Sindh Univ. Res. Jour. (Sci. Ser.) Vol.44 (3) 445-448 (2012)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Toxic Effect Of Chromium On Gills Of Cyprinid Fish, *Cyprinus Carpio*

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Received 09th April 2012 and Revised 16th June 2012

Abstract: Studies to know the impact of chromium on the gills of *Cyprinus carpio* was made. In this context, *Cyprinus carpio* body lengths (4-5cm) were brought live in the laboratory. After acclimatization the fish were exposed to four different concentrations 25mg/l, 30mg/l, 35mg/l and 40mg/l. The findings of the present studies indicated that the effect of chromium was dose dependent. The disintegration takes place in almost every part of the gill at lower concentration of the compound. The gill raker and gill arch lost their integrity at initial stage and at higher concentration disappeared completely. The cells of mucosal epithelium, basement membrane and submucosa at the lower dose disintegrated while at higher concentration showed hyperplasia. Adipose tissue was also disappeared gradually. Primary and secondary gill lamellae also disintegrated initially at lower concentration followed by hyperplasia.

Keywords: Chromium, Gills, *Cyprinus carpio*

1. INTRODUCTION

The industrial effluents ultimately enter in the water bodies available around the cities and contaminate the water. Consequently, the fauna that is living in that water will be affected drastically due to change in the quality of water (Jezierska and Sarnowski, 2002). The pollutants that come out from the source can be lead, nickel, cadmium, mercury, chromium. However the intensity of the effect of the contaminants can be variable (Jafri *et al*., 1999). Some of them are highly toxic and majority is less, but they may be dangerous for life exists in water. These elements play a role in the depletion of oxygen ratio in the water. Depletion in dissolved oxygen (O_2) results in the increase of biochemical oxygen demand (Vutukuru, 2005; Shereena and Logaswamy, 2008; Mishra and Mohanty, 2008; Oner *et al*., 2008). The toxic element like chromium is one of the very dangerous heavy metals (Canli and Furness, 1993). Even very small quantity can disturb the physiological processes of the fish that lead to its mortality or to disturb the growth and development of the animals, the gills of the fish always remain under stress Costa, 2003; Karadede-Akin and Ünlü, 2007). Many workers have reported their findings about the role of toxic elements in affecting the water quality (Mansour and Sidky, 2002; Seğlamtimur *et al*., 2003;

Wepener *et al*., 2001; Yilmaz, 2003). Despite reported studies on the toxicity of chromium and effect on the vital organs like gills, very few studies have been undertaken on the commercial fishes. For the proposed study, an attempt was made to know the effects of chromium on a commercial exotic fish *Cyprinus carpio*, which is very widely distributed throughout Pakistan. The freshwater fish, common carp (*Cyprinus carpio* L.) is of great commercial importance because it is the most common fish widely consumed worldwide. Therefore, it can be a good model to study the responses to various environmental contaminations. If the stress of the chromium, which is highly toxic heavy metal exist continuously for longer period, that can affect the fish drastically and will create a big loss to the economy of the country and also diminish the dietary requirement.

2. MATERIALS AND METHODS

Fish Sampling and Acclimation

100 specimens of gulfam, *Cyprinus carpio* (4-5cm TL) were obtained live from fish hatchery Chilya (District Thatta). The fish were brought to the laboratory in the plastic bags, filled with oxygen. The fish were kept in glass aquaria for acclimatization to the laboratory condition for a week before the start of experiment. The fish were fed daily with the pellet feed containing rice protein.

Test chemical

The potassium dichromate ($K_2Cr_2O_7$) (MERCK) was used as the test compound for determination of Lc_{50} of chromium. The stock solution for different concentration was prepared by diluting the compound in distilled water.

Estimation of Lc_{50}

For estimation of Lc_{50}, group of 10 fish were kept four different glass aquaria. Each tank contained 20 lit. of water and exposed to increasing concentrations of chromium {(potassium dichromate)($K_2Cr_2O_7$) from 15mg/L, 25mg/L, 35mg/L, 45mg/L. Different concentrations of the chromium tested in Lc_{50}. Experiment was terminated after 96 hours. Water in the aquarium was changed on daily and fresh solution of chemical was added. During the experiment the activities of the fishes were recorded daily.

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2.4 Experimental Design:

The fish were divided in five groups each contain 10 fish one group served as control. Other groups were exposed to the different concentration of potassium dichromate (25mg/l, 30mg/l, 35mg/l and 40mg/l. The experiment continued for 30 days through June to July 2011. Maintenance and feeding was same as above in estimation of Lc_{50}. At the end of the experiment fishes were dissected. Tissue sample of liver and gills were taken and fixed in Bouin's fluid for the purpose of histological studies. Since the gills and septum of the gills are cartilaginous and need to remove the calcareous material so that the tissue may be made soft enough for the further process. In this context, the gills were kept in decalcifier for 4-5 days and then washed in tape water and dehydrated. The tissue were infiltrated in Benzene and embedded by putting the tissues in melted wax for 1-2 hours in oven at a particular melting of the paraffin wax. The embedded tissues were prepared for section cutting. 6µm thick sections of the tissues were made by using rolatory microtome (Ricerd Jung) and stretched on the albumenized glass slides. The stretched sections were kept in safe place for 24 hours to ensure proper sticking. The section were deparaffinized in xylene and processed them for staining in Haemotoxylin (Gurr, 1956) and Eosin (Putt, 1948) and mounted with Canada balsam and covered the sections by glass cover slip. The gills and liver of the fish, were studied under light microscope and microphotography on Leica DM 2500. (Transmitted light microscope with digital camera 4LAS software).

