ORIGINAL RESEARCH PAPER

Zoology

HISTOPATHOLOGY OF GILL OF FRESHWATER FISH HETEROPNEUSTES FOSSILLIS AFTER THE EXPOSURE OF MALATHION

KEY WORDS: Gill, histopathology, *Heteropnuestes fossilis* , malathion

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ABSTRACT

In the present study, concentrations for malathion (25 mg/L,50mg/L and 75 mg/L) were used for determining changes in gill morphology in freshwater Fish Heteropneustes Fossillis. Gill showed various histopathological changes including epithelial lifting, hypertrophy, lamellar blood sinus dilation and epithelial rupture after 15 days of toxicant exposure. Higher dose of exposure had more severe effects.

INTRODUCTION

Malathion (O-dimethyl-S1-2-di (ethoxycarbonyl) - ethylphosphorodithioate) is an organophosphorous insecticide widely used in agriculture and houses for the control of diseases vectors. It is a major source of environment poisoning in the developing countries [13].The main sub-cellular target of the organophosphorous insecticides and the source generating free radicals, are the mitochondria [10,2]. Reactive oxygen species damage cellular targets and structural changes appear. Toxicological tests have shown that malathion affected the central nervous system, immune system, adrenal glands, liver and blood. Histological methods represent a practical tool to evaluate the effects of toxicants on living organisms[1]. It has also been extensively used in the evaluation of cadmium toxicity to fish exposed population . The analysis of histological changes in gills following malathion intoxication was the aim of this study, taking into account that these organs are involved in detoxification processes.

MATERIAL AND METHODS

Maintenance of fishes: Air-breathing fish H. fossiles were kept in glass aquarium containing Malathion at room temperature (28-30°C). The control groups were maintained in identical condition without Malathion. During the experimental period (after 15 days) the fishes were fed ad libitum with a complete test diet [3]. For each bioassay test, a series of three test concentrations (25 mg/l, 50mg/l and 75mg/l) of Malathion and a control were used.

The tissue samples were taken from the fishes exposed to the first three concentrations (25 mg/l, 50mg/l and 75mg/l). At the end of the experiment (15 days), live fish samples were collected from the above-mentioned three concentrations, sacrificed and their gill were excised out and fixed in Bouins fixative (for 24 hrs.) and prepared for histological analysis according to standard procedures dehydrated in successive grades of ethanol series and embedded in paraffin. Serial longitudinal sections (thickness 4–5 µm) were stained with haematoxylin and eosin (H/E) for histological examination under a light microscope Also, light photomicrographs were taken. The morphological changes of the gill sections noted in the experimental fish were compared with those of control group fish.

RESULTS

Control Group

In the Heteropneustes fossilis, the gill rays are completely cartilaginous and hyaline in nature. The successive gill rays are connected with one another by means of ligaments. In gill filaments, blood is circulated by means of primary and secondary afferent and efferent vessels. For intrafilmentar circulation,two major circulatory networks,respiratory and non-respiratory filaments are present. The secondary gill lamellae are present and consists of a mid vascular layer formed of pillar and pilaster cells covered by epithelial layer. The pillar cells form the channels of seconsdary gill lamellae. Within the pillar cells, many fine filaments are present which perform contractile function and so a regular blood flow is maintained within the secondary lamellae. The pillar cells remain completely fused with the cells of the upper and lower epithelial layers of the secondary gill lamellae (Fig.1).

Experimental group

Histopathological changes produced by Malathion (25mg/L,50 mg/L and 75 mg/L) in Heteropneustes fossilis

After sub lethal exposure to Malathion (25mg/L) severe changes were noticed in the primary gill lamellae. Epithelial covering showed ruptures, edema and slight vacuolations (Fig.2). Fusion of secondary gill lamellae and swelling of pillar cells were also noticed after exposure of Malathion (25mg/L) for 15 days. After exposure to sublethal Malathion (50mg/L) several changes were noticed. Epithelial cells of different regions of the gill were disintegrated. Vacuolation and fusion of gill lamellae were noticed after exposure of Malathion for 15 days (Fig.3). Several changes were noticed after the exposure of Malathion (75mg/L).Epithelial membrane showed ruptures, edema and vacuolation. Pillar cells shoed swelling and secondary gill lamellae showed fusion, afferent blood vessels in the gill septa became narrow and constricted after the exposure of 15 days (Fig.4).

