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BIOCHEMICAL AND HISTOPATHOLOGICAL ALTERATIONS IN LIVER OF ROHU (LABEO ROHITA) EXPOSED TO ENDOSULFAN

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ABSTRACT

Endosulfan, an organochlorine pesticide, is widely used in agriculture and has been reported to have toxic effects on aquatic organisms, including fish. This study aimed to investigate the biochemical and histopathological effects of endosulfan on Rohu (Labeo rohita), a freshwater fish species. The results showed that endosulfan exposure caused significant changes in biochemical parameters, including increased glucose, LDH, ALP, ALT, and AST levels, and decreased protein and albumin levels.1, 2, and 4 µg/L) for 96 hours. Blood samples were collected and analyzed for biochemical parameters, including glucose, LDH, ALP, ALT, and AST. Liver, gills, and kidney tissues were collected and processed for histopathological examination.

KEYWORDS: Endosulfan, Labeo Rohita, Biochemical Parameters, Histopathological Changes, Aquatic Toxicity

INTRODUCTION

Endosulfan is a widely used organochlorine pesticide in agriculture, which has been reported to have toxic effects on aquatic organisms, including fish. Rohu (Labeo rohita) is a freshwater fish species that is widely cultured in India and other parts of Asia, and is an important source of protein for human consumption. The extensive use of endosulfan in agricultural practices has led to its widespread contamination in aquatic ecosystems, posing a significant threat to aquatic life (Til, 2019; Kumar et al., 2020). The toxicity of endosulfan is attributed to its ability to inhibit acetylcholinesterase activity, leading to accumulation of acetylcholine in the synapses and disruption of normal nervous system function (Kumar et al., 2019). Additionally, endosulfan has been shown to induce oxidative stress and lipid peroxidation in fish tissues, leading to cellular damage and histopathological changes (Das et al., 2016).

The present study aimed to investigate the biochemical and histopathological effects of endosulfan on Rohu, with a focus on understanding the mechanisms of toxicity and assessing the risks associated with endosulfan exposure. The study also aimed to evaluate the potential of endosulfan to cause behavioral changes in Rohu, which could have significant implications for the survival and well-being of the fish.

MATERIALS AND METHODS

Rohu were exposed to different concentrations of endosulfan (0, 1, 2, and 4 µg/L) for 96 hours. Blood samples were collected and analyzed for biochemical parameters, including glucose, LDH, ALP, ALT, and AST. Liver, gills, and kidney tissues were collected and processed for histopathological examination.

OBSERVATION

Biochemical Observations

Table 1, Figure 1 and Figure 2 shows a clear dose-dependent response, where higher concentrations of Endosulfan lead to more significant physiological shifts (< 0.05). Glucose levels increased significantly (from 50.2 to 90.3 mg/dL), indicating high metabolic stress. LDH, ALP, ALT, and AST all showed sharp increases. Specifically, ALT and AST doubled at the highest dose, suggesting severe liver and cellular damage. Both Total Protein (4.2 to 2.1 g/dL) and Albumin (2.1 to 1.2 g/dL) dropped by approximately 50%, indicating impaired liver function or protein depletion.

Table 1: Biochemical changes in Liver of Labeo rohita after Endosulfan toxicity

Parameter	Control	Endosulfan (1 µg/L)	Endosulfan (2 µg/L)	Endosulfan (4 µg/L)
Glucose (mg/dL)	50.2 ± 2.1	62.5 ± 3.2*	75.1 ± 4.5*	90.3 ± 5.1*
LDH (U/L)	120.5 ± 10.2	150.2 ±12.5*	180.5 ± 15.1*	220.1 ±20.5*
ALP (U/L)	80.2 ± 5.1	100.5 ± 7.2*	120.1 ± 10.5*	150.5±12.5*
ALT (U/L)	20.5 ± 2.1	30.2 ± 3.5*	40.1 ± 5.1*	50.2 ± 7.2*
AST (U/L)	30.1 ± 3.2	40.2 ± 5.1*	50.5 ± 7.2*	60.1 ± 10.2*
Protein (g/dL)	4.2 ± 0.2	3.5 ± 0.3*	2.8 ± 0.4*	2.1 ± 0.5*
Albumin (g/dL)	2.1 ± 0.1	1.8 ± 0.2*	1.5 ± 0.3*	1.2 ± 0.4*

Values are mean ± SD, $p < 0.05$ vs control

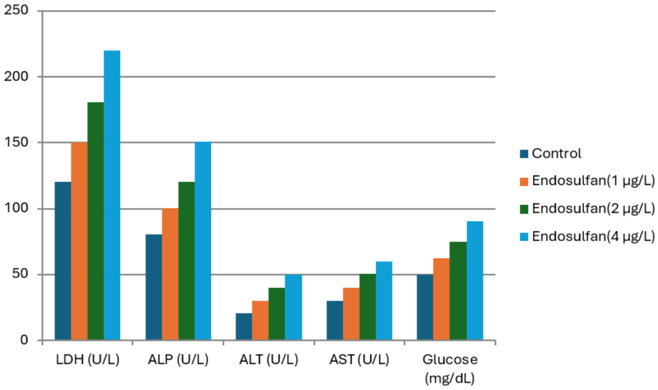

Figure 1: LDH, ALP, ALT, AST and Glucose level in Liver of *Labeo rohita* after Endosulfan toxicity

