International Journal of Multidisciplinary Education and Research
www.multidisciplinaryjournals.in
ISSN: 2455-4588
Received: 26-02-2024, Accepted: 20-03-2024, Published: 12-04-2024
Volume 9, Issue 2, 2024, Page No. 6-8

Biochemical effects of endosulfan on *Clarias gariepinus* (Burchell, 1822) kidneys

S Kurikose[1], P Verma[2*], D B Sawarkar[2]
[1] Centre for Higher Learning and Research in Zoology, N.H. College, Bramhapuri, Maharashtra, India
[2] Centre of Higher Learning and Research in Zoology, Hislop College, Nagpur, Maharashtra, India
Corresponding Author: payalrverma@gmail.com

Abstract
The kidney is among the first organs harmed by contaminants in the water. It is an essential organ in the body, and healthy kidney function is necessary to preserve homeostasis. The presence of potentially harmful substances entering the body because of these activities can affect the kidneys. The goal of every organism's detoxification system is to keep the body free of pollutants. Higher concentrations of dangerous substances, however, have an adverse effect on the body. The amount of biochemical components in different organs indicates how hazardous a pesticide is, and biochemical parameters offer a quick and accurate way to track how a pesticide is affecting aquatic biota and, eventually, the environment. The current study assessed the total protein and total carbohydrate in the kidney tissue of freshwater catfish *Clarias gariepinus* exposed to sublethal levels of endosulfan. The results of the present investigation show a progressive reduction in the protein content of kidney tissues treated with endosulfan in *Clarias gariepinus*.

Keywords: Biochemistry, *Clarias gariepinus,* kidney, total carbohydrate, total protein

Introduction

Because pesticides quickly dissolve in fat and bioaccumulate in creatures that are not their intended targets, they pose a major risk to human health in living systems. Pesticides are transported into aquatic environments, where they are ingested by creatures via interaction with water and food webs. Because aquatic ecosystems are the last sink for toxic chemicals, their health is negatively impacted (Mir *et al.,* 2011) [5]. Drainage, rainfall, microbiological activity, soil temperature, treatment surface, application rate, and pesticide solubility, mobility, and half-life are some of the variables influencing water contamination with pesticides and their residues (Agrawal *et al.,* 2010) [1].

The most common toxicant in the aquatic environment is an organochloride. These are hydrocarbons that have been chlorinated and have been widely utilized in agriculture and mosquito control since the 1940s. Due to its neurotoxicity, endosulfan is an organochlorine pesticide that causes breaks in DNA strands and disrupts the cell's damage response mechanism, which compromises DNA strand repair. By minimizing agricultural damage, endosulfan boosts crop yields. However, because it changes the physiology, metabolism, behavior, and fertility of fish, it may also be hazardous to non-target organisms like fish, which could ultimately affect the population's ability to survive (Tripathi & Verma, 2004; Altinok & Capkin, 2007; Verma *et al.,* 2022a, b, c) [17, 2, 18].

One of the first organs impacted by water pollution is the kidney (Thophon *et al.,* 2003) [15]. It is an essential organ of the body, and maintaining homeostasis requires healthy kidney function. Kidneys are sensitive to the presence of harmful substances entering the body as part of these processes. Male Swiss albino mice treated with insecticides showed a substantial decrease in protein, DNA, and RNA content in their kidneys, according to Prasanna & Vardhani (2013).

In contrast to mammals, where carbohydrate and lipid are more significant energy sources, fish primarily obtain their energy from protein and fat (Dorucu, 2000) [4]. Since protein is the building block of enzymes, protein serves as fish's primary energy source and plays a remarkable function in a number of metabolic processes. An organism's cellular protein structure and function alter in response to physiological stress. It is possible for toxicants to affect the synthesis and breakdown of proteins. In many species, carbohydrates serve as the primary energy source, and during times of stress, the reserves of carbohydrates are used to meet energy demands. Fish that are under stress go through energy-demanding activities, and glucose is a vital energy source for tissue metabolism in organs including the heart, brain, and blood cells and gills (Mommsen *et al.,* 1999) [6].

