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Effect of Malathion (EC_{50}) on Gill Morphology of Indian Flying Barb, *Esomus danricus* (Hamilton-Buchanan)

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Abstract: In the present study, sublethal concentrations for malathion EC_{50} (1.7 and 0.17 µgL^{-1}) were used for determining changes in gill morphology in Indian flying barb, *Esomus danricus* (Hamilton-Buchanan). Gill showed various histopathological changes including epithelial lifting, hypertrophy, lamellar blood sinus dilation and epithelial rupture after 28 days of toxicant exposure. Higher dose of exposure had more severe effects.

Key words: Flying Barb % Organophosphate % Gills % Chronic Exposure

INTRODUCTION

Malathion (diethyl [dimethoxy phosphino thioyl] butanediotae) is an organophosphate pesticide and one of the five most commonly used pesticides in India, accounting for 65% of all organophosphate pesticides applied in the field [1]. Malathion used in agriculture and finds its way with runoff water and its residue are frequently detected in soil, water, human, animal and plant tissues [2]. Yet, some developing countries in the Asia-Pacific region like India are still using these chemicals for agricultural and public health purposes [3]. The environmental concentration of Malathion in water, adjoining Indian agro ecosystem has been reported to vary from 0.699 to 298µgL^{-1} [4]. Several studies have indicated that organophosphate pollution may occur at higher concentrations in small and shallow ponds [5]. Indian flying barb, *Esomus danricus* (Hamilton-Buchanan) inhabits these shallow water bodies in north-eastern India and is economically important both as ornamental and food fish. Once abundant, their number is drastically declining in this region. One of the major effects of this pesticide on fish is seen in gill [6]. Present study is thus, an attempt to study changes in gill morphology of *E. danricus* under this pesticide stress.

MATERIALS AND METHODS

Fishes of similar length (46.77±4.30 mm) and weight (0.86±0.16 g) were collected from unpolluted, freshwater ponds near Assam University campus, Barak Valley, South Assam, India [7]. They were acclimatized under laboratory conditions seven days prior to experimentation and commercially available fish food was given *ad libitum* twice daily. Temperature, dissolved oxygen, hardness and pH under laboratory condition were 29°C, 5.5 mgL^{-1}, 30 mgL^{-1} and 6.8 respectively. Stock solution of commercial grade Devimalt (Malathion 50% E.C.) manufactured by Devidayal (Sales) limited, India, was prepared using double distilled water. Serial dilutions of stock solutions were prepared using chlorine free tap water. Two sublethal test concentrations viz., 1.79 and 0.179 µgL^{-1} were selected (1/10th and 1/100th of 96 hrs LC_{50} value) for inducing histological changes in fish gill. Ten fish were kept individually in three litres of test solution containing sublethal test concentrations of 1.79 and 0.179 µgL^{-1} for 28 days. Food was given during the study period. Test water was renewed every 24 hrs. After 28 days of exposure, fish were sacrificed and gill were removed immediately and kept in 10% Formalin, as fixative, for 24 h, dehydrated, embedded in paraffin and sections cut at 5 µm thickness and stained with Harris Haematoxylin and Eosin. Changes induced by Malathion treatment in the gill were photographed and analyzed by light microscope at 10X eye piece magnification and 40X objective magnification {Olympus (model U-CMAD3) with Camera attachment of Samsung (model SDC-313B)}.

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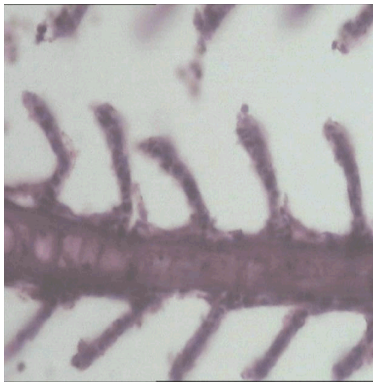
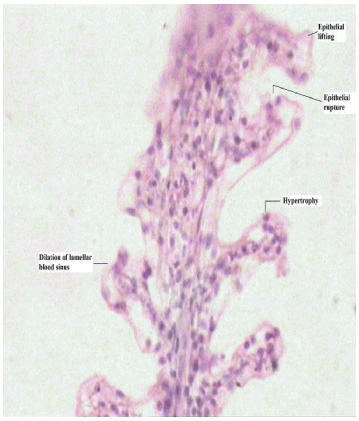


Photograph 1(a): T.S. of gills of Control fish, *Esomus danricus* showing normal gill architecture (X400).



