

A Review on Malathion Induced Toxicity in Freshwater Fishes

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ABSTRACT

Malathion is a widely used organophosphate pesticide, with a significant impact on aquatic ecosystems. Various researchers have studied the toxic effects of Malathion on fish, summarizing the histological, biochemical and haematological changes caused by sublethal exposure. This communication focuses on the review of the sub-lethal effects of Malathion in some freshwater fishes.

Figure : 00

References : 20

Table : 01

KEY WORDS : Acute toxicity, Biochemical parameters, Haematology, Histology, Malathion, Organophosphate pesticide, Sub-lethal effect.

Introduction

The environment is constantly being polluted by toxic substances from agricultural, industrial and domestic activities. In India, pesticides are a major source of toxic substances used to control pests. Malathion is an organophosphate insecticide that is commonly used in agriculture and household settings. Toxicological tests have shown that Malathion can negatively impact the reproductive system, defence system, nervous system, endocrine system, other systems as well as other organs such as the liver and kidneys of animals. The results of sub-lethal toxicity are mainly reported in terms of the median lethal concentration LC₅₀. Histopathological assessment has become an increasingly important tool for determination of the impact of toxicants on aquatic animals. The gills of fish are the main site of contamination with toxic substances, which can significantly damage their health¹⁴. Liver, Kidneys, other organs, tissues and blood of organisms are very sensitive to toxicological impacts. These hematological, histopathological and biochemical parameters are used to evaluate the physiological status

of fish.

LC₅₀ values of Malathion in different fish species

Several authors^{1,2,4,11-14,17,19} evaluated the toxicity of Malathion in various commercial and ecologically important fish species. 96 hours LC₅₀ values of Malathion in different fish species have been reported viz. *Channa punctatus*, *Clarias batrachus*, *Clarias gariepinus*, *Esomus danricus*, *Gambusia affinis*, *Heteropneustes fossilis*, *Labeo rohita*, *Ophiocephalus punctatus* and *Oreochromis mossambicus* (Table-1)

Researchers¹⁴ conducted an experiment to observe the effects of different concentrations of Malathion, like 0.62, 1.25, 2.5, 5.0, and 10.0 ppm, over a period of 96 hours on fishes. The results of the experiment indicated that the rate of mortality of the fishes varied from 0 to 100%, depending on the dosage and time of exposure. Various scientists have reported that Malathion harms different fish species, even at low concentrations. LC₅₀ values were estimated accordingly in different fish species.

TABLE-1 : LC₅₀ Values of Malathion reported in various fish species

S. No.	Fish Species	Time	LC ₅₀ values
1.	<i>Channa punctatus</i>	96h	6.65 ppm
2.	<i>Clarias batrachus</i>	96h	0.25 ppm
3.	<i>Clarias gariepinus</i>	96h	8.22 ppm
4.	<i>Esomus danricus</i>	96h	17.9 µg/l
5.	<i>Gambusia affinis</i>	96h	0.7 ppm
6.	<i>Heteropneustes fossilis</i>	96h	10.7 ppm
7.	<i>Labeo rohita</i>	96h	5µg/l
8.	<i>Oreochromis mossambicus</i>	96h	0.5925ppm

Effect of Malathion on Haematological Parameters

Malathion has been found to have negative effects on various haematological parameters of fish. It's linked to several haematological abnormalities and changes in blood serum proteins. A study on *Clarias gariepinus* to investigate the effects of sub-lethal exposure of Malathion on blood parameters, reported decreased RBC and WBC counts, Hb concentration and haematocrit value compared to the control group¹. Another study also observed significant haematological changes in *Cirrhinus mrigala* exposed to sub-lethal concentrations of Malathion, including a decrease in RBC counts, haemoglobin content, hematocrit, and WBC count as well as a significant increase in neutrophils count as compared to the control group¹³.

