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RESEARCH ARTICLE

EFFECT OF CHROMIUM ON HISTOPATHOLOGICAL CHANGES IN THE GILL TISSUE OF FRESH WATER FISH, *Oreochromis mossambicus* (PETERS)

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ABSTRACT

The present study was made to investigate the effect of chromium on the histopathological study in the gill tissue of fresh water fish, *Oreochromis mossambicus*. The fish exposed to chromium (2 ppm) for 10 days, 20 days and 40 days. The present study shows the breakage of lamellae and separation of lamellae was noted in the gill tissue for 20 days and 40 days respectively. The present study concludes that the increasing concentration chromium damages the gill tissue of *Oreochromis mossambicus.*

INTRODUCTION

Aquatic systems are very sensitive to heavy metal pollutants and the gradual increase in the level of such metals in aguatic environment, mainly due to anthropogenic sources, became a problem of primary concern. This is due to their persistence, as they are not usually eliminated either by biodegradation or by chemical means, in contrast to most organic pollutants. Heavy metal constitutes a serious type of pollution in fresh water and being stable compounds, they are not readily removed by oxidation and affect the animal (Nammalwar, 1985). Heavy metals enter into aquatic habitats by a number of routes and cause hazardues effect on their morphology and physiology. Heavy metal pollution of water is a major environmental problem facing the modern world (Shrivastava and Sathyanesan, 1987). Heavy metals have a unique property of accumulation over a period of time, along a food chain and a very high level can be accumulated in an organism from very low level concentration in water and sediments (Shrivastava and Sathyanesan, 1987; Bose *et al.,* 1994). Chromium is a heavy metal which is as hazardous as other heavy metals. Haematological changes due to chromium treatment in *Oreochromis mossambicus* have been reported recently (Ali et al., 2000). Many works on heavy metal induced histopathological changes in fishes have been reported. But only little attempt has been made on histological study of *Oreochromis mossambicus* exposed to heavy metals. Chromium is a lustrous, brittle and hard metal. It is silver gray and the main uses of chromium are in alloys such as stainless steel, chromium plating and metal ceramics. Chromium is used in metallurgy to impart corrosion resistance and a shiny finish; as dyes and paints. It causes danger to human health mainly for people who work in steel and textile industry.

Fishes are sensitive to contaminants of the water and pollutants may damage certain physiological and biochemical processes when they enter the organs of the fish(Tulasi *et al*.,1992). The fishes which are largely

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being used foe the assessment of the quality of the aquatic environment and can cause bioindicator of environmental pollution (Dautrempuits *et al.,* 2004; Lopes *et al*., 2001).The gills are the first target organ in the heavy metal accumulation because they are directly in contact with water (Dubale and Shah,1979).Fish gills, which serve as the primary uptake site in fish for trace metals, represent the most important targets when exposed to elevated levels of ambient metals (Newman and Jagoe, 1994). The gills are in direct contact with the contaminate medium (water) and have the thinnest epithelium of all the organs and metals can penetrate through the thin epithelia cells (Bebianno *et al*., 2004).

MATERIALS AND METHODS

Heavy metal chromium has purchased from High Media Chemicals, India Private Limited, Mumbai, India. The fresh water fish, *Oreochromis mossambicus* were collected from the local fish form. This fishes were brought to the laboratory and transferred to the rectangular fibre glass tanks (100X175cm) of 500liters capacity containing chlorine free aerated well water. Prior to the start of the experiment, the fishes were acclimatized to the food and laboratory conditions with 12 h dark and 12 h light cycles, pH range of 6.95 to 7.60 and temperature ranging from 16 to 24 °C for 15 days.

