Poisonous Effects of Cadmium Chloride On Histological Variations in The Liver of South Indian Fresh Water Murrel, *Channa Striatus* (Bloch-1793)

Suja. S * and Sherly Williams. E **

Environmental sciences, Aquaculture and Fish biotechnology unit,
Department of Zoology, Fatima Mata National College, Kollam, Kerala, India.
Email: sujasschnr@gmail.com

DOI: 10.29322/IJSRP.9.01.2019.p8536
http://dx.doi.org/10.29322/IJSRP.9.01.2019.p8536

Abstract- The liver exposed to 96-hour LC 50 concentration of cadmium chloride was studied in a freshwater murrel *Channa striatus*. The liver is very important organs in fish to achieve the process of detoxification and biotransformation, which is considered the most suitable indicators of water pollution levels. Changes of liver morphology and histology of *Channa striatus* due to sublethal concentration of cadmium chloride (6.9 ppm) heavy metals. After the exposure of cadmium chloride, the histopathological alterations observed in the liver tissue such hypertrophy of hepatocytes, nuclear hypertrophy, necrosis, blood congestion, vacuolation, cellular degeneration, damage of nuclei, bile stagnation and congestion in the blood sinusoids.

Index terms: *Channa striatus*, cadmium chloride, *Histopathology*, *Necrosis*, *Hypertrophy*

I. INTRODUCTION

Toxicity testing is an important measurement of the effect and chance of toxicants in aquatic ecosystems and has been widely used to identify suitable organisms as a bioindicator and to assess water quality standards for chemicals (Adams and Rowland, 2003). Several toxic substances entering into aquatic organisms daily may be very small and therefore, often no apparent or sudden effects are noticeable. However, this may result in harmful to many internal organs thus gradually affecting fish population indirectly. Hence, it is very essential to study the effect of cadmium exposure to sublethal doses of toxicant. The problem of toxic materials in water ecosystem is presently closely connected with increased concentration of different types of pollutants, which enter water bodies with industrial and communal wastewaters. The persistence of toxicity test is to evaluate various abnormalities caused due to the administration of a chemical or heavy metal to fish (Shuhaimi-Othman, 2004).

The heavy metal Cadmium gets bioaccumulated in freshwater biota and affects severely. Cadmium, a toxic heavy metal which is increasingly important as an environmental hazard to both humans and wildlife (Satarug and Moore, 2012). Cadmium toxicity with special reference to aquatic ecosystems has been reported by several workers (Jayakumar and Subburaj, 2017; Prabhakar et al., 2012). Cadmium is a ubiquitous contaminant in the aquatic environment. Exposure of cadmium is known to adversely affect fish morphology and physiology of fishes. For instance, in fishes, morphological changes in the liver (Ikram and Malik, 2009; Deore and Wagh,2012) has been reported.

A commercially and medicinal important freshwater fish *Channa striatus* were selected for the present study. *Channa striatus* (Bloch, 1793), is also known as snakehead murrel. This fish is well- known for its palate, high nutritious, curative and medicinal qualities. According to Mat Jais (1992) murrel flesh has high levels of arachidonic acid which is a precursor for prostaglandin and thromboxin, chemicals that affect blood clotting and the fusion of endothelial tissue in the process of wound healing. In the present study, an effort was made to assess the exposure effect of cadmium on the histology of liver of the freshwater fish *Channa striatus*.

II. MATERIALS AND METHODS

Channa striatus were collected from the fresh water habitat. They weighed 42 ±2 and their length was in the range 16±3 cm. The fishes were acclimated to the laboratory conditions for at least 20 days prior to the experiment in a glass aquarium (50 l) filled with dechlorinated water. Water quality characteristics were determined by using water quality analyser EUTEC, which were as follows: temperature 27.5 ± 2.37°C, pH 7.1 ± 0.02, dissolved oxygen 6.2 ± 0.2 mg/l, alkalinity 252 ± 2.5 mg/l as CaCO3, total hardness 453 ± 4.1 mg/l. The fishes were fed daily with minced fish.