Some workers¹⁹ conducted a study to observe the changes in haematological parameters of fish blood when exposed to sub-lethal concentrations of Malathion (0.25 and 0.31 ppm) for 48, and 96 hours. The study found that the exposure caused a significant reduction in the levels of Hb, RBC and MCV. A study also observed that the exposure of *Clarias gariepinus* to sub-lethal chronic concentrations of Malathion caused alterations in various haematological parameters¹. The fish exposed to different concentrations of Malathion showed a decrease in RBC and WBC counts, haemoglobin concentration, and hematocrit values as compared to the control fish. A slight change in the value of MCV, MCH, and MCHC were also noticed. Research workers¹³

observed that the mortality rate of fish increased significantly with time and concentration of Malathion exposure. The behavioral changes observed in the experimental animal included erratic swimming, loss of balance, hyperactivity, cough, rapid opercular movements, convulsions, gill mucous secretion, gulping of air and surfacing. Exhausted fish later sank to the bottom of the aquaria and died. Fish exposed to 9.32 mg/L of Malathion for 96 hours showed significantly lower values for erythrocyte count, WBC count and haemoglobin than the control group. The study found that the neutrophils of the exposed fish group increased significantly but no significant difference was observed in the other leucocyte counts of both groups.

Effect of Malathion on Histopathological Parameters

Exposure of Malathion shows extensive damages in the various organs of the affected living beings.

Liver and kidneys are the most affected organs of the experimental fishes. In the study of *Channa punctatus*, hepatic and renal tissues were found with severe abnormalities, whereas the control group showed normal structure³. According to some toxicologists^{2,9,10,12}, in the Malathion induced fish the damages in the liver recorded relatively higher than other organs. Since liver is considered as the chief organ of metabolic activities and the centre for detoxification of toxicants, thus, it has greater chances of damage when exposed to toxicants. After prolonged exposure, the fish

shows greater capacity of absorbing Malathion from blood which causes fibrosis of sinusoids, necrosis of liver cells and congestion of red blood cells into the hepatic blood vessels.

According to some workers^{10,15} organophosphate pesticides induce the synthesis of free radicals that destruct the vital macromolecules of the cells and therefore, the alterations in hepatocytes of organisms are the only reflections of the toxic effect of contaminants. A study⁷ in *Tilapia nilotica* revealed higher toxicity of Malathion in liver tissue than the brain due to significant deposition of Malathion in hepatic tissue. They also reported that liver is more sensitive to Malathion toxicity than brain because it inhibited carboxylesterase in the liver and later causes inhibition of Acetylcholine enzyme. Therefore, histopathological alterations in the liver acts as early signals for determining Malathion induced toxicity in fishes. The intensity of histological damage in Malathion exposed fishes could differ from species to species because physiological activities of each fish species are different from others⁹.

In the study of researchers^{7,14} it has been reported that Malathion induced toxicity causes significant changes in the activity of esterase and composition of some biomolecules in liver and kidney tissues in fishes *Tilapia nilotica* and *Oreochromis mossambicus*. They also concluded that kidneys of the control group showed normal histology of the structure of glomerulus, Bowman's capsule and tubular part of nephrons. After moderate exposure of Malathion, the epithelial layer of the renal tubule detached from the basement membrane and extensive vacuolization appear in the cytoplasm and hypertrophy and renal tubules degeneration were also

observed. After long term exposure it was observed that the epithelial lining of renal tubules deteriorated significantly, the lumen of renal tubules narrowed down, and spaces in Bowman's capsule increased. A study reported that the effect of malathion toxicity is attributed to variations in the activity of competing for hepatic and renal activities and detoxifying enzymes⁵.

Effect of Malathion on Biochemical Parameters

A Study on Malathion induced toxicity reported that the protein content in the muscle of the control fishes showed highest activity *i.e.* $8.5 \pm 0.4\text{mg/g}$ in the control group¹¹ on the first day. On the 7th-day of experiment, the fishes showed $6.25 \pm 0.1\text{mg/g}$ value of muscle protein. Due to Malathion induced toxicity the brain showed many neural bundles and severe damage in the brain cells was also reported.

Conclusion

On the basis of above studies, it has been concluded that the toxicity of Malathion is extremely harmful to different fish species. The impact of Malathion on their bodies is highly negative, leading to chronic effects such as significant changes in their tissues and blood. Even acute and chronic exposure to Malathion results in the alteration of hemato-logical, biochemical and histopathological parameters in exposed fish. Furthermore, Malathion can cause histopathological changes in different tissues, which can lead to severe inflammation in fish tissues after prolonged pesticide exposure. Thus, there is need to investigate protective effect of some natural and synthetic molecules to reduce Malathion induced toxicity.

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