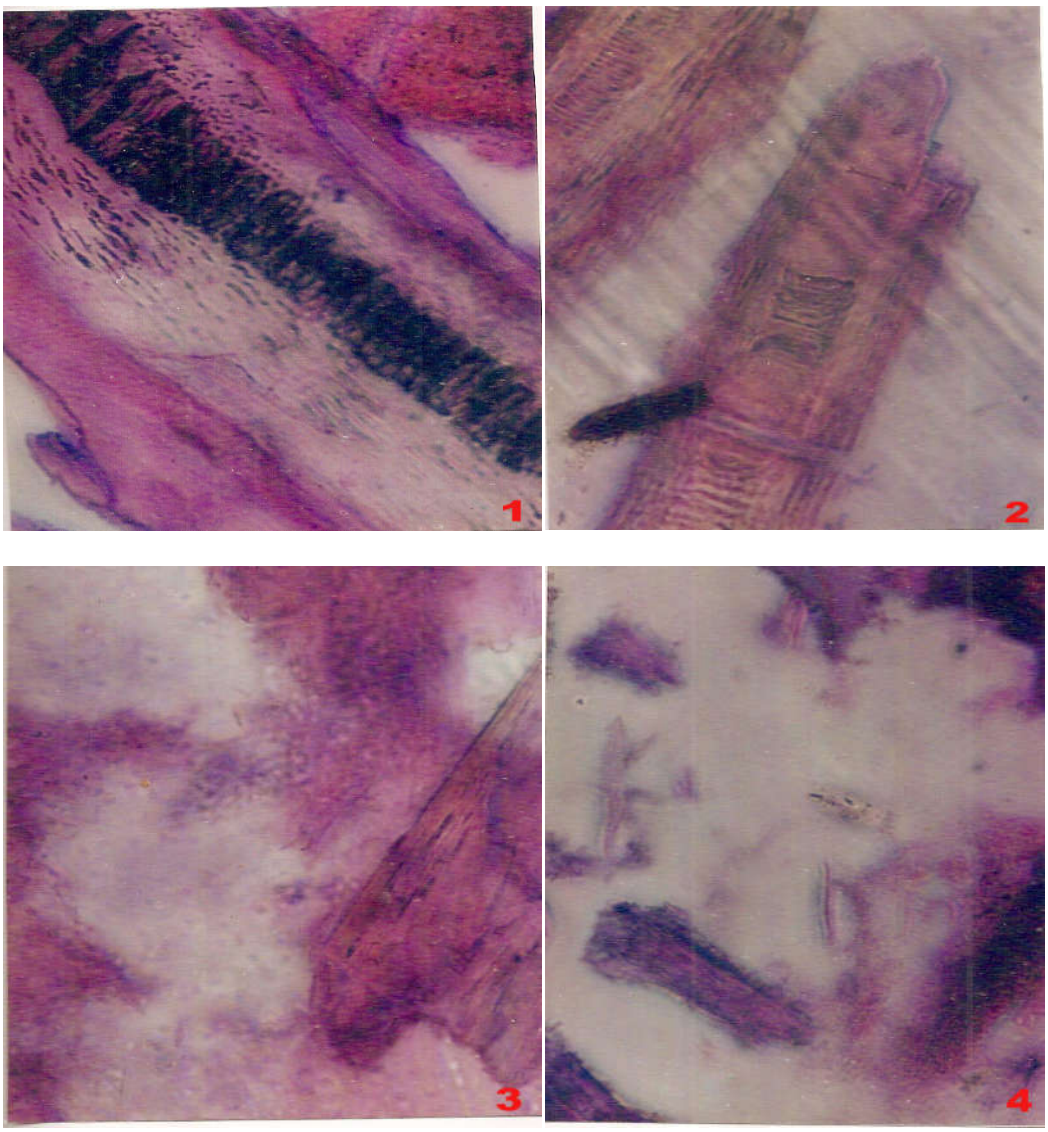

Fig.1. Shows gill of control fish; Fig. 2 shows gill of chromium treated fish for 10 days; Fig.3 shows gill of chromium treated fish for 20 days; Fig. 4 shows gill of chromium treated fish for 40 days.

Fishes were divided into four equal groups each comprising of 30 fishes. Each group was kept in separate plastic tanks. The first group was kept as negative control; the fishes were maintained in water containing normal water without any treatment. The fishes of three groups were exposed to a sub-lethal concentration of chromium (2ppm) for 10 days, 20 days and 40 days respectively. After the treatment, the gill tissue was isolated and used for the histopathological study.

