ACTA BIOLOGY FORUM

Original Research Article
ISSN: 2583-7419
Journal homepage: biologyforum.actabotanica.org

# Hemato-biochemical alterations in fish – *Cyprinus carpio* L. after exposure to 'Derisom' a botanical pesticide"

**Shoeiba Tasneem**

*Department of Zooogy, School of Biological Sciences, Univesity of Kashmir, Srinagar, Jammu & Kashmir, India, 190006*

**Citation:** Shoeiba Tasneem (2026). Hemato-biochemical alterations in fish – *Cyprinus carpio* L. after exposure to 'Derisom' a botanical pesticide". *Acta Biology Forum*. **DOI: https://doi.org/10.51470/ABF.2026.5.1.08**

Corresponding Author: **Shoeiba Tasneem** | E-Mail: **(shoeiba.tas@uok.edu.in)**

Received 08 January 2026 | Revised 10 February 2026 | Accepted 05 March 2026 | Available Online 02 April 2026

## ABSTRACT

*Research conducted in the last decade clearely shows a significant presence of various pollutants in waterbodies such as pesticides, detergents and effluents from industries which lead to changes in the physiological and biochemical aspects of non-target aquatic organisms especially fish. Focusing on the harmful effects caused by these pollutants especially the synthetic pesticides scientists have formulated eco-friendly plant based biopesticides, the one most commonly known are the neem based biopesticides. A new plant based biopesticide – Derisom has been manufactured by scientists recently from Pongamia pinnata plant which is now being used in many agricultural fields. The present study is conducted to observe the haematological alterations caused in Cyprinus carpio on exposure to sub-lethal concentrations of biopesticide – Derisom. Various haematological parameters such as RBC, WBC, Hb, PCV, MCV, MCH, and MCHC were examined. The results obtained after the conduct of the study shows a significant variation in the haematological profile of fish exposed to sub-lethal concentrations of Derisom.*

***Keywords:*** *Biopesticide, Karanjin, Derisom, sub-lethal exposure, Cyprinus carpio, haematology. .*

## Introduction

Since few decades freshwater aquatic ecosystems are facing the threat of harmful effects of synthetic pesticides which is creating a major problem to non-target organisms especially fish, which constitutes the major protein source for humans [1]. Much research has been done on plants for the production of environment safe pesticides that can be used both in field and in storage of grains. In many tropical countries there is a centuries old traditional practice of applying botanical material to crops as to control pests [2]. Studies have proven that plants possess a number of secondary metabolites some of which possess toxic effects, growth regulating effects and anti-feedant effects [3].

One of the most promising natural compounds known to all since several years is azadirachtin, an active compound extracted from the nee tree (*Azadirachtaindica*), whose pesticidal, antiviral, antibacterial and antifungal properties have been established[4], [5], [6]. Like the neem based pesticide a new and novel biopesticide - Derisom has been manufactured by agrilife private limited, Hyderabad. The active component of the biopesticide is an alkaloid – karanjin. The biopesticide Derisom is equally compatible with the modern synthetic pesticides. Derisom is used in all types of crop fields because of its effectiveness against wide range of pests. It is well know that plant based pesticides are eco-friendly and less harmful to the environment. They are degraded easily and do not form residues in the environment.

Fish forms an ideal model for toxicology research as it acquires the final trophic level in any given aquatic ecosystem and is very sensitive to any physico-chemical change in the water quality. Contamination of an ecosystem by pesticides causes imbalance and hazard to health of fishes.

Fish forms an important source of protein for human consumption [7]. The common carp *Cyprinus carpio* is an economically and commercially important fish species cultured worldwide. It is regarded as an important species to be cultured in integrated rice-fish farming system in India and many other countries. The fish *Cyprinus carpio* is sturdy, easily adapted and maintained in lab conditions, hence it has been used in the present study.

