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DELETERIOUS EFFECTS OF HEXAVALENT CHROMIUM ON THE BLOOD PYRUVATE LEVEL IN THE FINGERLINGS OF *CHANNA PUNCTATUS* (BL.), A TROPICAL FRESHWATER MURREL

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ABSTRACT

Blood pyruvate level in the fingerlings of *Channa punctatus* when subjected upto 48 hours to 5.6 mg/l (a sublethal concentration) of hexavalent chromium exposure, revealed statistically no significant increase. However, a progressive significant increase in the blood pyruvate level was noticed upto 96 hours of exposure. The result may prove useful parameters to assess the hexavalent chromium toxicity in freshwater fish's in general and their juvenile stages in particular.

KEY WORDS : Hexavalent chromium, Blood pyruvate level,Fingerlings, Channa punctatus, Hyperpyruvicinemea

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INTRODUCTION

Heavy metals get their way into the environment by a wide spectrum of natural sources such as erosion, volcanic activities and anthropogenic once including industrial wastes as well as leakage. Some of these metals viz; Nickel, Lead, Cadmium, Mercury etc, pose deleterious effects on living biota even at quite low concentration while others such as manganese, zinc, copper etc., are toxic only at very high concentration, Cohen *et al.,* (2001); Storelli *et al.,(* 2006); Karadede and Unlu ,(2007).

Chromium, a heavy metallic pollutant is released into the environment by dyeing, electroplating, tannery, hard alloy steel and stainless steel manufacturing and adversely affects the life on earth.

Chromium is also used as a catalyst and coating material (Idachaba *et al.,* 2007). The principal ways of introducing Chromium into the aquatic environment includes the burning of fossil fuel and waste ion concentration (WHO, 1988). Chromium (Cr^{vi}) is a well known carcinogenic metal for animal and human being. Hexavalent chromium compounds readily penetrate into cell membrane via anion transport system. In contrast to hexavalent chromium, trivalent chromium is thousand times less active against living cell because of its poor uptake (Alexander & Aaseth ,1995); Cohen *et al.,* (2001).

Sublethal effects of chromium in the fishes has been reported to be directly related with the inhibition of various metabolic processes through impairing enzymatic system and some other biochemical parameters (Khangarot *et al.,*1999); Delemos *et al.,(*2001); Vutukuru(2003); Roberts and Oris (2004); Cavas and Ergene (2005); Fulladosa *et al.,* (2006); Mishra and Mohanty (2008); Vinodini and Narayanan (2009); Venketramreddy *et al.,* (2009); Yilmaz *et al*., (2010); Shukla & Shukla (2012a,b). However, the toxic effect of sublethal concentration of metallic pollutants in general and hexavalent chromium in particular, if any on blood pyruvic acid level has been sparsely worked out. Keeping this in view, present study has been contemplated. In life cycle toxicity test carried out with several organic and inorganic pollutants, the embryo larval and juvenile stages of freshwater fishes have been demonstrated to be the most sensitive. (Shukla & Pandey, 1984;1986;) Shukla(1988);Shukla *et al.,* (2005). Keeping this in view, the fingerlings of *Channa punctatus* were selected to observe the deleterious effects of sublethal concentration of hexavalent chromium as potassium chromate, if any, on the blood pyruvate level of fingerlings of *Channa punctatus* at different intervals (24 to 96 hours).

MATERIALS AND METHODS

Healthy fingerling specimens of *Channa punctatus* (average weight 2.24$\pm$ 0.35 gm & length 24.02$\pm$ 1.6 mm) were procured from local lake. These were acclimatized for 10 days in the laboratory water having pH 7.5$\pm$ 0.3; DO 6.20 mg/l; hardness as $CaCO_3$ - 124.6 $\pm$ 3.2 mg/l; temperature 22.4 + 2.2^o C; electrical conductivity 1436.22 $\pm$ 30.32 µmho/cm. The physico-chemical characteristics of tap water were analyzed using the methods as outlined by APHA (2005). Analytic grade Potassium chromate (K_2CrO_4) (Marck, India) was taken to assess the LC_{50} (56.64mg/l/w/v) for 96 hours by graphical interpolation in plotting percentage survival Vs log K_2CrO_4 concentration. A sublethal concentration (5.6 mg/l) of Potassium chromate was selected as sublethal concentration as outlined by (Shukla & Pandey, 1988). Fingerlings were fed powdered dried shrimp daily, however, feeding was stopped prior to 24 hours during experiment. Separate control group mas also maintained along with treated group. Though, the fingerlings of *Channa punctatus* are active air breathers, however, the aquariums size - 24×12×12 cm were aerated with air stones for six hours daily for proper oxygen saturation.