Histological Study in the gill tissue

The gill tissue was quickly isolated in cold room and fixed in buffered formaldehyde solution for 3 hrs. The tissues were washed in running tap water and processed following the standard technique (Gurr, 1959) for microtomy. The tissues were dehydrated in ascending grades of alcoholic series. The dehydrated tissue was cleaned in xylol as embedded in paraffin wax (58°C – 60°C). Serial sections were cut at 6-8 µm thickness and there were deparaffinized in xylol and after passing through descending grades of alcoholic series. The specimen sections were counter stained with aqueous haemotoxylin-Eosin stains. The stained sections were mounted on DPX for microscopical studies.

RESULTS

The gill of control fish looks like a straight filament with primary and secondary lamellae, which are flat leaf like structures. The primary lamellae are the basement for secondary lamellae. The lamellar epithelium arises from the primary lamellae and covers the secondary lamellae (Fig.1). In the gill tissue of fish treated with 10 ppm for 10 days no histological changes was observed and its resembled the gill of control fish(Fig.2) After 20days of exposure breakages were observed in the gill (Fig.3). Also separation of lamellae was noted and several debris and filaments of lamellae were observed after40 days of exposure (Fig.4).

DISCUSSION

Gills are the immediate site for the entry of toxicants, since they are functioning as respiratory surfaces. The observations presented in tables 7 and 8 revealed that primary lamellae and secondary lamellae of the gills were more damaged in test fish exposed to different concentrations of chromium for different duration. Breakage of primary and secondary lamellae were observed in gills of *Oreochromis mossambicus* treated with 2mg/1 of chromium for 20 days. Sloughing of lamellar epithelium observed in present study is in accordance with the finding on the gill of the fresh water fish. *Colisa fasciatus* treated with 64 ppm of nickel for 10 days (Nath, 1989). In the present observation several debris with extensive breakage were also observed and secondary lamellae of gills have shown more damage after 40 days of exposure. This could be due to the flow of water (Hughes,1963) containing heavy metals through the secondary lamellae during respiration.

The lamellar epithelium which covers the primary and secondary lamellae has been found to get sloughted off in gills, of fish *Oreochromis mossambicus* treated with 0.01 mg/l and 0.03mg/l of mercury for 10 days and 30 days respectively (Ranilatha, 1996). Similar effects were also observed in gills tissues of fingerlings *Cyprinus carpio* exposed to mercury (Megala, 1989). The lamellar epithelium which acts as the site of gas exchange can be affected by the metal ions which pass through it (Pritchard, 1987). Separation of lamellar epithelium could also be due to the thickening of epithelial cell walls, which lead to 'enlargement (hypertrophy) of cells (Brown *et al.,* 1968). Hence the separation of primary lamellae observed after 20 days of exposure to 4 ppm of chromium could be due to the thickening of epithelial cells. Dwivedi and Sarin, (1996) reported that the histological changes in gill of *Heteropneustes fossilis* by lamellar clubbing and fusion were observed, formation of gap between lamellar filament were also observed in fish treated with Anthracene in gill tissue.The separation of lamellar epithelium might lead to breakage of lamellae. Similar observations Dwivedi and Sarin, (1996) reported that the histological changes in gill of *Heteropneustes fossilis* by lamellar clubbing and fusion were observed, formation of gap between lamellar filament were also observed in fish treated with Anthracene in gill tissue.The separation of lamellar epithelium might lead to breakage of lamellae. Similar observations have also been reported in gills of Atlantic salmon exposed to zinc (Zitco and Carson, 1977). In this investigation higher concentration (4mg/l) of chromium caused severe damage in gills of treated *Oreochromis mossambicus*. Increasing the duration of exposure also caused some damages in gill. In general, longer the period of exposure of fish to chromium and higher the concentration of chromium severer the damages noted in gills. The present study concludes that the increasing concentration chromium damages the gill tissue of *Oreochromis mossambicus*.

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