Photograph 1(c): T.S. of gills of fish, *Esomus danricus* exposed to 0.179 µgLG^{1} Malathion for 28 days, showing changes like leucocytes infiltration, hypertrophy and lifting of epithelium (X400).

Photograph 1(b): T.S. of gills of fish, *Esomus danricus* exposed to 1.79 µgLG^{1} Malathion for 28 days, showing epithelial lifting, hypertrophy, dilation of blood sinus and epithelial rupture (X400).

RESULTS

The gill of Indian flying barb is made up of double rows of filaments from which lamellae arise perpendicularly (Photograph 1a). Gills of fish exposed to 1.79 µgLG^{1} malathion after 28 days showed epithelial lifting, hypertrophy, lamellar blood sinus dilation and epithelial rupture (Photograph 1b) while 0.179 µgLG^{1} malathion for the same duration of exposure showed epithelial lifting, hypertrophy and less pronounced leucocytes infiltration in the epithelium (Photograph 1c).

DISCUSSION

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 [8], 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 [9]. 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 [10-11]. Gill pathologies are common symptoms of toxic effects on fishes due to organophosphates [12]. In Florida game fish, bluegill, low levels of Malathion after 24 hours could cause mild degenerative changes in the gills. After 48 hours, damage was more pronounced and after 96 hours there was severe damage resulting in a bulbing [13]. 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 [14-16]. The higher dose of Malathion (1.79 µgLG^{1}) 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 [17]. It is proposed that fish gill presents a model system which may be used to investigate general epithelial pathologies produced by toxicants.

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REFERENCES

1. Indian Chemical Statistics, 2002. Pesticides industry, driven by forcible shifts. Pestic. inform., 28(1): 12-27.
2. Harris, L.M., C.A. Bishop, J. Struger, B. Ripley and J.P. Bogart, 1998. The functional integrity of northern leopard frog (*Rana pipiens*) and Green frog (*Rana clamitans*) populations in orchard wetlands. II. Effects of pesticides and eutrophic conditions on early life stage development. Environ. Toxicol. Chem., 17(7): 1351-1363.
3. Dave, P.P., 1996. India: A generic giant. Farm Chem. Int., 10: 36-37.
4. Rao, A.S. and R.R. Pillala, 2001. The concentration of pesticides in sediments from Kolleru Lake in India. Pest. Manag. Sci., 57(7): 620-624.
5. Berril, M., S. Bertram, L. McGillivary, M. Kolohon and B.B. Pauli, 1994. Effects of low concentrations of forest-use pesticides on frog embryos and tadpoles. Environ. Toxicol. Chem., 13(4): 657-664.
6. Au, D.W.T., 2004. The application of histo-cytopathological biomarkers in marine pollution monitoring: a review. Mar. Poll. Bull., 48(9-10): 817-834.
7. Das, S. and A. Gupta, 2009. Biometrics and growth features of *Esomus danricus* (Hamilton-Buchanan), from Barak Valley, south Assam. J. Inland Fish. Soc. India, 41(1): 81-83.
8. Hoar, W.S. and D.J. Randall, 1984. Fish physiology. Vol. X A, Orlando: Academic Press, pp: 73-183.
9. Perry, S.F. and P. Laurent, 1993. Environmental effects on fish gill structure and function. In: Fish Ecophysiology, Eds., Rankin, J.C. and F.B. Jensen. London: Chapman and Hall, pp: 231-264.
10. 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.
11. 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.
12. Meyers, T.R. and J.D. Hendricks, 1985. Histopathology. In: Fundamentals of aquatic Toxicology: Methods and applications, Ed., Rand, G.M. and S.R. Petrocelli. Washington DC: Hemisphere Publishing Corp., pp: 283-331.
13. Richmonds, C.R. and H.M. Dutta, 1989. Histopathological changes induced by Malathion in the gills of Bluegill, *Leptomis macrochirus*. Bull. Environ. Contam. Toxicol., 43(1): 123-130.
14. 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.
15. Rosety-Rodríguez, M., F.J. Ordoñez, 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.
16. 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.
17. 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.