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Histopathological Impact of Dimethoate on the Kidney of Freshwater Fish, *Garra mullya* (Sykes)

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ABSTRACT- The present investigation was carried out to the effect of dimethoate on histopathological changes in kidney of freshwater fish, *Garra mullya*. Fishes was exposed to sub lethal concentration of dimethoate (0.0238ppm of 96hrs.) for 7, 14, 21 days. Fishes exposed to dimethoate were characterized by loosening of haemopoietic tissue, uriniferous tubules have lost their original appearance, vacuolated cytoplasm, degeneration in the epithelial cells of renal tubule, narrowing of the tubular lumen and damaged glomeruli. The lesions in the vital organ might have resulted in physiological and metabolical dysregulations. In chronic treatment of dimethoate exposure may pose serious threat to fish health and affect their population.

Key-Words- Dimethoate, Histopathology, Kidney, *Garra mullya*

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INTRODUCTION

The availability of adequate water supply in terms of both quantity and quality is essential for human existence. However, our exploitation of water resources to fulfill the growing need of man has exerted tremendous pressure, thereby deteriorating its quality substantially. Hence, conservation of water has become of utmost importance. The water pollution is thus no longer considered to be an aesthetic problem, but a serious economic and public health problem as well. Unfortunately, raw or inadequately treated sewage of millions of people still flow into our lakes and rivers, creating several kinds of disorders. The release of discharge of large number of pollutants, especially heavy metals and pesticides, pose a threat to human life (Saikia, 1988). Pollution of aquatic environment by heavy metals is an extremely important and serious problem and has attracted the attention of the scientists all over the world.

Pesticides are occasionally used indiscriminately in large amounts causing environmental pollution and potential health hazards.

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Dimethoate is systemic insecticides produced by reacting salts of Dimethyldithio-phosphoric acid with N-methylchloroaecetamide, in aqueous medium in the presence of some organic solvents is widely used against a broad range of insects and mites and is also used for indoor control of houseflies. The extensive use of DM poses a health hazard to animals and humans because of its persistence in soil and crops (WHO/IPCS, 1996). One of the major agricultural chemical groups is pesticide which play important role in increasing agricultural productivity through controlling pest. But on the other hand, they cause much damage to the non-target organisms both in terrestrial and aquatic environment. Fishes are accumulating pollutants directly from contaminated water and indirectly via food chain (Sasaki, et al., 1997). The runoff from treated areas enters the river and aquaculture ponds that are supplied by rivers and adversely affect the quality of water surfaces and creates hazards for aquatic life resulting in serious damage to non-target species, including fishes (Bondarenko, et al., 2004).

Histopathology deals with the study of pathological changes induced in the microscopically structure of body tissue. Any alteration in normal structure of tissue indicates presence of disease or the effect of toxic substances like heavy metal and pesticides. Sprague, (1973) described histopathology as important tool for evaluating the action of any toxicant at tissue level. Histopathology provides data concerning tissue damage. Histopathological alterations can be used as indicators for the effect of various anthropogenic pollutants on organisms and are a reflection of overall health of the entire population in the ecosystem. These

histopathological biomarkers are closely related to the other biomarkers of stress since many pollutants have to undergo metabolic activation in order to be able to provoke cellular change in the affected organism (Muhammad Ismail, et al., 2009). The present study was under taken to analyze the impact of chronic concentration of dimethoate in liver of fish, *G. mullya*.

