CIBTech Journal of Zoology ISSN: 2319–3883
An Online International Journal, Available at http://www.cibtech.org/cjz.htm
2025 Vol.14, pp.186-190/Ruchi and Ashish
Research Article

IMPACT OF CADMIUM CHLORIDE ON HAEMATOLOGICAL PARAMETERS IN FRESHWATER FISH CHANNA PUNCTATUS (BLOCH)

***Ruchi Gupta and Ashish Vishwakarma**
Faculty of Science, Department of Zoology, P. K. University, Shivpuri (M.P.)
**Author for Correspondence: ruchiavnigupta@gmail.com*

ABSTRACT
The purpose of this examination was to study the impact of sublethal concentration of heavy metal on haematological parameters of Channa punctatus (Bloch) after 48, 72 and 96 hours of exposure to Cadmium chloride. In Cadmium chloride exposed fish, the results indicated significant decrease in Hb (Haemoglobin), RBC (Red Blood Corpuscles), PCV (Packed Cell Volume), MCH (Mean Corpuscular Haemoglobin), MCHC (Mean Corpuscular Haemoglobin Concentration) and were noticed and WBC (White Blood Corpuscles) and MCV (Mean Corpuscular Volume) was significantly increased with respect to time of exposure and concentration. The observed data showed that C. punctatus can be used as a good bio-indicator for heavy metal contamination in fresh water bodies.

Keywords: *Channa punctatus, Haematology, Cadmium chloride, Sub lethal exposure*

INTRODUCTION
Heavy metals are natural elements of the Earth's crust. They cannot be destroyed or degraded. Which preferably lose their electron and converted into a cation. Some metalloids, transition metals, base metals, lanthanides and actinides known as heavy metals. Heavy metals occur naturally in the earth's crust and are concentrated due to anthropogenic activities. High levels of inert chemicals in the aquatic ecosystem can be attributed to both natural and anthropogenic sources. Human activities such as burning fossil fuels, mining work, cleaning the earth's surface and other various sources on upper earth surface like, discharging wastewater, and insect or disease control agents applied to crops and many others are responsible for heavy metal contamination of water bodies.

Some of the common heavy metals are arsenic, chromium, cadmium, etc. These are also known as trace elements, e.g., copper, selenium and zinc. These heavy metals are necessary to maintain body metabolism but are toxic to the body when are present in higher concentrations. The natural environment has been contaminated by the ongoing accumulation of heavy metals and metalloids, stemming from the rapid growth of industrial practices, ore mining, and the disposal of high levels of metal waste (Alabssawy and Hashem 2024).

Cadmium is the non-essential and most toxic heavy metal, which is widely distributed in the aquatic environment and earth's crust (Kumar *et al*, 2019). Cadmium chloride is widely used in industries along with the other heavy metals (Novelli *et al.,* 2000) which imparts a wide range of physiological effects on fish and aquatic organisms (Tabrez *et al.,* 2021).

Their bio-accumulation and bio magnification considered highly harmful for the aquatic animals. Various biological functions in animals that come in physiological and biochemical categories are also controlled by some metal, which work as co-factor. Once aquatic organisms accumulate heavy metals, they can be transferred to higher trophic levels of the food chain.

Hence, the present study was aimed to evaluate the toxic effects of $CdCl_2$ on the haematological parameters of the freshwater murrel *Channa punctatus* (Bloch).

MATERIALS AND METHODS

Chemical

Technical-grade Cadmium chloride, monohydrate, AR ($Cdcl_2$; 98.0% EC, maximum limits of impurities, iron 0.0005% and sulphate 0.005%) manufactured by HI Media Laboratories Pvt Ltd Mumbai, India, was procured and used for the study.

Experimental setup

Healthy Channa punctatus (Bloch) were collected from Betwa river of Jalaun District (U.P.) and brought to laboratory. *Channa punctatus* (Bloch) freshwater fish with an average length of 8.0- 8.5cm and an average weight of 7.0 -7.5gm. Fishes were rinsed with 0.1% $KMnO_4$ solution to avoid infection and were acclimatized to laboratory conditions for two weeks prior to experiments. The fishes were fed with fish food and water in the aquaria was changed at every 24 hrs, leaving no faecal matter, unconsumed food or dead fish. Proper aeration was maintained in test as well as control aquaria by aerators throughout the experiments.

The LC_{50} values of Cadmium chloride to *Channa punctatus* for 96 h was calculated by Probit's method (Finney and Probit 1964). The 96 h LC_{50} for $CdCl_2$ was found to be 559.23µg/l experiments were carried out in triplicates. Group I with 20 fishes was kept as control and Group II fishes (N=20) were exposed to 1/10th of 96 h LC_{50} (55.92 µg/L) for 48 and 96 h. During the period of exposure, the fish were fed with commercial feed at the end of 48 and 96 h of treatment, 10 fishes were collected and the blood samples were obtained from caudal region after piercing the caudal peduncle of fish from both experimental and control groups and analysed for haematological alterations and stored in EDTA vials.

