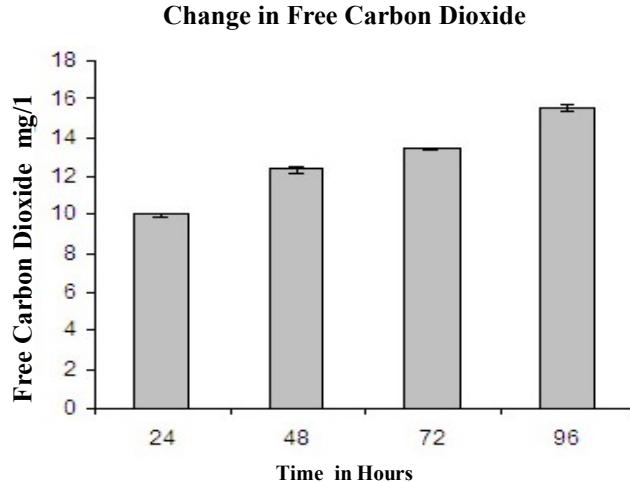


Fig. 4. Showing variation in Free Carbon dioxide in water fom 24hrs to 96hrs upon exposure of *Ophiocephalaus punctatus* to Cadmium LC-50.

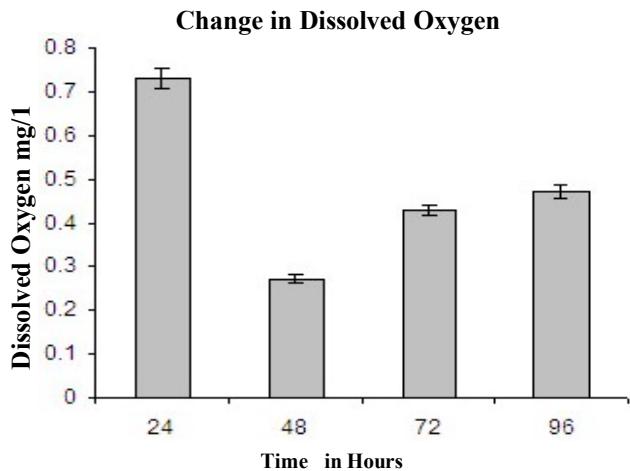


Fig. 5. Showing alternation in Dissolved Oxygen in water during the experiment from 24hrs to 96hrs upon exposure of *Ophiocephalaus punctatus* to Cadmium LC-50.

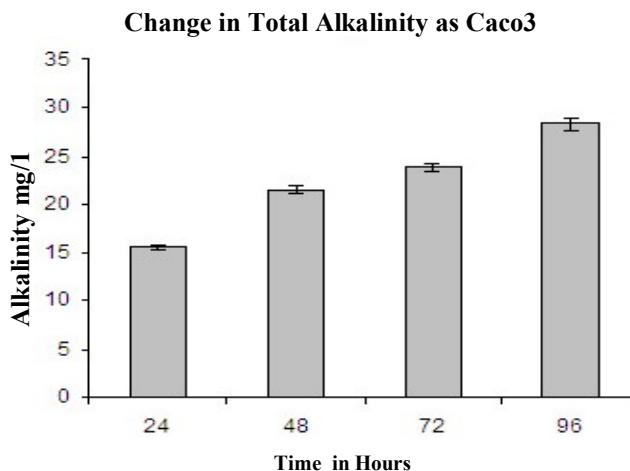


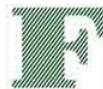
Fig. 6. Showing change in Total Alkalinity in water during the experiment from 24hrs to 96hrs upon exposure of *Ophiocephalaus punctatus* to Cadmium LC-

The ambient temperature alters the water temperature. During winter season the atmospheric and water temperature is always low. Fishes are poikilothermic animals and gradually adjust its body temperature with their surrounding. The temperature of water increased as compared to atmospheric temperature could be due to increase in basal metabolic rate of fish. At 96 hrs of exposure the water temperature reduced might be due to sudden drop in metabolic rate.

Hydrogen ion concentration (pH) affects the growth and reproductive capability of fish. The pH of water gradually changed from the first day of exposure

till 96 hrs. This increase can be attributed to the loss of protons by the fish. The cadmium is toxic to the fish even at sub-lethal concentration; it has been observed that the cadmium would have inducing the loss of protons in fish.

The conductivity of water is depends upon the total amount of dissolved ions. The increase in water conductivity from 24 hrs of exposure to 96 hrs can be implicated to the gradual accretion of ionic strength in the water. The cadmium could have induced the loss of ions by the fish by disturbing the metabolism.



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