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Original Research Article

Effect of Pesticides (Fenvalerate) on the Liver and Kidney of Freshwater Fish, *Channa punctatus*

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Abstract: Fenvalerate, a synthetic pyrethroid pesticide, is increasingly present in aquatic environments due to agricultural runoff. This study investigates its toxic effects on the liver and kidney of *Channa punctatus*, a common freshwater fish, through histopathological analysis. Fish were exposed to sub-lethal concentrations (LC50 Value 96 hrs. = 3ppb) of Fenvalerate over 24, 48, 72, and 96 hours. Observations revealed time-dependent structural damage in both organs, including vacuolation, necrosis, glomerular shrinkage, and tubular degeneration. The findings highlight the risk posed by Fenvalerate contamination to aquatic life and the need for regulated pesticide use.

Keywords: Fenvalerate, *Channa punctatus*, Liver and Kidney, toxicity, freshwater fish, neurotoxicity, aquatic pollution.

1. INTRODUCTION

The use of pesticides in agriculture has led to their unintended infiltration into aquatic ecosystems, affecting non-target organisms, particularly fish. Synthetic pyrethroids such as Fenvalerate are considered relatively safe for humans but can have profound effects on aquatic fauna (Ramesh and Maheswari, 2004). *Channa punctatus*, a freshwater fish found widely across South Asia, is an important bioindicator due to its environmental adaptability and sensitivity to pollutants. Among internal organs, the liver and kidney are vital for detoxification and excretion, making them primary targets of toxic insults (Chakraburthy and Konar, 1974; Mathur et al., 1981; Vijaya Lakshmi and Tilak, 1996). This study aims to assess histopathological alterations in these organs when exposed to Fenvalerate.

2. MATERIALS AND METHODS

2.1 Collection and Maintenance of Fish

Healthy specimens of *Channa punctatus* (12–15 cm length; 40–60 g) were collected and acclimatized in laboratory conditions for 15 days. Fish were fed with commercial feed, and water parameters were maintained at optimal levels (pH 7.3 ± 0.2, temperature 27 ± 1°C).

2.2 Preparation of Pesticide Solution

Analytical-grade Fenvalerate (98% purity) was used to prepare a stock solution. The 96-hour LC_{50} value 3ppb was preliminarily determined, and fish were exposed to 1/10th of this concentration (sub-lethal dose) for toxicity studies.

2.3 Experimental Design

Fish were divided into five groups (n = 10 each): one control group and four experimental groups exposed to Fenvalerate for 24, 48, 72, and 96 hours respectively.

2.4 Histological Procedures

Post-exposure, liver and kidney tissues were dissected and fixed in Bouin's solution for 24 hours. Standard histological processing was followed: dehydration, paraffin embedding, microtome sectioning (5 µm), and staining with hematoxylin and eosin (H&E). Slides were examined under a light microscope.

3. RESULTS

3.1 Liver Alterations

Control liver sections exhibited normal histoarchitecture: polygonal hepatocytes, central nuclei, and organized sinusoids.

Fenvalerate-exposed fish showed progressive damage:

- **24 hours**: Mild cytoplasmic vacuolation and sinusoid dilation.

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- **48 hours**: Hepatocyte necrosis, increased vacuolation, mild portal inflammation.
- **72 hours**: Severe hepatocyte disintegration, pyknotic nuclei, disrupted hepatic cords.
- **96 hours**: Massive necrosis, hemorrhaging, loss of lobular structure.