RESULTS AND DISCUSSION

Haematology is the study of blood and includes many facets of the blood's physiological, pathological, and biochemical properties.

Table 1: Effects of sublethal concentration of cadmium chloride (mg/L) on Erythrogram of *Channa punctata* at different exposure period(N=4).(- or + indicate % decrease or increase over control)

Haematological Parameters	Group	Exposure periods in Hours		
		48	**72**	**96**
RBC (millions)	Control	3.10 ± 0.11	3.09 ±0.34	3.14±0.64
	Exposed	2.85±0.13	2.64 ±0.15	2.57±0.22
	(% Variation)	(-6.80 %)	(-12.75%)	(-16.35%)
Hb(g/100ml)	Control	7.71± 0.17	7.87 ±0.68	7.75 ±0.33
	Exposed	6.89±0.22	6.30±0.56	5.85 ±0.31
	(% Variation)	(-11.65%)	(-22.25%)	(-27.82 %)
PCV (HTC%)	Control	33.61±0.58	32.43±0,63	32.78±0.62
	Exposed	32.13±0.37	29.18±0.20	28.33±0.26
	(% Variation)	(-4.10 %)	(- 10.40 0%)	(-13.51%)
MCV (fl)	Control	80.51± 3.5	81.12±3.2	79.85±3.2
	Exposed	88.21±2.5	91.10±2.7	94.51±3.10
	(% Variation)	(+9.85%)	(+12.65%)	(+18.87%)
MCH (pg)	Control	32.45±1.7	32.79±1.6	32.55±1.6
	Exposed	35.11±2.2	37.23 ±1.8	39.12±1.17
	(% Variation)	(+ 5.47%)	(+10.98%)	(+17.40 %)
MCHC (%)	Control	39.60±1.2	38.75±1.4	38.85 ±1.3
	Exposed	37.15±1.9	35.20 ±1.7	33.51±1.5
	(% Variation)	(- 6.85%)	(-9.95%)	(-14.40 %)

**Significant at P< 0.05; ** significant at P< 0.01.*

Fish haematology can be used to evaluate overall health. Numerous blood parameters (MCV), mean cell haemoglobin (MCH), and mean cell haemoglobin concentration (MCHC). Fish blood studies have become more and more important over the past three decades for ichthyologists and fishery biologists to regularly monitor the health of fish stocks and to build a database of information about intra- and inter-specific differences in blood characteristics under heavy metal exposure. have been utilized as markers of metal contamination in aquatic environments, including total red blood cell count, total white blood cell count, haemoglobin (Hb) content, packed cell volume (PCV), mean cell volume

Table 2: Effects of sublethal concentration of cadmium chloride (mg/L) on Leukogram of *Channa punctata* at different exposure period (N=4). (- or + indicate % decrease or increase over control)

Haematological Parameters	**Group**	**Exposure periods in Hours**		
		48	**72**	**96**
WBC(TLC) ($\times 10^3/mm^3$)	Control	3.72 ± 0.32	3.78 ±0.25	3.75 ±0.26
	Exposed	3.82 ±0.25	3.97±0.34	4.1 7±0.26
	(% Variation)	(+ 3.40 %)	(+7.50 %)	(+15.55%)
Lymphocyte (%)	Control	84.30 %	84.50%	84.80 %
	Exposed	80.80 %	77.55%	73.30 %
	(% Variation)	(- 4.30 %)	(- 8.55%)	(-14.20 %)
Monocytes (%)	Control	4.30 %	4.35%	4.20 %
	Exposed	4.80%	5.25%	6.75%
	(% Variation)	(+15.92%)	(+30.86%)	(+86.48%)
Neutrophil (%)	Control	10.30%	10.25%	10.15%
	Exposed	10.75%	11.90%	12.15%
	(% Variation)	(+4.87%)	(+18.83%)	(+22.85%)
Eosinophil (%)	Control	3.75%	3.65%	3.60%
	Exposed	5.25%	6.20 0%	7.25%
	(% Variation)	(+38.68%)	(+65.18%)	(+105.41%)
Basophil (%)	Control	2.15%	1.85%	1.80%
	Exposed	3.15%	4.15%	5.10%
	(% Variation)	(+69.85%)	(+135.33%)	(+207.25%)