The toxicity tests to calculate LC50 for 96 hrs is carried out by desired concentration of Cadmium, prepared by adding the stock solution (1000ml) of the heavy metal in distilled water. Series of different concentration grade were prepared. The ten healthy fishes were selected and tested for each concentration for 96 hrs. The experiment was started in the morning and behavioural changes were noted. The mortality and survival rate of fish were recorded after every 24, 48, 72 and 96 hrs. The LC50 values for different periods were calculated by the method of probit analysis (Finney, 1964). Then, fishes exposed in sub-lethal concentration of cadmium chloride is 6.9 ppm. The finishing of experiment the fish were selected for Histopathological studies. The liver tissue was isolated from control and experimental fish. The tissue was fixed in aqueous Bouin's solution, processed through graded series of alcohols, cleared in xylene and embedded in paraffin wax. Sections were cut at 3µ to 5µ thickness, stained with Ehrlich Haematoxylin and Eosin. The photographs at 10X and 40X magnification were taken with Leica microscope.

III. RESULTS AND DISCUSSION

The present study reveals that the liver of control fish exhibits a normal architecture and there were no pathological abnormalities. The liver of control fish consisted of polygonally shaped hepatocytes with their central nuclei, sinusoids. The hepatocytes present a homogeneous cytoplasm and a large central or subcentral spherical nucleus (Fig.1). The result of treated fish had marked pathological changes in its liver. The histopathological appearance of the liver exposure to cadmium chloride (Fig. 2 and 3) showed important alterations comprise hypertrophy of hepatocytes, nuclear hypertrophy, blood cells are crowding in the central veins, as well as the diffusion of melanomacrophages in the parenchymal tissues of the liver. Its revealed that the increase of cadmium chloride concentration causes cytoplasmic vacuolation, cellular degeneration, damage of nuclei, bile stagnation in addition to congestion in the blood sinusoids. Similar findings were reported in Labeo rohita (Muthukumaravel and Rajaraman, 2013).

The severity of histopathological changes increased with 6.9 mg/l because of this dose of cadmium chloride quick cellular necrosis in the parenchymal tissues and the number of hepatocytes is decreased. The exposure of sub-lethal dose of this insecticide resulted in liver necrosis, fatty deposition at the periphery, and glycogen deposition at one of the hepatic cells and around the central vein.

Histological variations in the liver of fishes have been widely reported. (Bais and Lokhande, 2012) reported the histological lesions, necrosis and cloudy swelling in the liver of *Ophiocephalus striatus* exposed to cadmium. The. Prabhahar *et al*., (2012); Radhakrishnan and Athikesavan *et al.*, (2006); Jabeen and Chaudhry (2013) and Nimmy and Pawlin joseph (2018) have also observed the histological changes in the liver of cadmium-treated in *Cirrhinus mrigala*, *Channa striatus* and *Oreochromis mossambicus*. They observed that the lost their polygonal shape vacuolation of cytoplasm, congestion of blood vessel, leucocytic infiltration and necrosis. The results of the present observations in Channa striatus exposed to cadmium were in agreement with the earlier workers especially in the distortion of hepatic tissue. Degradation of cellular hepatocytes, vacuolation, necrosis and shrinkage of nuclei were also observed in the present study in cadmium-treated *Channa striatus*. Similar changes are observed by (Pawlin and Nithya, 2016) in cadmium-treated *L. rohita.* The development of necrosis, congestion of hepatic blood vessels and vacuolization in cadmium-treated *C. Striatus* were mainly due to the large-scale accumulation of these heavy metal cadmium in the liver. The liver is the active organ for detoxification of undesirable and toxic substances. In this study, the liver is the dominant organ for the assessment of

metal accumulation in *Channa striatus*. The present study revealed that *Channa striatus* treated with heavy metals clearly histopathological alterations in the liver.

