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Histopathological Changes in the Liver and Kidney of Freshwater Teleost, *Channa striatus* (Bloch) on Exposure to Lead Nitrate

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Abstract: The present study was conducted to investigate the histopathological changes in the liver and kidney of freshwater murrel, *Channa striatus* after exposure to 10mg/l (10% of 96 h LC50) of Lead nitrate for a period of 30 days under laboratory conditions. The resultant histopathological changes in the liver and kidney were recorded by light microscope. The most common changes in the liver of fishes were cyotplasmic vacoulation, cluster formation of hepatocytes and degeneration of epithelial layer. Kidney of fishes exposed to 10 mg/l of Lead nitrate were characterized by deshaped renal tubules, loosening of haemopoietic tissues and degeneration of some tissues. The present investigation illustrates that these histopathological changes would serve useful purpose in evaluating the toxic effects of Lead nitrate.

Keywords: Heavy metals, Lead nitrate, Histopathology, *Channa striatus*, Liver, Kidney.

Introduction

Metals are introduced into the environment by a wide range of natural and anthropogenic sources (Wepener *et al.*, 1992) and with anthropogenic being either domestic or industrial (Seymore, 1994). Metals are often present at high concentrations in aquatic environment due to the fast growth of population (Seymore, 1994) and the increase in industrialization (Pelgrom *et al.,* 1994). Heavy metals have a unique property of accumulation in an organism from a very low level concentration in water through food chain (Shrivastava and Sathyanesan, 1987).

Lead is ubiquitous and the most common environmental pollutant naturally present in the earth's crust in small concentrations (Pracheta *et al*., 2009). Lead pollution has become a major environmental problem in many developing and industrializing countries due to both occupational and environmental exposure (Yucebilgic *et al*., 2003). It has many undesirable effects, including neurological (Senapati *et al*., 2001; Soltaninejad *et al*., 2003 and Sharma *et al*., 2011), behavioural (De Marco *et al.,* 2005 and Adeniyi *et al*., 2008), immunological (Bunn *et al.,* 2001 and Rosenberg *et al*., 2007), renal (Vargas *et al.,* 2003, Rastogi, 2008 and Sharma *et al.*, 2011c) and hepatic (Patra *et al*., 2001 and Sharma *et al.,* 2011b).

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 organ most associated with the detoxification and biotransformation process is the liver (Van der Oost *et al*., 2003) and due to its function, location and blood supply, it is one of the organs most affected by pollutants in the water (Rodrigues and Fanta, 1998). The teleostean kidney is one of the first organs to be affected by pollutants (Thophon *et al*., 2003). Hence, this study was undertaken to examine the effect of sublethal concentration of lead nitrate on histological aspects of liver and kidney of fresh water teleost, *Channa striatus.*

Materials and Methods

Fish Collection: Live specimen of *Channa striatus* measuring about 20-25 cm and weighing 50-75 gm were collected for experimental study from different fish markets of Bhopal, Madhya Pradesh.

Experimental Fish: Before introducing in the aquarium, fishes were treated with 0.1$KMnO_4$ solution to avoid dermal infection. Fishes were acclimatized in laboratory condition for one week in glass aquaria of 200L capacity prior to the start of experiment. During this period the fishes were fed with chopped meat daily. The 96hrs LC_{50} value of lead nitrate was found to be 400 mg/l in *Channa striatus.* After determining LC_{50} 96hrs value, they were divided in two groups having 10 fish in each aquarium. The first group was kept as control with plain fresh water while the second contained Lead nitrate at 10mg/l (10% of 96 h LC_{50}). Water of each aquarium was changed on every 5th day and lead nitrate was maintained throughout the experiment duration of 30 days.

Histopathological Procedure: On the 30th day of the exposure, fish from control and treated group were weighed and sacrificed. Liver and Kidney were removed and washed in saline water to remove blood and fixed in 10% formalin for 24hrs. Preserved tissues were washed under tap water to remove formalin, dehydrated in ascending series of ethanol, clarified with xylene and embedded in paraffin wax. Sections of 5-6 micron thickness were cut out using rotatory microtome, mounted and stained routinely with Hematoxylin and Eosin (H&E) for histopathological examination by light microscope.