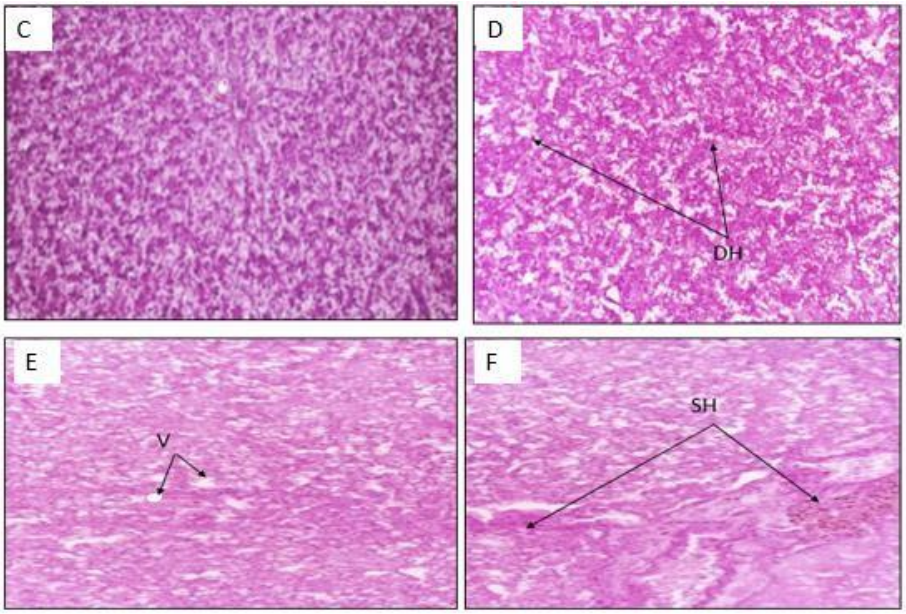

Figure 1: Image (C) depicted histopathology of control Image (D) Depicted of pesticide- treated fish liver, in which degeneration hepatocytes (DH), Image (e) Vacuolar (V), Image (G) swelling in hepatocytes (SH), were inferred

3.2 Kidney Alterations

Kidney tissues from the control group displayed healthy glomeruli, intact renal tubules, and defined interstitial spaces.

Fenvalerate exposure led to the following changes:

- **24 hours**: Swollen tubular epithelium, early glomerular damage.
- **48 hours**: Vacuolation in tubular cells, shrinkage of glomeruli, mild necrosis.
- **72 hours**: Degeneration of nephrons, cell debris in lumens.
- **96 hours**: Complete tubular degeneration, glomerular atrophy, hemorrhage in interstitial tissue.

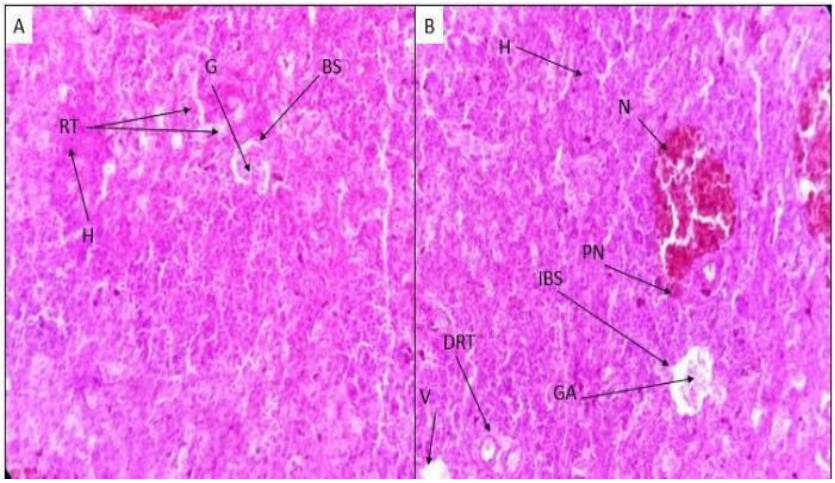

Figure 2: Comparative histological picture of the kidney of both the control group and the punctata group treated with pesticides. Image (A) shows the histology of a healthy fish kidney, with a normal renal tubule (RT), Bowman's space (BS), and glomerulus. The image (B) shows histopathology of pesticide- induced tubule damage (DRT) and glomerular atrophy. Pyknotic nuclei were observed in the kidneys of both controls fish as well as treated fish across all tubules. Renal glomerular atrophy (GA) and necrosis (N) were also observed, indicating degenerative changes in the treated fish. Presence of insecticides on the fish

4. DISCUSSION

The liver and kidney of *Channa punctatus* displayed marked histopathological changes upon exposure to Fenvalerate (Anita Susan and Tilak (2003), Tilak *et al.*, (2001, 2005b). These alterations were both dose- and time-dependent, confirming the compound's cumulative toxic effect. In the liver, vacuolation and necrosis suggest metabolic disturbances and impaired detoxification (Vijaya Lakshmi and Tilak (1996). Disruption of hepatic cords and sinusoid dilation indicate hepatocellular stress and vascular damage. In the kidney, tubular degeneration and glomerular shrinkage point to filtration dysfunction, which compromises osmoregulation and waste elimination (Thurston *et al.*, 1984; Meede and Herman, 1986; Ravindrakumar, 2000; Wannee *et al.*, (2002)). These observations align with earlier studies on pesticide toxicity in freshwater fish. Fenvalerate's lipophilicity may enhance its accumulation in organ tissues, further exacerbating damage over time. The study confirms that even at sub-lethal concentrations, Fenvalerate poses a significant threat to fish health.