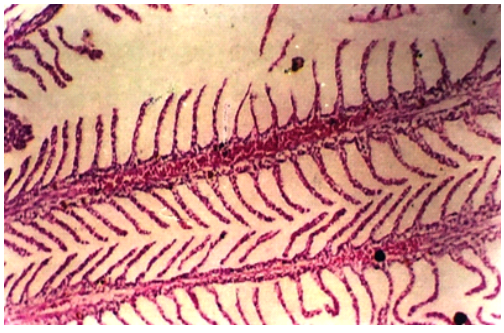

Fig. 1- Normal structure of gill of Heterpnuestes fossillis showing secondary lamellae and erythrocyte.

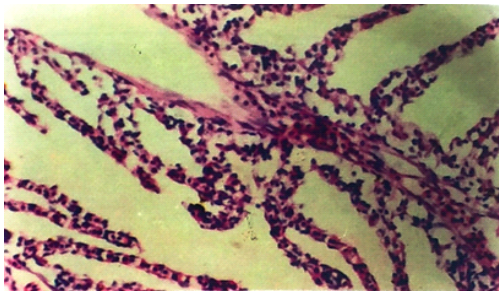

Fig.2-Gill of Heterpnuestes fossillis showing fusion secondary lamellae, swollen chloride cells and slight

vacuolation after exposure of Malathion 25 mg/L for 15 days.

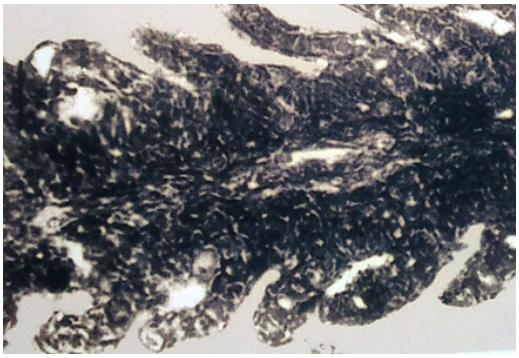

Fig.3-Gill of Heterpnuestes fossillis showing fusion of secondary lamellae, and vacuolation after exposure of Malathion 50 mg/L for 15 days.

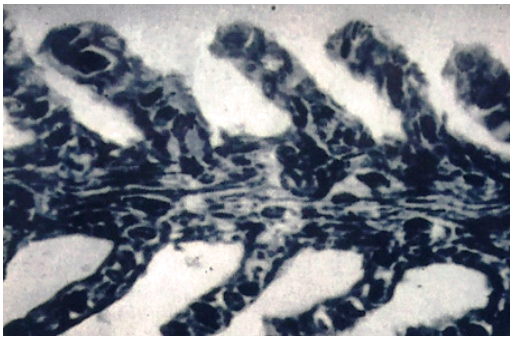

Fig-4 Gill of Heterpnuestes fossillis showing clumping, vacuolation and necrosis after exposure of Malathion 75 mg/L for 15 days.

DISSCUSSION

The teleost gill is covered by a complex epithelium The gill epithelium is the dominant site of gas exchange, ionic regulation, acid-base balance and nitrogenous wastes [4], thereby serving a multitude of vital functions for these aquatic animals. Fish gills are also in direct contact with external medium and are therefore susceptible to toxicant exposure. Such susceptibility may be in the form of alteration in gill morphology [6]. In the present study, histopathology has revealed marked alterations in gill structure of flying barb exposed to Malathion including epithelial lifting, hypertrophy, lamellar blood sinus dilation and epithelial rupture. The lifting of lamellar epithelium of gill in E. danricus, serves as a mechanism of defence, because separation of epithelia from the lamellae increases the distance across which waterborne pollutants must diffuse to reach the bloodstream [5,9]. Cell proliferation with thickening of gill filament epithelium is another histological change seen in the present study. Such type of thickening of gill filament epithelium was reported by several authors [7,11-12]. The higher dose of Malathion (75 mg/L) in the present study caused rupture of epithelium, which probably reflects respiratory dysfunction in Malathion exposed fish. Thus, it is clear from this study that Malathion injures gills even at one-hundredth of lethal concentration probably disrupting the osmoregulatory, acid base or hemodynamic function of the fish [8]. It is proposed that fish gill presents a model system which may be used to investigate general epithelial pathologies produced by toxicants.