Results and Discussion

The histopathological changes were noticed in treated fish exposed to Lead nitrate and were not observed in the control fish. After 30 days histological examination revealed that exposure of fish to 10 mg/l of lead nitrate, several changes were noticed in the histology of liver of fish *Channa striatus* as cytoplasm of hepatic cells has become vacuolated, cluster formation of hepatocytes and degeneration of epithelial layer (**Fig. 1 & 2**).

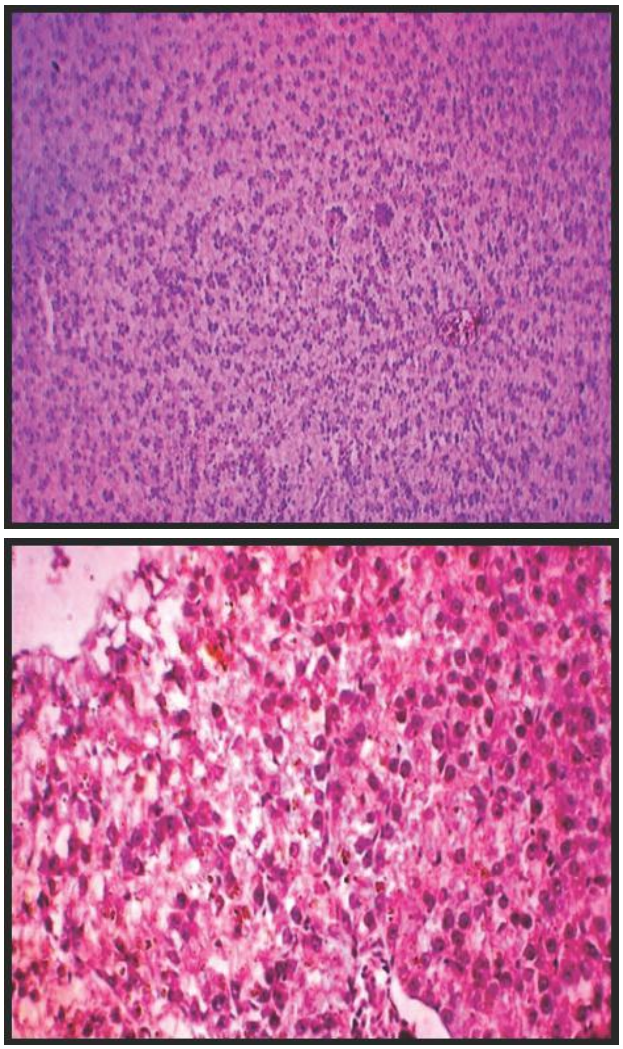

Fig. 1 & 2: Photomicrophotographs of Liver of treated fish exposed to $PbNo_3$ at concentration of 10mg/l after 30 days, showing cytoplasmic vacuolation, cluster formation of hepatocytes and degeneration of epithelial layer, 100X & 400X

Sharma *et al*. (2014) observed nuclear degeneration, deshaped hepatocytes, necrosis of hepatocytes, loosening of hepatic tissue, vacuolation in cell cytoplasm, nuclear vacuolation, and necrosis of cytoplasm in the liver of *Channa striatus* exposed to 20 mg/l and 30 mg/l of lead nitrate for 30 and 60 days. Similar results have been reported by Olojo *et al.* (2004) in the liver of African catfish, *Clarias gariepinus* exposed to 7mg/l lead nitrate for 21 days, Rani and Ramanmurthi (1989) in *Tilapia mossambica (Oreochromis mossambicus)* exposed to cadmium chloride at 5 and 50 ppm for 1, 7, 15 and 30 days, Mishra and Mohanty (2008) in liver of *Channa punctatus* exposed to hexavalent chromium and Thopan *et al.* (2003) in White Sea bass, *Lates calcarifer* exposed to 5mg/l cadmium chloride for 3 weeks.