5. CONCLUSION

Fenvalerate induces severe histopathological damage in the liver and kidney of *Channa punctatus*, even at sub-lethal concentrations. The observed changes compromise critical physiological functions such as detoxification and excretion. This study underscores the need for better pesticide regulation, sustainable farming practices, and ongoing monitoring of freshwater ecosystems.

REFERENCES

- Tilak, K. S., & Veeraiah, K. (2001). Toxicity and effects of fenvalerate on fish organs. *Environmental Biology*, 22(3), 239–242.
- Velmurugan, B. et al. (2009). Histopathological effects of pesticides in freshwater fish. *Environmental Toxicology*, 24(4), 429–434.
- Mishra, A., & Srivastava, A. K. (2004). Biochemical and histopathological effects of pesticides on *Channa punctatus*. *Ecotox. Environ. Safety*, 59(1), 84–92.
- Cengiz, E. I. (2006). Gill and kidney histopathology in fish exposed to pyrethroids. *Pesticide Biochemistry and Physiology*, 85(2), 125–13
- Ramesh, A. and S.T. Maheswari (2004). Dissipation of alachlor in cotton plant, soil and water and its bioaccumulation in fish. Chemosphere, 54, 647-652
- Chakraburthy, Gouri and S.K. Konar (1974). Chronic effects of sublethal levels of pesticides in fish. Proc. Nat. Acad. Sci. India, 44B, 241-246.
- Mathur, D.S., H.D. Agarwal and P.D. Rana (1981). Histopathological changes in the liver and intestine of Rana cyanophyticlis (Sehne) induced by aldrin. J. Environ. Biol., 2, 105-107.
- Vijaya Lakshmi, S. and K. S. Tilak (1996). Effect of pesticides on the gill morphology of *Labeo rohita*. J. Ecotoxicol. Environ. Monit., 6, 059-064.
- Thurston, R.V., R.C. Russo, R.J. Luedtke, C.E. Smith, E.L. Meyn, C. Chakoumakos, K.C. Wang and C.J.D. Brown (1984). Chronic toxicity of ammonia to rainbow trout. Trans. Am. Fish. Soc., 113, 56-73.
- Meede, J.W. and R.L. Herman (1986). Histopathological changes in cultured lake trout, Salvelinus nameycush, subjected to cumulative loading in a water reuse system. Can. J. Fish. Aquat. Sci., 43, 226-23.
- Ravindrakumar (2000). Chronic ammonia induced histopathological changes in Indian subtropical freshwater murrel, Channa punctatus (Bloch). Pollut. Res., 19, 611-613.
- Wannee, Jiraung Koorskul, E Suchart Upatham, Maleeya Kruatrachue, Somphong Sahaphong, Suksiri Vichasri-Grams and Prayad Pokethitiyook (2002). Histopathological effects of round up, a glyphosate herbicide, on *Nile tilapia Oreochromis niloticus*. Science Asia, 28, 121-127.
- Anita, Susan, T. and K.S. Tilak (2003). Histopathological changes in the vital tissues of the fish *Cirrhinus mrigala* exposed to fenvalerate technical grade. Pollut. Res., 22, 179-184.
- Tilak, K.S., D. Koteswara Rao and K. Veeraiah (2005a). Effects of chloropyrifos on histopathology of the fish *Catla catla*. J. Ecotoxicol. Environ. Monit. 15, 127-140.
- Tilak, K.S., K. Veeraiah and D. Koteswara Rao (2005b). Histopathological changes in the gill, liver, brain and kidney of the Indian major carp *Cirrhinus mrigala* (Hamilton) exposed to chloropyrifos. Pollut. Res., 24, 101-111.

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