The haematological techniques are considered as important markers and tools in assessing fish health, environmental monitoring and toxicity. Haematological profile (RBC count, WBC count, Hb, PCV, MCV, MCH, MCHC) of a fish acts as an important parameter to detect the physiological response to a contaminated environment [8]. Any kind of significant variations in the morphology and total RBC count, acts as a major and reliable indicator of stress[9], [10], [11].

Till date, extensive literature is available on the toxixicty and sub-lethal effects of neem based pesticides on various fish species. Studies relevant to the effect of biopesticide- Derisom on haematological profile in fish *Cyprinus carpio* has not been studies so far. Hence, the present study is conducted to elucidate the sub-lethal exposure of fish *Cyprinus carpio* to biopesticide-Derisom and analyze variations in haematological parameters (total RBC count, WBC count, Hb, PCV, MCV, MCH and MCHC), comparing them later on with the haematology profile of healthy fishes of the control group.

## Materials and Methods

The fish common carp - *Cyprinus carpio* weighing 28.53 ± 1.79 gm and measuring 14 ± 0.83 cm were obtained from a nearby fish farm.

***Copyright:*** *This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.*

The fishes were transported to the Department's animal house facility in well-aerated tanks. The fishes were then acclimatized for a period of one month in well aerated tanks of 500L capacity. Fish were fed twice daily with commercially available fish feed pellets and de-chlorinated tap water was renewed on a daily basis. The 96 hrs LC 50 value for the biopesticide - Derisom was found to be 2.8 ppm. Fishes were exposed to the sub-lethal concentration of Derisom 0.28ppm for a period of 21 days. Control group was also maintained simultaneously. The experiment was carried out with six replicates. The fishes were fed twice daily during the sub-lethal exposure period and the concentration of Derisom was renewed in a semi-static method.

**Estimation of Haematological profile**

After successful completion of sub-lethal exposures i.e., 24hrs, 7 days, 14 days and 21 days blood was collected from both control and exposed groups separately in heparinised syringes through caudal vein puncture. Blood was then immediately used for the haematological analysis. Total RBC count and total WBC count was measured using Neubaur haemocytometer for which the blood was diluted (200 times for total RBC count and 50 times for total WBC count) with Diace solution containing brilliant cresyl blue 0.1 g, sodium citrate 3.8 g, and formaldehyde 37% 0.2mL in 100mL distilled water [12]. Haematocrit or Packed cell Volume (PCV %) was measured using micro haematocrit capillary tubes after centrifugation (2500 rpm for 5 min). Haemoglobin concentration (Hb: g/dl) was measured using cyanomethemoglobin spectrophotometrically. Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated using the standard formulae as follows [12].

MCV (fl/cell) = PCV (%) ×10 cubic microns/RBC ($10^6$/µl).

MCH (pg/cell) = Hb (g/dl) × 10 cubic microns/RBC ($10^6$/µl),

MCHC (g/dl) = Hb (g/dl) ×100ml/PCV (%).

Statistical analysis was performed by one way ANOVA at 5% significant level. Two tests (Tukey & LSD – Least Significance Difference) were performed to compare the significant differences using SPSS V.16 and Graph Pad Prism version 5.

## Results

The various haematological parameters estimated in fish *Cyprinus carpio* on sub-lethal exposure to Derisom are presented in Table: 1.

*Table 1: mean ± standard deviation values of haematological profile of Cyprinus carpio onsub-lethal exposure to Derisom.*