Material and Methods

Young Clarias gariepinus fish (12-13 grams and 10-11 centimetres long) were purchased from the market, acclimatized under laboratory conditions for 15 days, and subsequently treated with Endosulfan 35% EC (Endocel). Chronic Toxicity measures long-term effects of exposure (typically 21-28 days). Sub lethal or safe level concentrations were derived from 96h LC 50 (APHA, 1992). In the present study the 96 h LC_{50} value of Endosulfan in *Clarias gariepinus,* was found to be 4.355µg/l with a 95% confidence limit ranging from 3.428µg/l (lower confidence limit) to 5.651µg/l (upper confidence limit). LC_{50} values of 24, 48 and 72 h of Endosulfan in *Clarias gariepinus* are 5.912µg/l, 5.459µg/l, 4.927µg/l, respectively (Verma *et al.*, 2022a, b, c) [18].

Estimation of total Proteins: Total proteins were measured with Bradford Reagent (Bradford, 1976). 50 mg of tissue was homogenized in Tris-HCl buffer (pH 7.0) at 4ºC. The homogenate was then centrifuged at 10,000 rpm for 10 mins at 4ºC. 100 µl of the supernatant was used for the assay with 3 ml Bradford Reagent (Sigma-Aldrich Inc.). Bovine serum albumin (BSA) solution was used as standard solution.

Estimation of total Carbohydrates: Total carbohydrates analysis was done by the method of Dubois *et al.,* (1956). 100 mg of tissues sample was weighed, ground using a pestle and mortar and homogenized in 4 ml of 5% TCA. To 0.1 ml of supernatant, 0.05 ml of 80% phenol was added, followed by addition of 5 ml of concentrated sulphuric acid against the sample surface. Allowed the tubes to stand for 20 minutes, shaken well and absorbance was measured after 20 minutes using spectrophotometer. Glucose was used as standard.

Observation

In the present study it is estimated the total protein and total carbohydrate in kidney tissue of fresh water cat fish *Clarias gariepinus* exposed to sub lethal concentrations of Endosulfan for 5, 10 and 15 days.

Total Protein: Kidney tissue exposed to the sub lethal concentrations of Endosulfan showed a significant decrease in total protein content compared to control values for 5 days, 10 days and 15 days exposure. Total protein content decreased with the increase of concentration and number of days of exposure (Table 1).

Table 1: Total protein content (µg/g) of kidney tissue of *Clarias gariepinus* exposed to sub lethal concentrations of Endosulfan

	Control	0.215 µg/l	0.430 µg/l	0.645 µg/l	0.860 µg/l
5 days	22.28 ± 0.51	20.07 ±0.68	10.22 ± 0.87	9.45 ± 0.24	8.48 ± 0.09
10 days	23.29 ± 0.19	19.73 ± 0.95	9.91 ± 0.54	8.83 ± 0.76	7.18 ± 0.08
15 days	23.18 ± 0.10	18.49 ± 0.89	6.47 ± 1.01	5.68 ± 0.65	4.64 ± 0.45

Total Carbohydrate: Kidney tissue exposed to the sub lethal concentrations of Endosulfan showed a significant decrease in total carbohydrate compared to control values for 5 days, 10 days and 15 days exposure. Total carbohydrate decreased with the increase of concentration and number of days of exposure (Table 2).