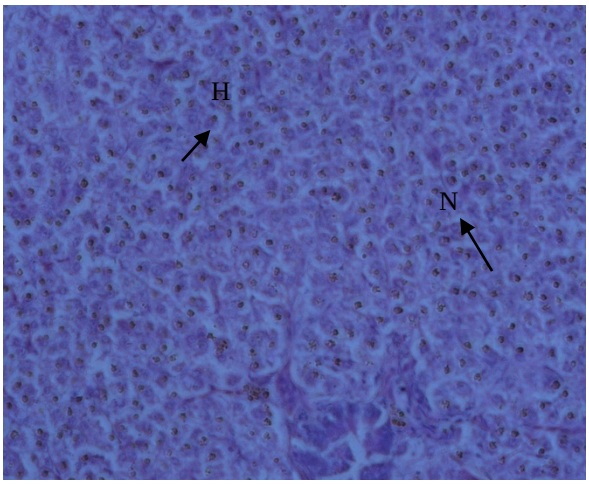
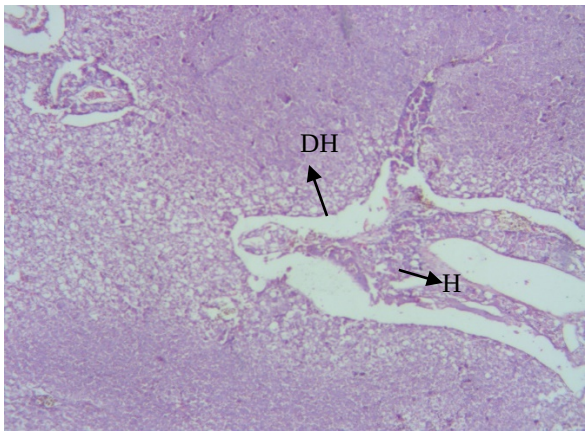


Fig 1: Photomicrograph of liver control. H– Hepatocytes, N- Nucleus (5µm thick; H&E staining; 40X).



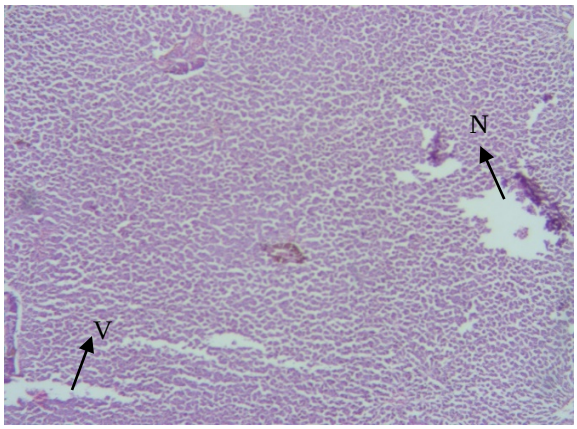


Fig 2&3: Photomicrograph of liver of fish exposed to Cadmium. Degradation of cellular hepatocytes- DH, vacuolation of cells - V, hypertrophy -H, Necrosis- N (5µm thick; H&E staining; 10X.

IV. CONCLUSION

Heavy metal toxicant leads to many pathological chages in different tissues of fish exposed to cadmium chloride. The increasing amounts of heavy metal cadmium chloride incoming to aquatic bodies can result in the amount of accumulation of contaminants increased in the fish and their consumers, which create a serious hazard to ecosystems and human health. In the last decades, the fast growth of industry and agriculture has resulted in increased heavy metals pollution, which is a significant environmental hazard for invertebrates, fish, and humans.

ACKNOWLEDGMENT

I am grateful to RGNF for the economic support in the form of JRF. The facilities provided by Research Department of Zoology, Fatima Mata National College, Kollam are greatly acknowledged.

REFERENCES

[1] Adams, W.J., Rowland, C.D. (2003). Aquatic toxicology test methods. In: Hoffman DJ, Rattner BA, Burton GA Jr., Cairns J Jr., editors. *Handbook of Ecotoxicology*. 2nd edition. Boca Raton, FLa, USA: Lewis Publisher, CRC Press.