3. RESULTS

Exposure of the fish *Cyprinus carpio* to the sub-lethal concentration of potassium dichromate 25mg/L, 30mg/L, 35mg/L and 40mg/L separately for thirty days result into sever alteration in the histological makeup of the gill and the result in the form of photographs.

The gill sections normal fish consists of gill arch, gill septum and gill lamellae. The gill arch is divided into outer gill rakers and inner to it the arch is supported by three portions 1. Mucosal epithelium 2. Basement membrane 3. Submucosa. The gill septum lies between the gill arch and gill lamellae. The gill lamella is rod like and gives of the gill filament. The chloride cells occur in primary gill lamellae and the pillar cells are located in the secondary gill lamellae. In the 25mg/l concentration of the chromium, the distal portion of the gill filament including gill lamellae has become drastically collapsed. However, proximal portion of the gill filaments is normal and in a functioning position. The gill septum has also been hypertrophied **(Fig. 1A).** The results of the fish exposed to Cr 30mg/L reveal that the gill rakers have been compressed totally. Mucosal epithelium and basement membrane has either regressed or degenerated **(Fig. 1B).** Gill reker has completely disintegrated and converted into a mass like structure. No demarcation is left between mucosal epithelium; basement membrane and submucosa. Adipose tissue has become widen because of elimanation of mass. Primary and secondary gill lamellae have also become fused with each other. **(Fig. 1C).** It shows the structure of complete gill exposed to 40mg/l concentration of chromium. The rakers have totally lost and disintegrated. No sign of mucosal epithelum etc. the primary and secondary gills has completely destroyed no trace of lamellae seen. This indicates the total collapse of the gill structure (**Fig.1D).**

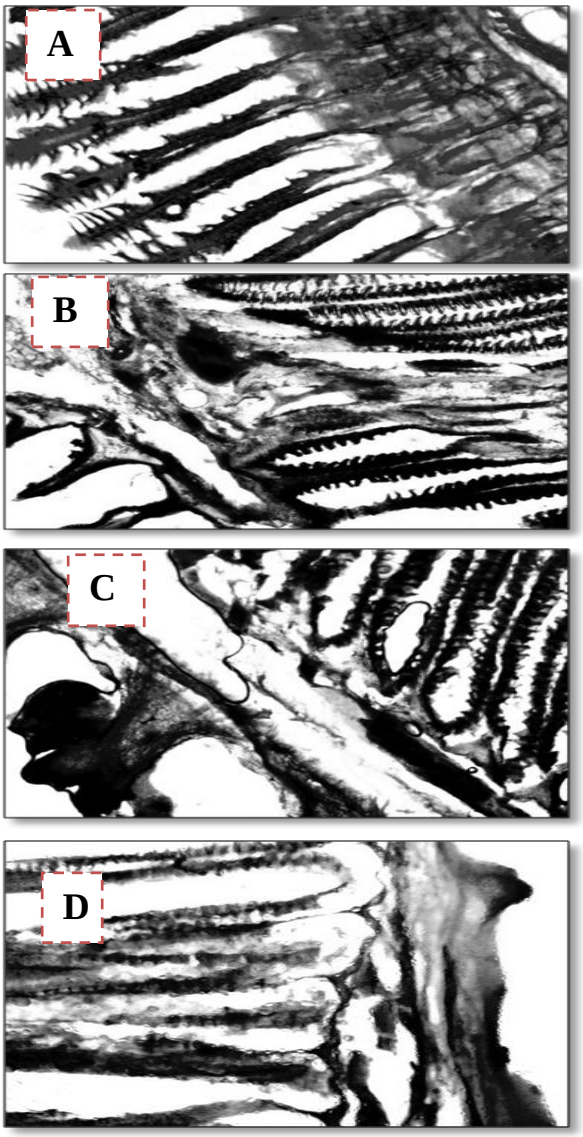


Fig.1 (A) showing the complete gill of the fish exposed to 25mg/l concentration of chromium. Fig.2 (B) exposed to 30mg/l concentration of chromium. Fig.3 (C) represents the toxicity of chromium at 35mg/l concentration. Fig.4 (D) shows the effect of chromium at 40mg/l.

4. DISCUSSIONS

The present study reveal that the gills which are very soft part of the body involved in the respiratory process start damaging expose at lowest concentration of Cr (25mg/L). The damage was noted increasing at the exposure of 30mg/L onwards. In the lowest concentration through the effect was mild but the damage it caused was effective to the respiratory processes. The gill rakers were changed structurally with the stress on supporting mucosal epithelium, basement membrane and submucosa.

Simultaneously, the adipose tissue was also affected gradually with the increase of the concentration. The gill filaments and its constituents were damaged gradually which reached to the total collapsed level at the highest concentration (40mg/L). At the higher concentration, the gill rakers start hypertrophy and that was follow by the hypertrophy in gill filaments. During the same time the disintegration of the chloride cells and the pillar cells was noted fallow by their hypertrophy. All these changes caused the fish to avoid taking food and intake of oxygen. These patterns of changes have also been reported by many workers (Kumar and Pant, 1981; Randi, *et al*., 1996; Cengiz and Unlu, 2003; Ahmad *et al*., 2006; Antonio *et al*., 2007; Ashish, and Banalata, 2008; Bhatkar, 2010; Daksh and Capoor, 2011; Senthil *et al*., 2011)

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