The Impact of Industrial Waste on Haematological Parameters of *Labeo rohita*

Nootan Katiyar and Ashish Vishwakarma
Faculty of Science, Department of Zoology
P. K. University, Shivpuri (M.P.)

Abstract-- *Labeo rohita* is the most common fish found in Indian rivers and water bodies. In addition to providing information on the health status of organisms, haematological parameters are utilized as markers in the measurement of health conditions and toxicological symptoms. These measures may also reveal abnormal environmental conditions. Because of the impact of acute exposure to industrial pollution, the haematological parameter of fish was investigated. Fish exposed to sublethal levels of industrial waste for varying lengths of time showed that the waste alters a number of blood parameters. When compared to control, *Labeo rohita* exposure to sublethal concentrations of industrial waste resulted in a significant decrease in HB%, RBC count, MCV, and MCHC values, ultimately leading to anaemia. The present study was conducted to investigate the Impact of Industrial Waste on economically important fish, *Labeo rohita*.

Keywords: Industrial Waste, *Labeo rohita*, Haematology, Toxicity.

Introduction

In recent years, freshwater ecosystem has experienced serious threats from human activities such as industrial effluents, agricultural activities, urban waste man-argument issues, and increase in urbanization (Meijide et al., 2018; Zhu, Zhang, & Zagar, 2018). In addition, climate change impacts resulting changes in abiotic factors such as precipitation and temperature levels have affected the normal function of aquatic ecosystems including reproduction and feeding. These pollution levels have also affected the aquatic flora and fauna of habitats (Schmeller et al., 2018)

The different types of pollutants can be classified into inorganic, organic or biological. Organic pollutants include the domestic, agricultural, and industrial waste that adversely harm the life and health of animals and human beings living on the earth. Inorganic pollutants mostly include the potentially toxic elements (PTEs), like mercury (Hg), lead (Pb) and cadmium (Cd). Most of these SoC get accumulated within supply chains, thereby largely harming the earth living organisms (Majolagbe et al.2017). There are, also, biological pollutants that are anthropogenic derived. The key types of biological pollutants within the environment include viruses, bacteria, and several forms of pathogens (Marfe and Di Stefano 2016).

The growth of industrialization and urbanization around the world has led to the introduction of several substances of concern (SoC). SoC into the air, hence bringing about the respective type of pollution. Life on our planet is fully supported by the Earth’s atmosphere. (Duan et al. 2015).

Manufacturing waste, including sludges, product residues, kiln dust, slags, and ashes, is referred to as industrial waste. Three industries account for the majority of industrial waste: the food processing, nanometallurgy and metallurgy sectors. Depending on the raw materials utilized, the manufacturing procedures and the product outlets, waste may vary from one industry to the next; however, these wastes can be divided into three categories: solids, liquids, and gases. Not all wastes are created equal; some may contain recyclable materials, inorganic and organic components, biodegradable and nonbiodegradable materials, etc.

In general, there are two types of industrial waste: hazardous and non-hazardous. Containers, plastic, metals, glass, rock, and organic garbage are examples of non-hazardous industrial waste, which is trash from industrial activity that does not endanger the environment or public health. Hazardous waste, on the other hand, is any leftover substance from industrial processes that poses a risk to the environment or public health, such as toxic, combustible, corrosive, or active elements.

The toxicological effects of many wastewater pollutants on aquatic organisms have mostly been studied in laboratory settings. The toxicological effects of many wastewater pollutants on aquatic organisms have mostly been studied in laboratory settings.

Materials and Methods

For 21 days, the fish were kept in a sizable tank and acclimated to the lab environment. Every day, the water was replaced to keep the oxygen level stable and to get rid of fish waste. Every day, at least an hour before the tank water was changed, the fish were kept at room temperature and fed at will. To keep the animal in roughly the same condition of metabolic need, feeding was discontinued one day before the experiment. The industrial waste was gathered from the Sharda Nagar, Kanpur Region, which is close to the Ganga River.

To determine the LC_{50} value, batches of ten healthy fish were subjected to varying quantities of industrial waste. Another group of fish is kept in the tap water as a control. The number of dead or impacted fish in each setup was counted at regular intervals for up to 24 hours in order to determine the wide range of concentrations. 1 to 10 ml of industrial waste were selected. Hardness, alkalinity, pH, and dissolved oxygen levels were all tracked and kept constant.