MATERIALS AND METHODS

Healthy adult fish, *G. mullya* were collected from local river Shivan Dist. Nandurbar, India in the month of December, 2015. Fishes were washed with 0.1% of potassium per magnate ($KMnO_4$) solution to avoid dermal infection. They were then rinsed in water and acclimatized to the laboratory conditions in the department of Zoology for two weeks in 500 *l.* capacity glass aquaria. Dead fish were removed immediately that such mortality may deplete dissolved oxygen with resultant effect on other fishes. During acclimatization fishes were fed with pieces of live earthworm on alternate days. Water also changed once in every day. The experiment was conducted natural and photoperiod of temperature $25{\cdot}1\pm3{\cdot}2^0$C. Water quality was measure as per by APHA (2005), Conductivity- 0.64±0.3, Dissolved O_2^- 6.3±1.1 (ml/L), pH- 8.60±0.3, Acidity- 2.5±0.1, Alkalinity- 44.1±0.5, Total hardness- 67.5±0.3. LC50 of dimethoate for 96 hours was determined by probit analysis method (Finney, 1971). The animals were dissected and kidney tissues carefully removed. Tissues were immediately washed in 1% saline solution to remove the adhering mucus and blood and soaked between the blotting papers. The tissue from the control and exposed batches were taken out and preserved in aqueous Bouin's fluid for 24-48 hrs. This was followed by successive dehydration in ascending grades of alcohol. Tissues were cleared in xylene and embedded in paraffin wax (at 58˚–60˚ C.). The tissue was then processed routinely and prepared into paraffin block cut at 6µm thickness using microtome and stained with Haematoxyline and Eosin by Luna (1968). Standard histopathological procedures were followed for histopathological investigations, Roberts, (1989). Observations were taken under light microscope.

RESULTS AND DISCUSSION

Histopathological changes have been widely used as biomarkers in the evaluation of the health of fish exposed to contaminants, both in the laboratory (Thophon, et al., 2003) and field studies (The, et al., 1997).

Histological studies revealed that the kidney sections from control fishes showed normal histoarchitecture, kidney is characterized by well built haemopoietic tissue, uriniferous tubules and glomerulus with clear Bowman's capsule (Fig. 1). Kidney of fishes exposed to 0.0238 ppm dimethoate for 7,14 and 21 days resulted in the Loosening of haemopoietic tissue, uriniferous tubules have lost their original appearance, vacuolated cytoplasm. The cells constituting the wall of uriniferous tubules have become completely destroyed. The lumen of uriniferous tubules has become greatly shrunken and deshaped. Expansion of space has taken place inside the renal corpuscle (Fig. 2 & 3). Kidney of fishes exposed to 0.0238 ppm dimethoate for 21 days resulted in loss of compactness of haemopoietic tissue as its cells got scattered, uriniferous tubules and glomeruli got deshaped and degenerated (Fig. 4).

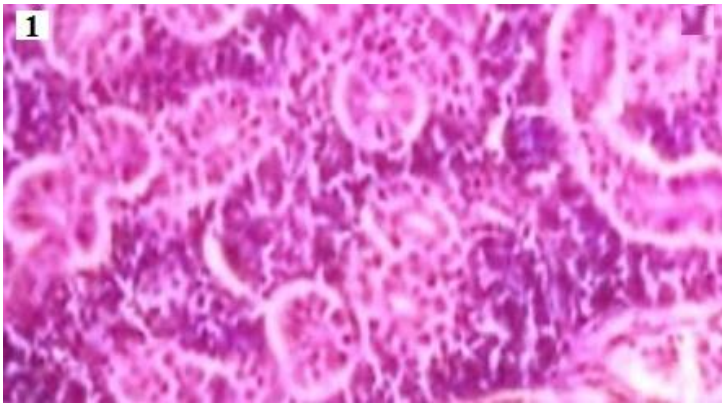

Fig. 1: Normal structure of Kidney showing well marked glomeruli and haemopoetic cells and renal tubules (H&E, 450X)