This study found significant changes in the haematological Parameters of fish, Channa punctata, subjected to cadmium chloride. RBC count, Hb percent, PCV, and MCHC significantly decreased after 96 hours of exposure to sublethal levels of cadmium chloride, whereas MCV and MCH increased in Channa punctata subjected to cadmium chloride (Table 1). Chandra and Verma (2022) and Elarabany *et al.,* (2019) reported similar results. These alterations could be the result of abnormalities in the fishes' hemopoietic and metabolic states, where exposure to sublethal levels of cadmium causes hemopoietic organ dysfunction, which lowers Hb concentrations because of the harmful effects of cadmium (Sharma and Langer, 2014). All of these indicate the onset of the chemical stress response in fish and heavy metals changed these haematological markers. According to Svobodova *et al.,* (1994), fish exposed to high concentrations of heavy metals or to sublethal concentrations over an extended period of time typically have lower haematocrit, haemoglobin percentage, and total erythrocytes. The current study's findings showed fish exposed to cadmium had lower PCV, RBC count, Hb%, and MCHC indicate that their bodies may take in more oxygen from the surrounding air to meet tissue's oxygen needs under stressful conditions.

In this study, Channa punctata exposed to sublethal levels of cadmium chloride showed a significant rise in WBC count. Teleost fish exposed to metals have also been shown to exhibit leukcytogenesis. Leucocyte count changes are associated with antibody formation, which helps fish exposed to sublethal levels of pollutants survive and recover (Joshi *et al.,* 2002).
Increased leukocyte mobilization to defend the body against infections in cadmium-damaged tissue may be the cause of the current study's decrease in lymphocytes. A decrease in the number of lymphocytes in fish exposed to cadmium is an indication that the immune system is deteriorating. The current study found that fish exposed to metals experienced leucocytosis as a result of an increase in monocytes, neutrophils, eosinophils, and basophils. Fish exposed to cadmium chloride had higher levels of monocytes, basophils, and eosinophils. Therefore, an immunological response to the stress caused by the toxicant by manufacturing more antibodies may be the cause of the leucocytosis seen in this study.

CONCLUSION

Blood offers important profile to study the toxicological impact on animal tissues. Different blood parameters are often subjected to change depending on stress condition and environmental factors. The study indicates that Cadmium chloride caused severe anaemia and alterations in haematological profiles there was a significant decrease in Hb, RBC, PCV, MCH and MCHC and were noticed and WBC and MCV was significantly increased. Further, the fish *Channa punctatus* may be considered as a suitable model to detect the toxicity of heavy metals contaminated in the aquatic ecosystems. The present basic information would serve as a useful tool for ecological assessment and monitoring.

ACKNOWLEDGEMENTS

The authors are grateful to Department of Zoology, P. K. University, Shivpuri, Madhya Pradesh for guiding and providing necessary help for conducting this research studies.

REFERENCES

Alabssawy NA and Hashem HA (2024) Bioremediation of hazardous heavy metals by marine microorganism: a recent review. *Archives of Microbiology* **206** 103, 1–18.
Chandra A and Verma AK (2022) Impact of cadmium on haematological parameters of freshwater snake-headed fish, *Channa punctata* (Bloch). *Journal of Experimental Zoology India* **26**(1) 345–348.
Elarabany NF, Bahnsawy MH and Alfakheri M (2019) Effects of cadmium on some haematological and biochemical parameters of African catfish, *Clarias gariepinus*. *African Journal of Biological Sciences* **15**(1) 43–52.
Joshi PS and Deepa H (2002) Effect of lindane and malathion exposure on certain blood parameters in a freshwater teleost fish *Clarias batrachus*. *Pollution Research* **21**(1) 55–57.
Kumar A, Prakash S, Parmar A and Bajpayee AK (2019) Effect of cadmium on freshwater teleost, *Heteropneustes fossilis* (Bloch). *International Journal of Biological Innovations* **1**(1) 14–17. *https://doi.org/10.46505/IJBI.2019.1103*
NovelliFilho JLVV, Novelli ELB, Manzano MA, Lopes AM, Cataneo AC, Barbosa LL and Ribas BO (2000) Effect of tocopherol on superoxide radical and toxicity of cadmium exposure. *International Journal of Environmental Health Research* **10** 125–134.
Sharma J and Langer S (2014) Effect of manganese on haematological parameters of fish, *Garra gotyla gotyla*. *Journal of Entomology and Zoology Studies* **2** 77–81.
Svobodova Z, Vykusova B and Machova J (1994) The effects of pollutants on selected haematological and biochemical parameters in fish. In: Muller R and Lloyd R (eds), *Sublethal and Chronic Effects of Pollutants on Freshwater Fish*. Fishing News Books, London, pp. 21.
Tabrez S, Torki A, Zughaibi J and Javed M (2021) Bioaccumulation of heavy metals and their toxicity assessment in *Mystus* species. *Saudi Journal of Biological Sciences* **28**(2) 1459–1464.

CIBTech Journal of Zoology ISSN: 2319–3883
An Online International Journal, Available at http://www.cibtech.org/cjz.htm
2025 Vol.14, pp.186-190/Ruchi and Ashish
Research Article