The tank was continuously ventilated with electric ventilated nipples. An appropriate narrow concentration range of 1-5 mL was used to determine the median lethal concentrations containing at least 6 fish for each concentration, and mortality was recorded every 24 hours up to 96 hours. It was found as 1.3 mL in 96 hours. For this regular solution, various concentrations were prepared for bioassay studies. Fish from four groups were exposed to 0.13 mL (sublimation concentration of LC50 values) of industrial waste for 24, 48, 72, and 96 hours. Another group was retained as control at the end of each exposure period.

The blood was collected from gills using syringe and anticoagulants (ammonium oxalate, EDTA) were added and the haematological parameters such as Hb, RBC, WBC, MCV, MCH, MCHC and PCV were analysed. The haemoglobin content was estimated by acid haematin method (Sahil,1962). Total RBC count and WBC count were counted using an improved Neubaurhaemo cytometer (Shah and Altindag 2004). The mean corpuscular volume was calculated by using values of PCV% and the red blood cell counts expressed in µm-3(Anderson and Klontz, 1965). The mean corpuscular haemoglobin content was calculated by using the value of haemoglobin content and the red blood cell counts and expressed in pg(Anderson and Klontz, 1965). The percentage of mean corpuscular haemoglobin concentration was calculated by using the values of haemoglobin content and the PCV% (Anderson and Klontz, 1965). The PCV percentage was calculated employing standard method and formulae (Shandu, !990).

Results and Discussion

The amount of RBC in the fish blood was found to be 3.2, 2.6, 2.2, 1.8 x $10^6/mm^3$ exposed to 0.12 of industrial waste for 24, 48,72 and 96 hours and mean control of 3.6 x 106/mm3. The amount of WBC was found to be increased from the control. The values were35.0,47.0,54.0, 78.0 and 30.0 x $10^6/mm^3$ in control 24, 48, 72 and 96 hrs respectively.

Labeo rohita a haemoglobin level in fish exposed to 24, 48, 72 and 96 hrs were found to contain 3.0, 2.4, 1.8, 1.4 gm% and mean control was found to be 3.8 gm %. The MCV values of the fish were exposed to 0.12 ml industrial waste water effluent for 24, 48, 72 and 96 hrs were found to contain 22.6, 19.5, 13.4, 9.0 μm^3 and mean control was found to be 26.00 μm^3.

The amount of MCH in the blood of the fishes exposed to 0.12 ml industrial waste was recorded as 16.4, 14.2, 12.0, 8.2, and the control was found to be 18.00 Pg. The amount of MCHC recorded as 19.5, 18.2, 16.2, 14.8, 12.2 and 8.00 gm/dL in control 24, 48, 72 and 96 hrs exposures respectively. The amount of PCV in the blood of the fishes exposed to 0.12 ml industrial waste for 24, 48, 72 and 96 hrs was found to contain 18.4, 16.2, 14.3, and 11.0 and mean control was found to be 19. %.

Decrease in the RBC may be due to the disruptive action of the effluent on the peripheral cell due to which viability of the cells was affected. The general reduction in blood parameter is an indication of anaemia. The number of RBC with low blood clotting content may be due to the destructive action of pollutants on erythrocytes. The anaemic status of fish can be determined using haematocrit.

An Increase in the number of WBCs may correlate with increased antibody production This helps in survival and recovery of fisheries exposed to toxicants. A significant increase in the total number of numbers of white blood cells may be due to immunological reactions to produce more antibodies to cope with the stress induced by the toxicant.

The reduction of Hb might be attributed to the blood coagulation. The decrease in haemoglobin concentration indicates the fish inability to provide sufficient oxygen to the tissues. Prolonged reduction in haemoglobin content material is deleterious to oxygen delivery and any blood dyscrasia and degeneration of the erythrocytes will be defined as pathological condition in fishes exposed to toxicants.

Acceptance of MCH and MCHC in this study clearly indicates decrease in haemoglobin concentration in RBCs. MCH is a good indicator of RBC swelling. The significant decrease in the MCHC values in the present study may be due to swelling of RBC or decrease in haemoglobin synthesis. The decreased MCV and MCH clearly indicate the hypo chronic micro lytic anaemia.

Conclusion

From the above investigation it can be inferred that the aquatic animals are affected by the industrial waste effluent. So, we should create awareness among the people not to discharge the industrial waste effluent directly to the water bodies without treatment.