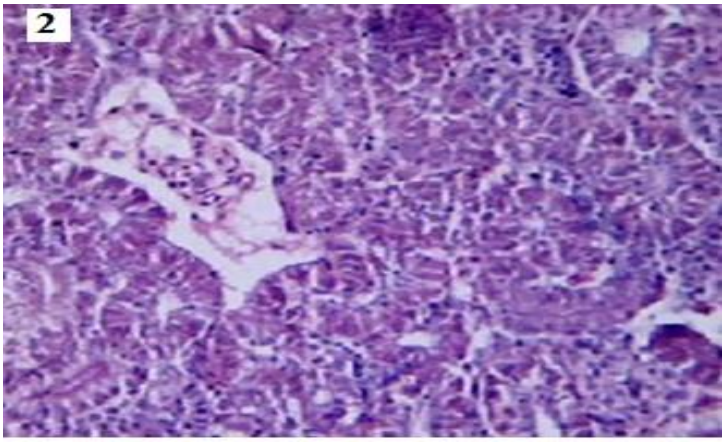

Fig. 2: On Dimethoate treatment after 7 days structure of Kidney shows enlargement in haemopoetic tissue, vacuolation are observed (H&E, 450X)

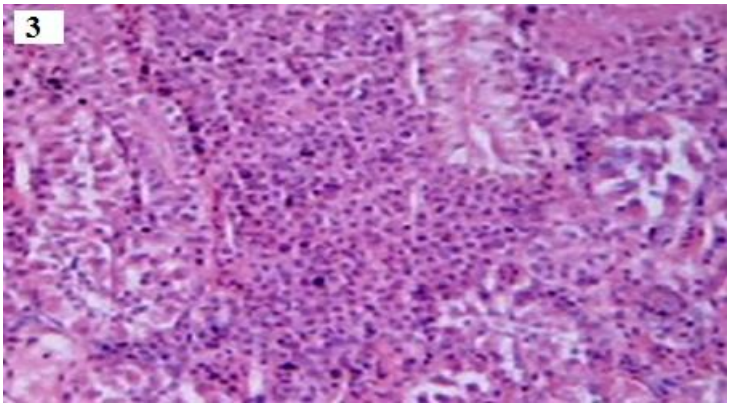

Fig. 3: On Dimethoate treatment after 14 days of Kidney shows cellular atrophy and shrinkage in lumen of renal tubule (H&E, 450X)

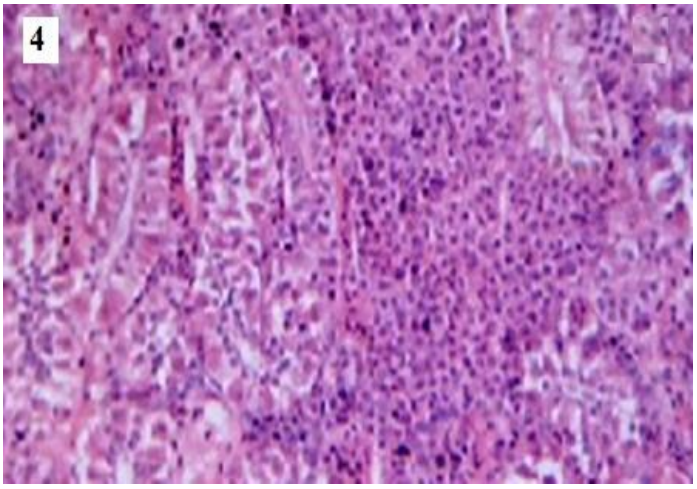

Fig.4 On Dimethoate treatment after 21 days of Kidney shows cellular atrophy and shrinkage in lumen of renal tubule (H&E, 450X)

Fig. 1: Kidney structure of control fish showing well built haemopoietic tissue, uriniferous tubules and glomerulus with clear Bowman's H & E, X 450.

Fig. 2: Kidney of *G. mullya* exposed to dimethoate (0.0238 ppm) for 7 days showing damaged haemopoitic tissue, uriniferous tubules, vacuolation and glomeruli H&E, X 450.

Fig. 3: After 14 days Kidney showing loosening of haemopoietic tissue, clustering of cells, damaged uriniferous tubules, vacuolation, narrowing of tubular lumen and expansion of Bowman's space H&E, X 450.

Fig. 4: After 21 days Kidney showing showing severely damaged haemopoietic tissue, and uriniferous tubules H&E, X 450.