REFERENCES

1. Cengiz E.I., Unlu, E., (2006)-Sublethal effects of commercial deltamethrin on the structure of the gill, liver and gut tissues of mosquitofish, Gambusia affinis: a microscopic study, Environ. Toxicol. Phar. 21: 246-253.
2. Delgado, E.H.B., Streck, E.L., Quevedo, J.L., Dal-Pizzol F., (2006)- Mitochondrial Respiratory dysfunction and oxidative stress after chronic Malathion exposure, Neurochem. Res. 31:1021-1025. 453
3. Halver J. E. and Coates J. A. A Vitamin Test Diet for Long-Term Feeding Studies. The Progressive Fish Culturist Banner, 1957; 19 (3)
4. Hoar, W.S. and D.J. Randall, 1984. Fish physiology. (Oncorhynchus mykiss). Aquat. Toxicol.,Vol. X A, Orlando: Academic Press, pp: 73-183.
5. Pane, E.F., A. Haque and C.M. Wood, 2004. Mechanistic analysis of acute, Ni-induced respiratory toxicity in the rainbow trout (Oncorhynchus mykiss): an exclusively branchial phenomenon. Aquat.. Toxicol., 69(1): 11-24..
6. Perry, S.F. and P. Laurent, 1993. Environmental effects on fish gill structure and function. Ecophysiology, Eds., Rankin, J.C. and F.B. Jensen. London: Chapman and Hall, pp: 231-264.
7. Rosety-Rodríguez, M., F.J. Ordońez, J.M. Rosety, I. Rosety, A. Ribelles and C. Carrasco, 2002. Morpho- histochemical changes in the gills of turbot, Scophthalmus maximus L., induced by sodium dodecyl sulfate. Ecotoxicol. Environ. Safety, 51(3): 223-228.
8. Saravana, B.P. and P. Geraldine, 2000. Histopathology of the hepatopancreas and gills of the prawn Macrobrachium malcolmsonii exposed to endosulfan. Aquat. Toxicol., 50(4): 331-339.
9. Schwaiger, J., H. Ferling, U. Mallow, H. Wintermayr and R.D. Negele, 2004. Toxic effects of the non-steroidal anti-inflammatory drug diclofenac. Part I. Histopathological alterations and bioaccumulation in rainbow trout. Aquat. Toxicol., 68(2): 141-150
10. Tos-Luty S., Obuchowska-Przebi D., Latuszynska J, (2003)-Dermal and oral toxicity of Malathion in rats, Ann. Agric. Environ. Med. 10: 101-106.
11. Van den Heuvel, M.R., M. Power, J. Richards, M. MacKinnon and D.G. Dixon, 2000. Disease and gill lesions in yellow perch (Perca flavescens) exposed to oil sands mining-associated water. Ecotoxicol. Environ. Saf., 46(3): 334-341.
12. Van Heerden, D., A. Vosloo and M. Nikinmaa, 2004. Effects of short-term copper exposure on gill structure, metallothionein and hypoxia-inducible factor-1 (HIF-1) levels in rainbow trout (Oncorhynchus mykiss). Aquat. Toxicol., 69(3): 271-280.
13. WHO (2003)-Lindane in drinking-water. Background document forpreparation of WHO Guidelines for drinking-water quality. Geneva, World Health Organization (WHO/SDE/WSH/03.04.102).