Acknowledgement

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

Anderson, D. and Klontz, G.W. (1965) Basic haematology for the fish culturist, Ann. Northwest Fish Culture Conference, 16: 38-41.

Duan, H., Wang, J. and Huang, Q. (2015) Encouraging the environmentally sound management of C&D waste in China: an integrative review and research agenda. Renew Sust Energ Rev 43:611–620

Meijide, F. J., Da Cuna, R. H., Prieto, J. P., Dorelle, L. S., Babay, P. A., and Lo Nostro, F. L. (2018). Effects of waterborne exposure to the antidepressant fluoxetine on swim-ming, shoaling and anxiety behaviours of the mosquitofish *Gambusia holbrooki*. *Ecotoxicology and Environmental Safety*, *163*, 646–655.

Sahli, T. (1962) Text book of clinical pathology, (Ed. Sc ward, Ei miller). Williams and Williams and Co., Baltimore, pp 35.

Shah, S.L. and Altindag, A. (2004) Haematological parameters of Tench (Tingatinga L.) after acute and chronic exposure to lethal and sublethal mercury treatments. Bull. Environ. Contam. Toxicol, 73: 911-918.

Sandhu, G. S. (1990) Research Technique in Biological Sciences. Anmol Publications, 1990, New Delhi.209.

Schmeller, D. S., Loyau, A., Bao, K., Brack, W., Chatzinotas, A., De Vleeschouwer, F., Vredenburg, V. T. (2018). People, pollution and pathogens – Global change impacts in mountain freshwater ecosystems. *Science of the Total Environment*, *622–623*, 756– 763. **Wepener, V., Van vuren, J. H. and Du preez, H. H. (1992)** The effect of hexavalent chromium at different pH values on the haematology of Tilapia sparmani (Cichlidae), Comparative Biochemistry and Physiology, 101 C (2): 375-381.

Zhu, S., Zhang, Z., & Zagar, D. (2018). Mercury transport and fate models in aquatic sys-tems: A review and synthesis. *Science of the Total Environment*, *639*, 538–549. https ://doi.org/10.1016/j.scitotenv.2018.04.397

Effect of industrial waste on haematological parameters in blood of the fresh water fish, *Labeo rohita*

Sample (mg/g wet tissue)	EXPOSURE PERIODS				
	Control	24hrs	48hrs	72hrs	96hrs
RBC **'t' value** **% Change**	3.6 ± 0.45	3.2 ± 0.53 0.929ns -14.28	2.6 ± 0.41 2.181* -31.42	2.2 ± 0.35 2.3* -42.85	1.8 ± 0.17 2.525* -51.42
WBC **'t' value** **% Change**	29 ± 1.10	35 ± 2.18 6.472** 11968.96	47.0 ± 0.35 8.048** 16106.89	54.00 ± 3.45 19.347** 18520.68	78.00 ± 3.11 47.15** 26796.55
HB **'t' value** **% Change**	3.8 ± 0.58	3.0 ± 1.09 1.283ns -24.32	2.4 ± 0.52 1.961* -40.54	1.8 ± 0.35 13.01** -54.05	1.4 ± 0.45 6.53** -62.16
PCV **'t' value** **% Change**	19.8 ± 1.28	18.4 ± 1.15 1.89^{ns} -7.14	16.2 ± 0.74 6.21** -18.36	14.3 ± 1.12 6.53** -27.04	11.0 ± 0.83 10.97** -43.87
MCV **'t' value** **% Change**	26 ± 1.56	22.6 ± 1.24 2.83* -10	19.5 ± 0.84 6.621** -22.40	13.4 ± 1.10 8.53** -47.2	9.0 ± 0.53 11.97** -64
MCH **'t' value** **% Change**	18 ± 1.19	16.4± 1.02 2.47* -8.88	14.2 ± 0.75 4.65** -21.11	12.0 ± 0.47 6.83** -33.33	8.2 ± 0.64 31.97** -54.44
MCHC **'t' value** **% Change**	19.5 ± 1.27	18.2 ± 1.03 1.452^{ns} -6.66	16.2 ± 0.82 5.621** -17.43	14.8 ± 0.42 9.48** -24.61	12.2 ± 0.79 14.42** -38.46

Results are mean (±SD) of 5 observations
% = Parenthesis denotes percentage increase/decrease over control.