Similar results have been reported by Cengiz, (2006) in *Cyprinus carpio* after acute exposure to deltamethrin. Bilal Ahmad (2011) reported the lesions in these vital organs might have resulted in physiologic and metabolic deregulations, which further led to behavioral alterations and growth impairment.

CONCLUSIONS

The lesions in the vital organ might have resulted in physiologic and metabolic dysregulations, which further led to behavioral alterations and growth impairment. In the long run, therefore, dimethoate exposures to even sub lethal concentrations may pose serious threat to fish health and affect their population. Dimethoate used to protect many fruits, vegetables and field crops against disease, hence farmer come direct contact it and may affect their health.

REFERENCES

[1] APHA AWWA and WPCF (2005) Standard methods for the examination of water and wastewater. 21st Edn.Washington DC USA.

[2] Bilal Ahmad, Qureshi.T.A., Susan Manohar, Pinky Kaur, Rumysa Khaliq (2011) Effect of Cadmium Chloride on the Histoarchitecture of Liver and Kidney of a freshwater Catfish, *Clarias Batrachus. International J. of Environ. Sci.* 2(2),531-537.

[3] Bondarenko, S., Gan, J., Haver D.L. and Kabashima, J.N. (2004) Persistence of selected organophosphate and carbamate insecticides in waters from a coastal watershed, *Environmen. Toxicol. and chemistry*, 23(11); 2649-2654.

[4] Cengiz Elif. (2006) Gill and kidney histopathology in the freshwater fish, *Cyprinus carpio* after acute exposure to deltamethrin. *Environmental Toxicology and Pharmacology*, 22 (2); 200-204.

[5] Finney, D.J., (1971) 'Probit analysis' Third edition, Cambridge University, Press.

[6] Luna L.C (1968), manual of histologic staining methods. Armed Forces Institute of Pathology, 3 rd Ed. *McGraw Hill Book Company*, New York.

[7] Muhammad Ismail, Rahat Ali., Tayyaba Ali, Usman Waheed, and Khan, Q.M. (2009) Evaluation of acute toxicity of profenofos and its effect on behavior pattern of fingling common carp (*Cyprinus carpio. L.*) *Bull. Environ. Contam. Toxicol.*, 82; 569-573.

[8] Reuber, M. D. (1984) Dimethoate, *Environment Res*.34:193.

[9] Robert, R.J. (1989) Fish pathology (2'nd edition), London, Billier, Tindall. 11, 453.

[10] Saika, D. K., Mathur, R. P. and Srivastava, S. K (1988), heavy metal in water and sediments of upper Ganga. *Indian Journal of Environmental Helath*, 31(1); 1117.

[11] Sasaki, Y., Izumiyama, F., Nishidate, E., Ishibashi, S., Tsuda, S., Matsusaka, N., Asano, N., Saotome, K., Sofuni, T. and Hayashi, M. (1997) Detection of genotoxicity of polluted sea water using shellfish and the alkaline single-cell gel electrophoresis (SCE) assay: A preliminary study.*Mutation. Res*. 393; 133-139.

[12] Sprague, J.B., (1973) The ABC's of pollutant bioassay using fish. In biological methods for the assessment of water quality, *Am. Soc. Test. Mater. Tech. Publ.*, 528, 6-36.

[13] Teh, S. J., Adams, S.M. and Hinton, D.E. (1997) Histopathological biomarkers in feral fresh water fish populations exposed to different types of contaminant stress. *Aquatic Toxicol.*, 37:51-70.

[14] Thophon, S., Kruatrachue, M., Upathan, E.S., Pokethitiyook, P., Sahaphong, S. and Jarikhuan S. (2003) Histopathological alteraions of white sea bass, *Lates calcarifer* in acute and subchronic, *Environ. Poll.*, 121: 307-320.

[15] WHO/IPCS (1996) Principles and methods for assessing direct immune toxicity associated with exposure to chemicals. *Environ. Health Criteria* 180: 110-112.

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