| Blood parameter | Control group | 24 hrs S/L exposure to Derisom | 7 days S/L exposure to Derisom | 14 days exposure to Derisom | 21 days exposure to Derisom |
|---|---|---|---|---|---|
| RBC $10^6$ /µl | 1.325±0.018 | 1.43±0.055* | 1.26±0.037ns | 1.15±0.037* | 1.041±0.034* |
| WBC $10^3$/µl | 197.5±1.870 | 210.5±5.16* | 219.75±0.935* | 222.7±1.006* | 225.35±0.796* |
| Hb g/dl | 8.08±0.048 | 8.185±0.018ns | 7.75±0.187* | 7.458±0.063* | 7.26±0.074* |
| PCV % | 23.33±0.53 | 24.7±0.37* | 22.05±0.56* | 21.19±0.14* | 20.62±0.15* |
| MCV fl/cell | 176.08±1.57 | 172.25±4.08ns | 175.01±0.74ns | 184.4±5.03* | 193.14±5.16* |
| MCH pg/cell | 61.04±0.49 | 57.1±2.8* | 61.51±0.34ns | 64.89±1.56* | 69.73±1.61* |
| MCHC g/dl | 34.67±0.58 | 33.47±0.29* | 35.14±0.04ns | 35.19±0.17ns | 35.19±0.11ns |

The total RBC count showed significant changes in the blood of fishes during the sub lethal exposure to Derisom when compared to the control group fishes. The total RBC count increased after 24 hrs exposure as compared to the control group. The total RBC count remained almost equal to the control group after 7th day of exposure, the value decreased significantly after 14th day and the least value was recorded on the 21st day. The total WBC count significantly increased as the days of exposure was increased. The total HB concentration remained almost equal to the control group after 24hrs exposure. The Hb concentration decreased significantly as the exposure period increased. The PCV value showed an increase after 24 hrs of exposure as compared to the control group, the PCV value decreased significantly after each consecutive exposure period.

The blood indices parameter MCV value remained similar to the control value after completion of 24 hrs and 7 days. MCV value significantly increased after 14th days and was recorded as the highest value after 21st day. The blood indices parameter MCH decreased significantly after 24 hrs exposure, remained equal equal to control group after 7 days exposure period. The MCH value significantly increased after 14th day and 21st day. The blood indices parameter MCHC decreased significantly after 24hsrs exposure, the value remained almost equal to the control group value after 7days, 14 days and 21 days.