The kidney in air breathing fishes is distinguished in head kidney and trunk kidney (Kumar and Tembhre, 2010). In the present investigation only trunk kidney has been studied, degeneration of renal tubules, loosening of haemopoietic tissues and disintegration was also noticed in the glomerulus and Bowmen's capsule of the fish examined after 30 days exposure to 10mg/l of lead nitrate (**Fig.3 & 4**).

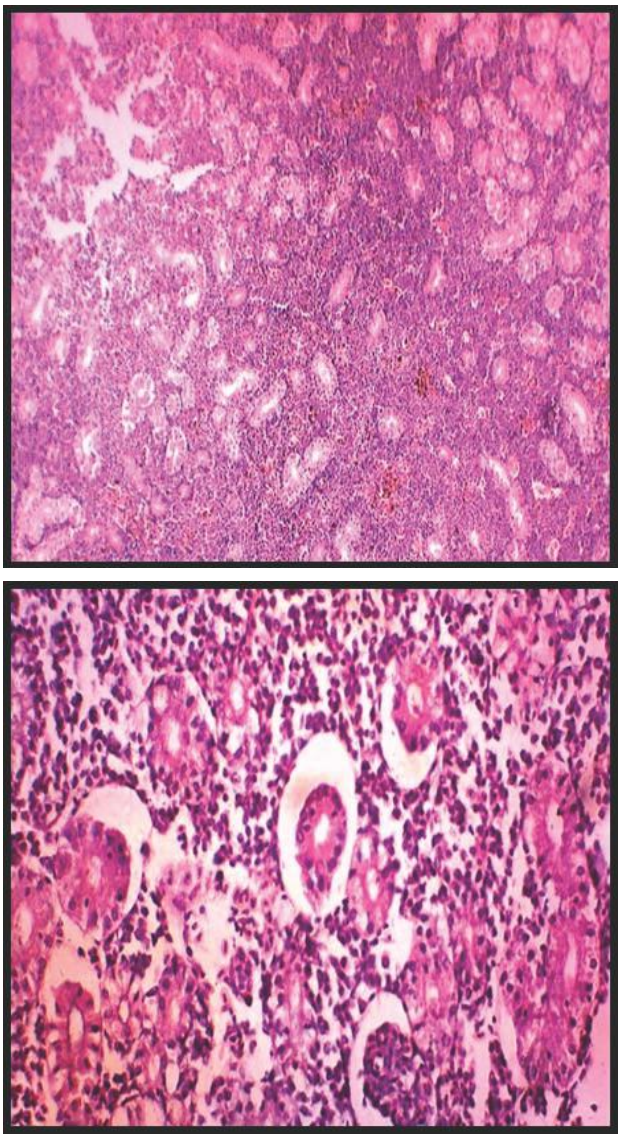

Fig. 3 & 4: Photomicrophotographs of treated fish exposed to $PbNo_3$ at concentration of 10mg/l after 30 days, showing disintegration of renal tubules and loosening of haemopoietic tissues, 100X & 400X

Ahmad *et al*. (2011) observed loosening of haemopoietic tissue, vacuolated cytoplasm, degeneration in the epithelial cells, shrinkage in glomeruli and increase of space in renal corpuscles in the kidney of African catfish, *Clarias batrachus* exposed to 4 ppm and 8 ppm of cadmium chloride for 30 and 60 days. Gupta and Srivastava (2006) noticed dilation, oedema, hypertrophied nuclei of renal tubules, vacuolated glomeruli and disorganized blood capillaries in the kidney of fresh water fish, *Channa punctatus* exposed to three sub-lethal concentrations of zinc (10 mg/l, 15 mg/l and 2mg/l) for 15 days. Iqbal *et al.* (2004) studied the histopathological changes in the kidney of a common carp following lead nitrate exposure and observed increase in Bowman's space, degeneration of glomeruli, shrinkage of proximal tubule cells with pycnotic nuclei in the exposed fish.

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