Table 2: Total carbohydrate content (µg/g) of kidney tissues of *Clarias gariepinus* exposed to sub lethal concentrations of Endosulfan

	Control	0.215 µg/l	0.430 µg/l	0.645 µg/l	0.860 µg/l
5 days	12.560 ± 1.060	7.16 ± 0.240	4.79 ± 0.29	3.95 ± 0.64	3.68 ± 0.20
10 days	11.490 ± 1.240	7.12 ± 0.240	4.70 ± 0.68	3.45 ± 0.87	2.65 ± 0.86
15 days	11.460 ± 0.814	2.61 ± 0.190	2.48 ± 0.46	1.58 ± 0.26	0.97 ± 0.53

Discussion

According to the current study's findings, the protein content of the renal tissues of *Clarias gariepinus* treated with endosulfan gradually decreased. The therapy lasting 15 days had the lowest protein concentration and the longest, lasting 5 days. Protein content was determined to be highest in the lowest concentration and lowest in the highest concentration.

According to Tilak *et al.,* (2009) [16], renal tissues of *Channa punctatus* treated to alachlor showed a decrease in protein. According to Rohankar *et al.,* (2012) [9], freshwater fish *Channa punctatus* subjected to phosphorimide for 24, 48, and 72 hours showed a significant decrease in both soluble and insoluble proteins in their kidney tissues. They suggested that an increase in the rate of protein breakdown into amino acids or a decrease in protein synthesis could be the cause of the protein decrease. Additionally, Suneetha (2014) [13] observed that fish *Labeo rohita* kidney tissues underwent lethal and sublethal exposure to endosulfan and fremvalerate showed a decrease in total protein content. Patnaik *et al.,* (2016) [7] reported a reduction in protein in *Anabas testudineus* following exposure to naphthalene.

According to Umminger's (1970) theory, fish that are under stress use carbohydrates as their primary and immediate energy source. A decrease in the amount of carbohydrates shows that they are being used to combat pesticide stress. the reduction of carbohydrates in fish tissues exposed to endosulfan as a result of the fish using carbohydrates to combat the stress brought on by pesticide exposure. Sobha *et al.,* (2007) [12] observed a decrease in the amount of kidney glycogen in cats exposed to cadmium chloride, a heavy metal toxin. Glycogen was shown to be depleted in kidney tissues by Satyavardhan (2013) [10], who investigated the effects of fenvalarate and malathion on the biochemical components of the freshwater fish *Ctenopharyngodon idella*. Following exposure to Confidor, Reddy *et al.,* (2015) [8] observed a decrease in the total glycogen of *Labeo rohita* renal tissues. According to Tamizhazhagan *et al.,* (2017) [14], kidney tissues of cats exposed to monocrotophos 36% EC showed a decrease in the amount of carbohydrates. Sharmila & Kavitha (2017) [11] also reported on a decrease in total soluble carbohydrates caused by monocrotophos in the renal tissues of *Cyprinus carpio*.

Acknowledgement

The help and support rendered Dr. R. J. Andrew, Director, Centre of Higher Learning and Research in Zoology, Hislop College, is gratefully acknowledged.

References

1. Agrawal A, Pandey RS, Sharma B. Water Pollution with special reference to pesticide contamination in India. Journal of Water Resource and Protection,2010:2:432-448.
2. Altinok I, Capkin E. Histopathology of rainbow trout exposed to sublethal concentrations of Methiocarb or Endosulfan. Toxicologic Pathology,2007:35:405–410.
3. APHA. Standard methods for the examination of water and waste water. 18th ed. APHA: Washington D.C, 1992.
4. Dorucu M. Changes in the protein and lipid content of muscle, liver and ovaries in relation to *Diphyllobothrium* spp. (Cestoda) infection in Powan (*Coregonus lavaretus*) from Loch Lomond, Scotland. Turkish Journal of Zoology,2000:24:211–218.
5. Mir FA, Ghulam MS, Ulfat J, Javaid IM, Vineet KD. Studies on influences of sublethal concentrations of organophosphate pesticide- Dimethoate (Rogor), on gonadosomatic index (GSI) of female common carp, Cyprinus carpio communis. Journal of Ecophysiology and Occupational Health,2011:11:117-121.