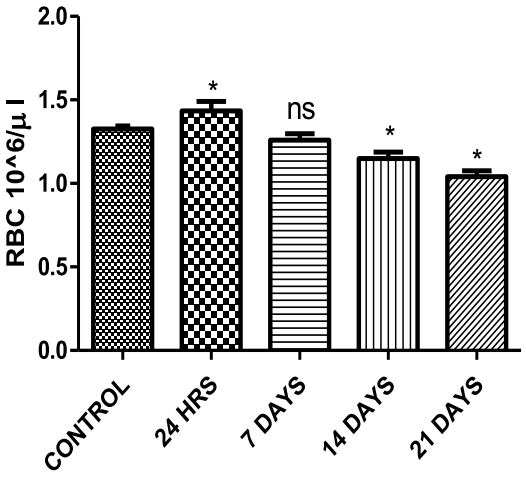


Figure: 1

MEAN RBC (10^6 / µ l) IN BLOOD OF FISH - *Cyprinus carpio*

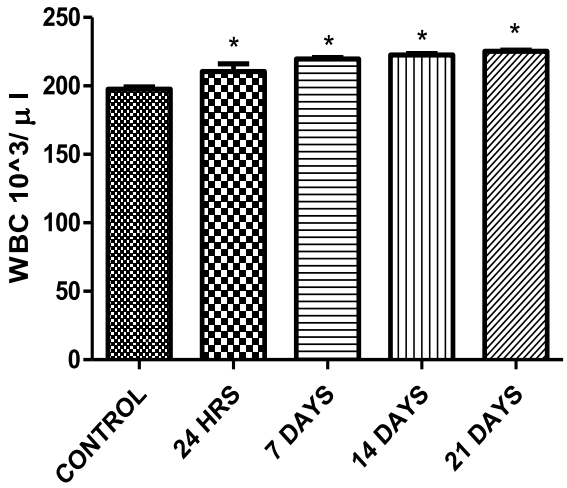


Figure: 2

MEAN WBC (10^3/µ l) IN BLOOD OF FISH - *Cyprinus carpio*

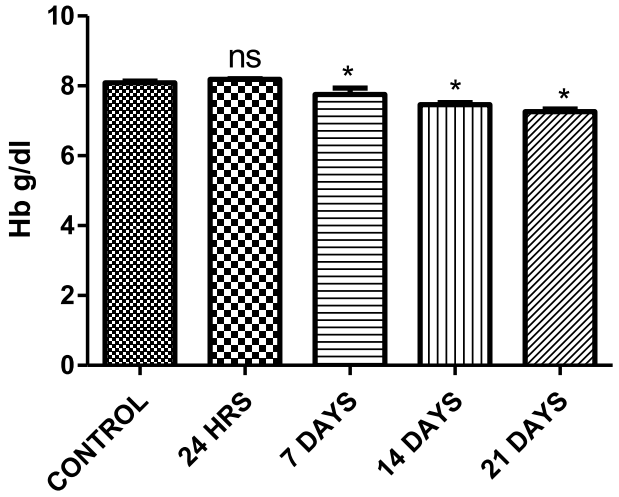


Figure: 3

MEAN Hb (g/dl) IN BLOOD OF FISH - *Cyprinus carpio*

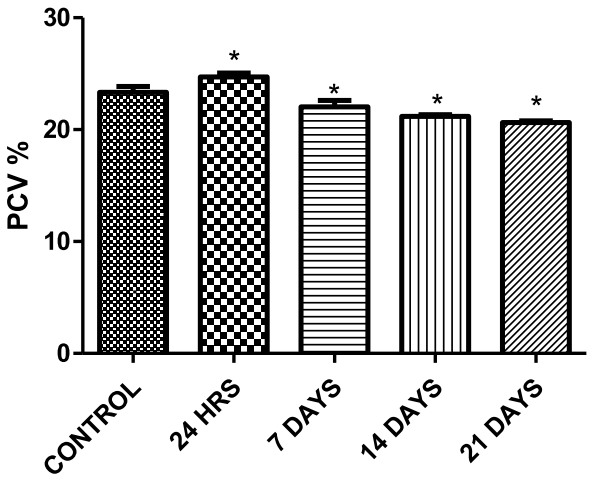


Figure: 4

MEAN PCV (%) IN BLOOD OF FISH - *Cyprinus carpio*

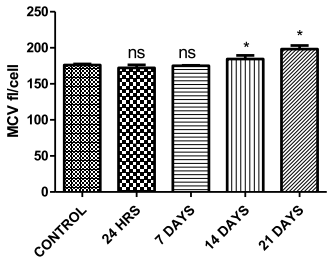


Figure: 5

MEAN MCV (fl/cell) in blood of fish - *Cyprinus carpio* during exposure to sub-lethal conc. of Derisom.