[2] Athikesavan, S., Vincent, S., Ambrose, T. and Velmurugan, B. (2006). Nickel induced histopathological changes in the different tissues of freshwater fish,

Hypophthalamichthysmolitrix (Valenciene). *J. Environ. Biol.*, 27: 391-395.

[3] Bais, U. E. and Lokhande, M. V. (2012). Effect of cadmium chloride on histopathological changes in the freshwater fish *Ophiocephalus striatus*. *International journal of zoological research*, 8(1):23-32.

[4] Bloch, M. E. (1793). "Naturgeschichte der auslandischen fische. 7", Berlin, Germany, Morino and Co. 7,1-xiv+1-44, pls.325-360.

[5] Deore, S. V. and Wagh, S.B. (2012) Heavy metal induced histopathological alterations in liver of *Channa gachua* (Ham). *Journal of Experimental Sciences* 3(3):35-38.

[6] Farhat Jabeen and Abdul Shakoor Chaudhry. (2013). Metal Uptake and Histological Changes in Gills and Liver of Oreochromis Mossambicus Inhabiting Indus River Pakistan. *Journal of Zoology*, 45(1): 9-18.

[7] Finney, D.J. (1971). Probit Analysis, University Press, Cambridge, p:333.

[8] Ikram, S. and Malik, M. A. (2009) Histo-pathological profile of organs of immune system (kidney, liver and spleen) on acute cadmium intoxication in *Labeo rohita*. *Biologia* (Pakistan). 2009; 55(1, 2):51-58.

[9] Jayakumar, N. and Subburaj, A. (2017). Sub-lethal cadmium toxicity induced histopathological alterations in the gill, liver and kidney of freshwater catfish (*Heteropneustes fossilis*), *Journal of Entomology and Zoology Studies*, 5(5): 1339-1345.

[10] Mat Jais, A. M. (1991). Haruan, *Channa striatus*, Farming in Backyard, Proceedings of the Third Asian Conference of Technology for Rural Development, pp:91, 230 - 232.

[11] Muthukumaravel, K. and Rajaraman, p. (2013). A study on the toxicity of chromium on the histology of gill and liver of fresh water fish Labeo rohita. *International journal of pure and applied zoology*, 1(2):122-126, 2013.

[12] Nimmy, M. V and Pawlin joseph. (2018). Effect of lead nitrate on the histopathology of the gill, liver and kidney of the fresh water fish, C*irrhinus mrigala*. *European Journal of Pharmaceutical and Medical Research*, 5(2), 416-420.

[13] Pawlin Vasanthi Joseph and Nithya, R. (2016). Organotoxicity of cadmium chloride on the fresh water fish *Labeo rohita*. *European Journal of Pharmaceutical and Medical Research, 3(11), 435-43*.

[14] Prabhahar, C. and Saleshrani, K. Tharmaraj, K. and Vellaiyan, M. (2012). Effect of Cadmium Compound on the Histological Changes of Various Vital Organs of the Fresh Water Fish *Cirrhinus mrigala*. *International Journal of Pharmaceutical and Biological Archives*, 3(1):84-88.

[15] Satarug, S. and Moore, M. R. (2012). Emerging roles of cadmium and heme oxygenase in type-2 diabetes and cancer susceptibility. Tohoku Journal of Experimental Medicine, 228(4):267-288.

[16] Shuhaimi-Othman, M.and Nurlailawati, A. R. (2004). Study of metals concentration (Cu, Cd, Zn and Pb) in water, sediment and freshwater shrimp Macrobrachium sp. in Langat River, Selangor. *Malaysian Journal of Analytical Sciences*, 8: 117–122.

AUTHORS

First Author- Suja.S, MSc; BEd; MPhil, Research scholar, Department of Zoology, Fatima Mata National College, Kollam.

Email: sujasschnr@gmail.com

Second Author- Dr. Sherly Williams E, Associate Professor, Department of Zoology, Fatima Mata National College, Kollam.

Correspondence Author- Suja.S, Email: sujasschnr@gmail.com