6. Mommsen TP, Vijayan MM, Moon TW. Cortisol in teleosts: dynamics mechanisms of action, and metabolic regulation. Reviews in Fish Biology and Fisheries,1999:9(3):211-268.
7. Patnaik L, Raut D, Panda D, Nayak S. Naphthalene induced biochemical changes in *Anabas testudineus*. Journal of Biodiversity and Environmental Sciences,2016:8(2):154-158.
8. Reddy A, Veeraiah K, Rao T, Vivek C. Studies on some biochemical changes in the tissues of the Fresh water fish *Labeo rohita* (hamilton) exposed to Confidor. Journal of International Academic Research for Multidisciplinary,2015:3(1):323-329.
9. Rohankar P, Zade V, Dabhadkar D, Labhsetwar N. Evaluation of impact of Phosphamidon on protein status of Freshwater Fish *Channa punctatus.* Indian Journal of Scientific Research,2012:3(1):123-126.
10. Satyavardhan K. Effect of Fenvalarate™ and Malathion™ on biochemical constituents of freshwater fish, *Ctenopharyngodon idella* (Valenciennes). World Applied Sciences Journal,2013:27(5):649-655.
11. Sharmila G, Kavitha AV. Alterations in biochemical parameters of *Cyprinus carpio* (Linn. 1758) induced by chronic exposure to organophosphorus pesticide, Monocrotophos. International Journal of Applied Research,2017:3(9):399-403.
12. Sobha K, Poornima A, Harini P, Veeraiah K. A study on biochemical changes in the fresh water fish, *Catla catla* (Hamilton) exposed to the heavy metal toxicant Cadmium Chloride. Kathmandu University Journal of Science, Engineering and Technology,2007:1(4):1-11.
13. Suneetha K. Effects of Endosulfan 35% EC and Fenvalerate 20% EC on protein and aminotransferase activity in a freshwater fish *Labeo rohita*. International Journal of Innovative Research in Science, Engineering and Technology,2014:3(3):10250-10256.
14. Tamizhazhagan V, Pugazhendy K, Sakthidasan V, Jayanthi C, Hkim K, Swawicka B, *et al*. The toxicity effect of Monocrotophos 36% EC on the biochemical change in *Catla catla* (Hamilton, 1882). Global Journal of Pharmacy and Pharmaceutical Science,2017:2(2):1-7.
15. Thophon S, Kruatrachuc M, Upathau E, Pokcthitiyook P, Sahaphong S, Jarikhuan S. Histopathological alterations of white seabass, *Lates calcarifer* in acute and subchronic Cadmium exposure. Environmental Pollution,2003:121:307-320.
16. Tilak KS, Wilson RP, Butchiram MS. Effects of alachlor on biochemical parameters of the fresh water fish, *Channa punctatus* (Bloch). Journal of Environmental Biology,2009:30(3):420-426.
17. Tripathi G, Verma P. Endosulfan-mediated biochemical changes in the freshwater fish *Clarias batrachus*. Biomedical and Environmental Sciences,2004:17(1):47-56.
18. Verma P, Kurikose S, Sawarkar DB. Histopathological effect of Endosulfan on the liver of *Clarias gariepinus* (Burchell, 1822) (Siluriformes: Clariidae). Journal of International Academic Research for Multidisciplinary,2022a:10(2):1-10.
19. Verma P, Kurikose S, Sawarkar DB. Histopathological effect of Endosulfan on the kidney of *Clarias gariepinus* (Burchell, 1822) (Siluriformes: Clariidae). Biological Forum – An International Journal,2022b:14(1):1439-1443.
20. Verma P, Sawarkar DB, Kurikose S. Histopathological effect of endosulfan on the muscles of *Clarias gariepinus* (Burchell, 1822) (Siluriformes: Clariidae). International Journal of Multidisciplinary Research and Development,2022c:9(11):12-15.
21. Umminger BL. Physiological studies on supercooled killifish *Fundulus heteroclitus* III. Carbohydrate metabolism and survival at subzero temperature. Journal of Experimental Zoology,1970:173(2):159-174.