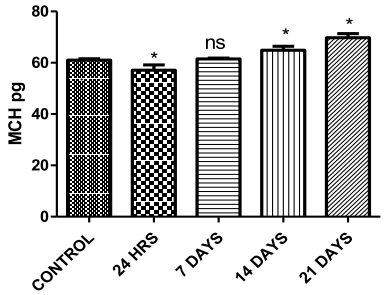


Figure: 6

MEAN MCH IN BLOOD OF *C.carpio*

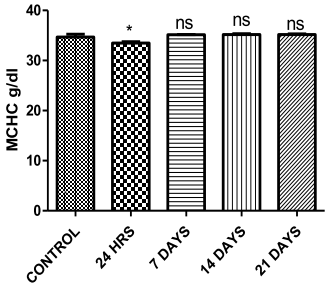


Figure: 7

MEAN MCHC (g/dl) IN BLOOD OF FISH - *Cyprinus carpio*

**Discussion**

The present study clearly shows significant alterations in haematological profile of *Cyprinus carpio* on sub-lethal exposure to Derisom. Altered haematological status of a fish species indicates the toxic impact of xenobiotics on its health [13]. Blood parameters generally change in the presence of stressors and pollutants [14]. Our findings presented in this article provide a proof that long-term exposure of fish species to botanical/plant based pesticides cause significant deviations in haematological profile [15]. Similar changes in total RBC count and Hb concentration were also reported by other researchers [16]. Another study also showed similar decreasing trend in total RBC count in *Cirrhinus mrigala* exposed to sub-lethal concentrations of dyes [17]. A decrease in PCV is directly proportional with the decrease in total RBC count, as reported in the present study. Similar kind of variations in haematological profile were reported by researchers in Coho salmon and in *Anabas testudineus* [18], [19]. Literature shows that total RBC count and packed cell volume values decreased significantly in *Cyprinus carpio* exposed to combined heavy metals [20]. Few other researchers [21] proved that malachite green is also able to produce similar kind of haematological variations in Nile tilapia on sub-lethal exposures. Few reports support the present findings wherein the haemoglobin concentration decreased in Indian carps, *Labeo rohita* and *Catla catla* exposed to sub-acute concentrations of Cr and Cd [22], [23]. A significant reduction in total RBC count and Hb content was also reported in *Labeo* rohita exposed to aquatic contaminants[24], [25].

Total RBC count and Hb concentration may act as important markers which help in estimating the overall health condition of fish. Any significant deviations in these values may lead to conditions such as partial anaemia, hypoxia, erythrocytopenia, decreased haemopoiesis or damage in the haematopoietic tissues. Other reasons for decrease in Hb content reflects the anaemic state of the fish which may be a result of iron deficiency and its consequent decreased utilization for Hb synthesis [22]. The above mentioned deviations in the haematological profile may lead to the structural damage in RBC membranes resulting in haemolysis and impairment in haemoglobin synthesis, stress related release of RBCs from the spleen and hypoxia condition in fish. Anaemic condition might also result due to haemo-dilution caused by imbalanced osmoregulation across gill epithelium. Condition like naemia may affect the general well-being of the fishes. The overall reduction in total RBC count and Hb content may be the result of damage and destruction of red blood cells [26], [27].

Present study shows a significant increase in total WBC count throughout the sub-lethal exposure period. This significant increase in total WBC count may be considered as an adaptive immunological defence mechanism, leucocytosis or lymphocytosis against sub-lethal exposure to Derisom. Similar deviations in haematological profile was observed by other researchers [28] in *Poecilia reticulate* exposed to methyl red. Some other researchers recorded Leucocytosis in *Cirrhinus mrigala* exposed to various pollutants [29].

Red Blood cell indices - mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) are very sensitive indicators of overall fish health and significant deviations from their normal range may cause reversible changes in the homeostatic environment of fish.

Variations in these blood indices are directly proportional to the total RBC count, haemoglobin concentration and packed cell volume. Results of the present study showed a significant variation in these indices in *Cyprinus carpio* during sub-lethal exposure to Derisom. Similar responses were also recorded in common carp and other freshwater fish on exposure to various pesticides [30], [31], [32], [33].

**Conclusion:** Water borne pollutants like pesticides may alter the haematological parameters in fish. Survival of fish in an aquatic ecosystem depends not only on their biological state but on the quantity and type of pollutants. The results obtained in the present study clearly show that Derisom is moderately toxic to *Cyprinus carpio*. Exposure of common carp to sub-lethal concentrations of Derisom resulted in significant haematological alterations. Hence the above mentioned changes in haematological profile suggest that the fish during sub-lethal exposure to Derisom are facing some metabolic problems which are not normal. The decreasing values of haematological parameters such as total RBC count, haemoglobin concentration and PCV in the exposed fish may act as indicators of stress. The increased WBC value indicates the immunological response of fish against the biopesticide Derisom. Therefore it may be concluded that the usage of pesticides both synthetic and botanical, either in the agricultural fields should or aquaculture ponds should be monitored well as they may be a threat to both aquatic fauna and flora including humans.