After acclimatization, fingerlings were transferred to glass aquarium having 20 liters of tap water in each besides one control. In

each aquarium 20 fingerlings were kept. Medium in each aquarium was replaced after 24 hours. All possible efforts were made to avoid stress to fingerlings. They were blotted dry and after cleaning with 95% ethyl alcohol, their caudal peduncles were severed and the blood from each group exposed to 24, 48, 72, 96 hours was collected into heparinized tubes. The blood pyruvate level to each lot was quantitatively estimated colorimetrically following techniques adopted by (Friedman & Haugen, 1943).

The data obtained in our experiment were statistically analyzed using student 't' test.

Exposure period was four days & the observation for blood pyruvate level were estimated after 24,48,72 96 hours at sublethal concentration of K_2CrO_4 .

RESULTS

Fingerlings of a tropical freshwater murrel, *Channa punctatus*, exposed to sublethal concentration of hexavalent chromium exhibited restlessness, haphazard movement, increased mucus secretion and coming to the water surface at every 2-3 min.

As shown in **Table-1**, blood pyruvate level in the fingerlings of *Channa punctatus* upto 48 hours showed a slight increase after subjecting to sublethal concentration of hexavalent chromium (5.6 mg/l), which was actually statistically insignificant as compared to control. Thereafter, a progressive and statistically significant increase was noticed. The blood pyruvate level at 72 and 96 hours was 0.48±0.05 and 0.55 ±0.04 mg/100ml revealing 71.42 and 96.42% increase & statistically significant when Compared to control.

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Table-1

Blood pyruvate level in fingerlings of Channa punctatus (Bl.) exposed to a sublethal concentration (5.6 mg/l) of chromium (Cr^{vi}) as Potassium chromate. Value expressed as mean ± SE(N=6).

Parameters	Control	Cr^{+6} Exposure duration in hours			
		24	48	72	96
Blood pyruvate(mg/100ml)	0.28 ± 0.06	0.34±0.04*	0.40±0.06**	0.48±0.05***	0.55±0.04****
% increase		21.42	42.85	71.42	96.42

= insignificant(P>0.05);**= significant (P<0.05); ***= significant (P<0.02);*= Significant(P<0.01)***

DISCUSSION

It is common fact that metal toxicity is more accurately measured in freshwater than in sea water. It is because the metals appear to a great extent as complex compound in the sea water and there reduces the toxicity to the metal ion. The reaction and survival of fish depends upon the physicochemical nature of water and also on the kind, toxicity and duration of exposure of the toxicant (Mays,1996); Vutukur (2005). Behaviour provides a unique perspective linking the physiology and ecology of an organism in its environment (Little and Brewer, 2001) and Kane et al., (2005). In the present study restlessness, haphazard movement, increased mucus secretion and coming of the fishes at the water surface is to avoid the hexavalent chromium toxicity. Alterations in various biochemical parameters viz; DNA, RNA, protein etc. in fishes under metallic stress have been extensively studied by (Shukla & Pandey, 1984 ; 1986) ; Zhitkovich *et al.,*(1996); Unlu *et al.,* (2003). However, impact of of hexavalent chromium on blood pyruvic acid level in fishes in general and fingerlings in particular in sparsely worked out, though it is an important metabolite of

body energy reserve involved in both aerobic and anaerobic metabolism.

The time course of blood pyruvate response to serve exercise in fishes has been noticed by (Black *et al.,* 1961). They reported statistically significant increased in blood pyruvic acid level, during 15 min of severe exercise & recovery period between four to twenty four hours. Further, (Black *et al.,* 1962) in another experiment reported increased blood pyruvic acid level in the fishes following 15 min. of strenuous activity.

During recovery in the beginning, they observed a further steady increase in the pyruvic acid content which later suddenly decreased to the initial unexercised level. Marked elevated pyruvic acid concentration at 20-24 hours in Rats intoxicated with dieldrin have also been noticed (Bhatia *et al.,* 1972).

In *Heteropneustes fossils*, Indian catfish, when subjected to eldrin and methyl parathion showed elevated level of blood pyruvate (Srivastava & Singh, 1981). More or less similar observations have been observed by (Shukla *et al.,* 2005) under arsenic stress in *Colisa fasciatus,* a tropical freshwater fish.

In the present investigation, statistically significant increase in the blood pyruvate (hyperpyruvicinemea) at 72 & 96 hours in the fingerlings of *Channa punctatus* (Bl.) has been observed which may be attributed to fast glycolysis & slower rate of oxidation of pyruvic acid. The impairment of tissue respiration due to hypoxia as indicated by the fingerlings of *Channa punctatus* coming at surface of water to gulp the atmospheric air, restlessness, haphazard movement etc., may lead inhibition of pyruvic acid oxidation in tissue after fast glycolysis and thereby enhancement in toxicity in the fingerlings the blood pyruvic acid content results. Such enhancement in the blood pyruvic acid level may be regarded as an index of chromium of *Channa punctatus.*

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