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Sublethal Toxic Effects of Cadmium Chloride to Liver of Freshwater Fish *Channa striatus* (Bloch.)

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Abstract: The present investigation has been conducted to understand the hazardous effect of sublethal concentration of cadmium chloride solution (0.8ppm on the histology of the liver of the fish *Channa striatus* for a period of 45 days. The histopathological changes induced in the liver were cytoplasmic vacuolization of the hepatocytes, blood vessel congestion, inflammatory leucocytic infiltration and necrosis. All these alterations in liver histology can be considered to monitor the water contaminated with heavy metal salt(s).

Key words: Cadmium toxicity · *Channa striatus* · Liver

INTRODUCTION

Extensive industrialization and urbanization has increased the concentration of metals in the aquatic environment which affect the survival, reproduction and growth of organisms including fish [1]. Most of the heavy metals exhibit toxicity through the formation of coordination complexes and clusters in the animal cells [2]. Among heavy metals, cadmium causes poisoning in various tissues of animals [3-5]. It can react with polythiol groups of cellular biomolecules such as protein, carbohydrates and lipids. Heavy metal contamination exerts an extra stress on metabolically active tissues and organs [6]. The liver is an important organ performing vital functions including biotransformation, migration of lipids, glycogen storage and release of glucose into the blood. Moreover liver contain many enzymes and proteins, heavy metal chelation may disrupt the liver tissue by disintegrating the functional and structural properties of the cells. Considerable interest has been shown in recent years in histopathological study while conducting sub-lethal tests in fish. Tissue changes in test organisms exposed to a sub-lethal concentration of toxicant are a functional response of organisms which provides information on the nature of the toxicant. Hence the present investigation has been designed to asses the impact of sublethal concentration of cadmium chloride on histopathology of the liver of *Channa striatus* to monitor the quality of water contaminated with heavy metal salt(s).

MATERIALS AND METHODS

Irrespective of the sex healthy specimens of *C. striatus* of 65-67g of body weight and 15-17cm length belonging to a single population were collected locally and confined to large plastic aquaria bearing tap water for 30 days in the laboratory for acclimation. They were fed with minced goat liver on everyday (d) for 3 hours (h) before the renewal of the medium. Water was renewed after every 24 h with routine cleaning of the aquaria leaving no faecal matter, dead fish (if any) and unconsumed food. Prior to the commencement of experiment, 96 h median lethal concentration (96h LC_{50}) of cadmium chloride (99% pure, E-merck, India) was estimated following trimmed spearman Karber method [7] and 24 h renewal bioassay system and was found to be 100 ppm after 5% trimming.

For the analysis of sublethal toxicity two groups of ten fish each were exposed separately to 0.8 ppm of cadmium chloride solution prepared in tap water. The experimental medium was prepared by dissolving cadmium chloride (0.8mg/l) in tap water having dissolved oxygen 6.5ppm, pH, 7.4, water hardness 360mg/l and water temperature 27±2°C [8]. Each group was exposed to 50 l of the experimental medium. Parallel groups of 10 fish each were kept in separate aquaria containing 50 l tap water without cadmium chloride as controls. Feeding was allowed in the experimental as well as control groups' everyday for a period of 3h before the renewal of

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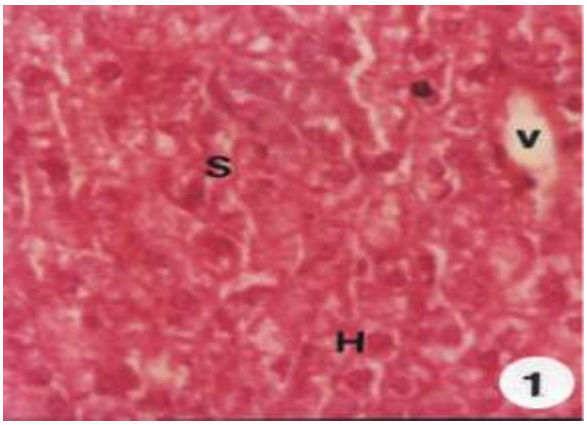

Fig. 1: Section of the liver of control fish *C. striatus* showing its structural organization. (S = sinusoidal lumen; H = hepatocytes; V = vein) (H/E X 320)

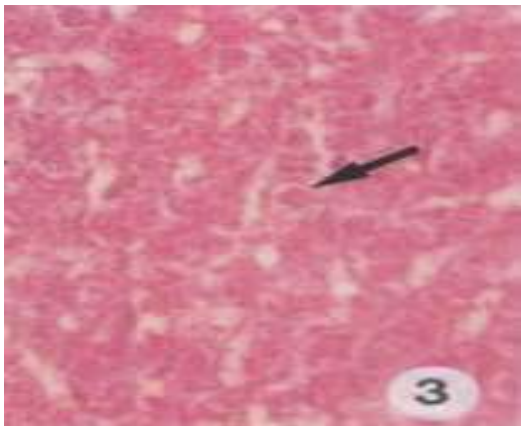

Fig. 2: Liver of *C. striatus* showing vacuolization and necrosis after 45 days of exposure to 0.8ppm cadmium chloride solution (H/E X 200).

the media throughout. After the expiry of 45 days of exposure, five fish each from the respective experimental as well as control groups were sacrificed. Pieces of liver were fixed in 10% neutral formaldehyde. 5µm sections were stained with Ehrlich's Haematoylin/Eosin (H/E) for routine histopathological analysis.

RESULTS AND DISCUSSION

In liver sections of normal fish the hepatocytes form a rather cord-like pattern. These cords are arranged around tributaries of the hepatic vein. The liver cells are large in size, polygonal in shape with homogenous eosinophilic cytoplasm and centrally located nuclei. A large number of blood sinusoids were observed and separates the hepatic cords one from another (Fig. 1). Exposure of *Channa striatus* to 0.8 ppm of sublethal cadmium chloride for 45 days, the liver lost their normal architecture and a large number of hepatocytes appeared with pyknotic nuclei. The intra hepatic blood vessels were dilated and congested with blood and inflammatory leucocytic infiltrations were observed (Fig. 2). Numerous hepatocytes showed marked cytoplasmic vacuolization (Fig. 2). Sinusoids in most areas distended and central veins appeared severely damaged due to marked swelling and degeneration of the endothelial lining cells. The liver is the primary organ for detoxication of organic xenobiotics. Wide varieties of insecticides and other toxic by-products tend to accumulate in high concentrations within it [9] and the organ suffers harmful effects. Hinsen *et al*. [10] studied fish exposed to pesticides under laboratory conditions and observed that the liver contained highest pesticide concentration. It appears to be a general feature of the liver of intoxicated fish that the degree of structural heterogeneity is enhanced with increasing concentrations of the toxicant [11]. Narayan and Singh [12] observed extensive degeneration of cytoplasm with pyknosis of nuclei and loss of glycogen in liver tissue of *Heteropneustes fossils* while subjecting them to acute thiodan toxicity.

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