**Conflict of Interest:** The author declares "no conflict of interest of any kind".

## References


1. Kumar AA, Prasad MR, Srivastava K, Tripathi S, Srivastava AK (2010) Branchial Histopathological Study of catfish Heteropneustes fossilis following exposure to purified Neem Extract, Azadirachtin. World journal of zoology 5(4): 239-243.
2. Van Huis A, Dicke M, Rietjens I (2004) Safety evaluation of neem (Azadirachtaindica) derived pesticides. Journal of Ethnopharmacology 94: 25–41.
3. Sunita F, Lalijee B (2008) Study of Various Extracts of Ayapanatriplinervis for their Potential in controlling Three Insect Pests of Horticultural Crops. Tropicultura 26 (2): 119-124.
4. Isman MB, Koul O, Luczyski A, Kaminski J (1990) Insecticidal and antifeedant bioactivities of neem oils and their relationship to azadirachtin content. Journal of Agricultural and Food Chemistry 38: 1406–1411.
5. Harikrishnan R, Rani MN, Balasundaram C (2003) Hematological and biochemical parameters in common carp, Cyprinus carpio, following herbal treatment for Aeromonas hydrophila infection. Aquaculture 221: 41–50.
6. Oruce EO, Usta D (2007) Evaluation of oxidative stress responses and neurotoxicity potential of diazinon in different tissues of Cyprinus carpio. Environmental Toxicology and Pharmacology 23: 48-55.
7. Dethloff GM, Bailey HC, Maier KI (2001). Effect of dissolved copper on selected haematological, biochemical and immunological parameters of wild rainbow trout (Oncorhynchus mykiss). Achieves of Environmental Contamination and Toxicology 40: 371-380.
8. Ranzani-Paiva MJTEL, Rodrigues ML, Veiga AC, Eiras BES (2003) Differential leukocyte counts in "dourado" Salminus maxillosus Valenciennes, 1840 from the Mogi- Guaçu River, Pirassununga, SP. Brazilian Journal of Biology 63: 517-525.
9. Pavlidis M, Futter WC, Kathario P, Divanach P (2007) Blood cells of six Mediterranean mariculture fish species. Journal of Applied Ichthyology 23: 70-73.
10. Tavares-Dias M, Moraes FR (2007) Leukocyte and thrombocyte reference values for channel catfish (Ictalurus punctatus Raf.) with an assessment of morphological, cytochemical, and ultrastructural features. Veterinary Clinical Pathology 36: 49-54.
11. Dorafshan S, Kalbassi MR, Pourkazemi M, Mojazi Amiri B (2008) Effects of triploidy on the Caspian salmon (Salmo truttacaspius) haematology. Fish Physiology and Biochemistry 34: 195-200.
12. Li ZH, Velisek J, Grabic R, Li P, Kolarova J, Randak T (2011) Use of haematological and plasma biochemical parameters to assess the chronic effects of a fungicide propiconazole on a freshwater teleost. Chemosphere 83: 572–578.
13. Agarwal U, Srivastava AK (1976) Effect of cold shock on the abundance of red blood cells in the circulation of a freshwater teleost, Colisa fasciatus. Archives d'Anatomie Microscopique et de Morphologie Experimentale 65: 165-174.
14. Voegborlo R, El-Methnani A, Abedin M (1999) Mercury, cadmium and lead content of canned tuna fish. Food Chemistry 67(4): 341-5.
15. Barot J, Bahadur A (2014) Toxic effect of azo dye (c.i. direct green 6) on blood parameters of freshwater fish Labeo rohita (Ham.). Journal of Cell and Tissue Research 14(2): 4251-4254.
16. Afaq S (2010) Water pollution with leather dyes and its effect on fish fauna. Research Journal of Agricultural Science 1: 259-261.
17. McLeay DJ (1975) Sensitivity of blood cell counts in Coho Salmon. Oncorhynchus kisutch to stressors including sub-lethal concentrations of pulpmill effluent and zinc. The Journal of the Fisheries Research Board of Canada 30: 395-400.
18. Murugesan AG, Haniffa MA (1985) Effect's of textile mill effluent on haematological changes of the obligatory air breathing fish. Anabas testudineus (Bloch). Proceedings of Symposium of Assessment of Environmental Pollution 121-128.
19. Vinodhini R, Narayanan M (2009) The impact of toxic heavy metals on the haematological parameters in common carp (Cyprinus carpio L.). Iranian Journal of Environmental Health, Science and Engineering 6(1): 23-28.
20. El-Neweshy MS, AbouSrag MA (2011) Chronic malachite green toxicity in nile tilapia: Pathological and hematological studies with special reference to quantitative histopathological assessment. Researcher 3: 55-64.
21. Vutukuru S (2005) Acute effects of hexavalent chromium on survival, oxygen consumption, hematological parameters and some biochemical profiles of the Indian major carp, Labeo rohita. International Journal of Environmental Research and Public Health 2(3): 456-462.
22. Vosylienė MZ (1999) The effect of heavy metals on haematological indices of fish (survey). Acta Zoologica Lituanica 9(2): 76-82.
23. Verma SR, Bansal SK, Gupta AK, Delela R (1979) Pesticide induced haematological alterations in a freshwater fish Saccobranchus fossilis. Bulletin of Environmental Contamination and Toxicology 22: 267- 274.
24. Witeska M, Kondev E, Szymanska M, Ostrysz M (2010) Hematological changes in common carp (Cyprinus carpio L.) after short-term Lead (Pb) exposure. Polish Journal of Environmental Studies 19(4): 825- 831.
25. Crandall CA, Good night CJ (1963) Effects of sub-lethal concentration of several toxicants to the common guppy, Lebistes reticulates. Peters Transactions of the American Fisheries Society 82: 59- 73.