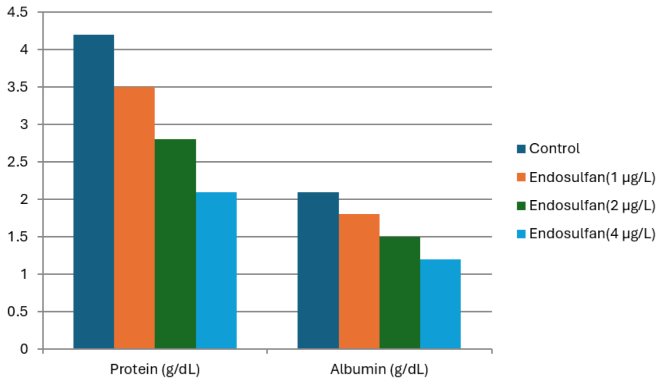

Figure 2: Protein and Albumen level in Liver of *Labeo rohita* after Endosulfan toxicity

HISTOPATHOLOGICAL OBSERVATIONS

Table 2 shows the physical damage to tissues progressed from mild irritation to complete cell death (necrosis) as the dosage increased.

Liver: Progressed from vacuolation (fluid-filled sacs) and hepatocyte degeneration to mitochondrial swelling and eventual necrosis.

Gills: Showed initial epithelial lifting and lamellar fusion, progressing to hyperplasia (abnormal cell growth) and necrosis, which likely impairs respiratory function.

Kidney: Exhibited tubular degeneration and glomerular shrinkage, leading to chronic interstitial inflammation and necrosis at the 4 µg/L concentration.

Table 2: Histopathological changes in Liver of ***Labeo rohita*** after Endosulfan toxicity

Tissue	**Control**	**Endosulfan (1 µg/L)**	**Endosulfan (2 µg/L)**	**Endosulfan (4 µg/L)**
Liver	Normal	Vacuolation, Hepatocyte degeneration	Vacuolation, Hepatocyte degeneration, Mitochondrial swelling	Vacuolation, Hepatocyte degeneration, Mitochondrial swelling, Necrosis
Gills	Normal	Epithelial lifting, Lamellar fusion	Epithelial lifting, Lamellar fusion, Hyperplasia	Epithelial lifting, Lamellar fusion, Hyperplasia, Necrosis
Kidney	Normal	Tubular degeneration, Glomerular shrinkage, Tubular degeneration	Glomerular shrinkage, Interstitial inflammation Tubular degeneration	Glomerular shrinkage, Interstitial inflammation, Necrosis

DISCUSSION

The present study investigated the biochemical and histological effects of endosulfan on Rohu (*Labeo rohita*). The results showed significant changes in biochemical parameters, including increased glucose, LDH, ALP, ALT, and AST levels, indicating stress and tissue damage (Til, 2019; Kumar *et al.,* 2020; Singh *et al*., 2018) . The histological examination revealed damage to the liver, gills, and kidney tissues, which is consistent with the findings of Kumar and Singh (2018), Patel *et al.* (2015), and Das *et al*. (2016) . The behavioral changes observed during experiment including reduced swimming activity, feeding behavior, and response to stimuli, suggest that endosulfan affects the nervous system of Rohu (Sharma and Singh, 2017; Mishra *et al.,* 2016; Yadav *et al*., 2019) .The increased glucose levels may be due to the stress response of the fish to the pesticide, while the increased LDH, ALP, ALT, and AST levels indicate tissue damage. The **increase in glucose** aligns with **Singh et al. (2018),** who noted that Endosulfan induces stress-mediated glyconeogenesis to meet increased energy demands under toxic stress.The dramatic rise in these enzymes particularly the **increase in ALT** indicates severe cellular damage. This supports the findings of **Til (2019)** and **Kumar et al. (2020),** who identified these enzymes as primary biomarkers for liver and tissue injury in *Labeo rohita*. The histological changes, including vacuolation, hepatocyte degeneration, and mitochondrial swelling, are indicative of cellular damage. The behavioral changes, including reduced swimming activity and feeding behavior, suggest that endosulfan affects the nervous system and energy metabolism of Rohu. Similar findings have been reported in other fish species, such as Cyprinuscarpio and Oreochromisniloticus, exposed to endosulfan (Srivastava et al., 2018; Abdel-Tawwab *et al.,* 2016; Rajesh *et al.,* 2017). The results of this study suggest that endosulfan is highly toxic to Rohu and can cause significant biochemical and histological changes.

The toxicity of endosulfan can be attributed to its ability to inhibit acetylcholinesterase activity, leading to accumulation of acetylcholine in the synapses and disruption of normal nervous system function (Kumar *et al*., 2019). Additionally, endosulfan has been shown to induce oxidative stress and lipid peroxidation in fish tissues, leading to cellular damage and histopathological changes (Das *et al*., 2016) .

CONCLUSION

Endosulfan acts as a potent toxin that disrupts both the **chemical balance** (increasing stress enzymes and decreasing proteins) and the **physical structure** (causing inflammation and necrosis) of vital organs.The study suggests that endosulfan is highly toxic to Rohu and can cause significant biochemical and histopathological changes. Therefore, it is essential to regulate the use of endosulfan and other pesticides to prevent environmental pollution and protect aquatic life.

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