26. Hardy HL, Chamberlain RI, Maloof GW, Boylen R, Howell MC (1973) Lead as an environmental poison. Clinical Pharmacology and Therapeutics 12: 982- 1002.
27. Sharma S, Sharma S, Sharma KP (2006) Identification of a sensitive index during fish bioassay of an azo dye methyl red (untreated and treated). Journal of Environmental Biology 27: 551-555.
28. Afaq S, Rana KS (2009) Toxicological effects of leather dyes on total leukocyte count of fresh water teleost, Cirrhinus mrigala (Ham). Biology and Medicine 1: 134-138.
29. Svoboda M, Luskova V, Drastichova J, Zlabek V (2001) The effect of diazinon on haematological indices of common carp (Cyprinus carpio L.). Acta Veterinaria Brno 70: 457-465.
30. Rao DS (2010) Carbaryl induced changes in the haematological, serum biochemical and immunological responses of common carp, Cyprinus carpio, (L.) with special emphasis on herbal extracts as immunomodulators. Ph. D. Thesis. Andhra University, India. p. 235.
31. Gunasekaran S, Vellaichami KA (2019) Haematological status of common carp, Cyprinus carpio. L. exposed to sub-lethal doses of organophosphorous pesticide, monocrotophos. The Pharma Innovation Journal 8(3): 178-182.
32. Prudencio A, Alexis H, Alfred O, Arlette D, Gisele H, Ibrahim IT (2022) Haemoatopoietic Alterations Induced by Cotton Insecticide Thalis 112 EC (Emamectin Benzoate 48 g/L, Acetamiprid 64g/L) in African Catfish Clarias gariepinus. Journal of Toxicology Risk Assessment 8 (2): 1-9.
33. El-bouhy ZM, Mohamed FAS, Elashhab MWA, El- Houseiny W (2023) Toxicity bioassay and sub-lethal effects of profenofos-based insecticide on behavior, biochemical, hematological, and histopathological responses in Grass carp (Ctenopharyngodon idella). Ecotoxicology 32: 196–210.