IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 11, Issue 2 Ver. IV (Mar.- Apr.2016), PP 23-25
www.iosrjournals.org

Effect of Electroplating Effluent on Haematological Parameters of the Fresh Water Fish, *Catla Catla*

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Abstract: *Haematological parameters are being used as indicators in the measurement of health conditions and toxicological symptoms of organisms while providing information about the health status of organisms, these parameters may also indicate abnormal environmental conditions. The haematological parameter of fish was studied due to the effect of acute exposure to electroplating effluent. Fishes exposed to sublethal concentration of electroplating effluent for different duration revealed that the electroplating effluent causes alternations in various blood parameters. The exposure of Catla catla to sublethal concentration of electroplating effluent significantly decreased HB %, RBC count, MCV, MCHC values leading to anaemia when compared to control. The anaemia might have led to a fall in the RBC, Hb, MCV and MCHC. Anaemia under electroplating effluent induced stress may also be due to blood cell injury and disrupted haemoglobin synthesis.*

Keywords: *Electroplating effluent, Catla catla, Haematology, Toxicity.*

I. Introduction

The onset of the industrial revolution has lead to massive exploitation of a vast amount of our natural resources within a period of a few hundred years at unimaginable rates. Large amount of wastes and poikilothermic animals and performs best under a narrow range of optimum environmental conditions. Pollution due to industrial waste is increasing and it is a problem throughout the world. The effluent contains various organic and inorganic contents in different concentration which are required by the plants [1]. Electroplating and metal finishing are widely practiced and provide support to many major industries [2]. Electroplating industries are using highly toxic and hazardous chemicals and metal ions which find their way into the effluent [3]. Occupational exposure to many chemicals results in various forms of poisoning and other diseases [4]. Continuous discharge of industrial effluents into the aquatic environment can change both aquatic species diversity and ecosystem, due to their toxicity and accumulative behaviour. Among industries, electroplating industries play an important role in creating heavy metal pollution in water bodies through direct discharge of effluent in water bodies. Aquatic organisms including fish accumulate metals many times higher than in water or sediments.

Electroplating applies a surface coating to provide corrosion protection, wear or erosion resistance, anti-fractional characteristics or for decorative purpose. The electroplating of common metals includes the processes in which a ferrous or non ferrous basis material is electroplated with copper, nickel, chromium, zinc, tin, lead, cadmium, iron, aluminium or combinations of metals. Electroplating is considered a major polluting industry because it discharge toxic materials and heavy metals through wastewater in environment

The use of haematological studies in fish for assessment of impacts of toxicants in environmental research has increased tremendously in recent years. The cellular, biochemical, and physiological systems of multicellular animals that can be maintained in ecotoxicology, the use of haematology has some uniquely attractive features. Likely more than other biological processes, haematology is directly concerned with the internal mechanism of an individual in relation to its survival or essential factor of ecology detrimental changes in blood parameters as a result of contaminants are of great ecotoxicology concern because they have the potential to influence the individual organisms by affecting the susceptibility to disease [5].

II. Materials and Methods

Fishes were maintained in a large tank and acclimatized to laboratory conditions for 21 days. Water was changed daily to maintain the oxygen content and to remove the excreta of fishes. Fishes were maintained at room temperature and fed with ad libitum daily at least one hour prior to the replacement of the tank water. Feeding was stopped one day prior to the experiment in order to keep the animal more or less in the same state of metabolic requirement. The electroplating effluents were collected from the electroplating industry located in the Podannur, Coimbatore near the Noyyal River.

Batches of 10 healthy fishes were exposed to different concentrations of electroplating effluents to calculate the LC_{50} value. One more set of fishes are maintained as control in tap water. To find the wide range of concentration 1 to 10 ml of electroplating effluents were chosen and the number of dead or affected fish in each set up was counted at regular intervals upto 24 hours. The level of the dissolved oxygen, pH, alkalinity and hardness were monitored and maintained constant. The tanks were continuously aerated with electrically operated aerator. Appropriate narrow range of concentration 1-5 ml was used to find the median lethal concentration using a minimum of 6 fishes for each concentration and the mortality was recorded for every 24 hours upto 96 hours. It was found as 1.3 ml for 96 hours. For this stock solution various sub lethal concentrations were prepared for bioassay study. Four groups of fishes were exposed to 0.13 ml (sublethal concentration of 96 hours LC_{50} value) concentration of the electroplating effluents for 24, 48, 72 and 96 hours respectively. Another group was maintained 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 analyzed. The haemoglobin content was estimated by acid haematin method [6]. Total RBC count and WBC count were counted using an improved Neubaurhaemocytometer [7].The mean corpuscular volume was calculated by using values of PCV% and the red blood cell counts expressed in μm-3 [8]. The mean corpuscular haemoglobin content was calculated by using the value of haemoglobin content and the red blood cell counts and expressed in pg [8].The percentage of mean corpuscular haemoglobin concentration was calculated by using the values of haemoglobin content and the PCV% [8]. The PCV percentage was calculated employing standard method and formulae [9].

III. Results and Discussion

The amount of RBC in the blood of the fishes exposed to 0.13 ml Electroplating effluent for 24, 48, 72 and 96 hrs was found to contain 3.0, 2.4, 2.0, 1.7 x $10^6/mm^3$and mean control was found to be 3.5 x $10^6/mm^3$. The amount of WBC were found to be increased from the control. The values were 29.0, 35.0, 47.0, 54.0 and 78.0 x $10^6/mm^3$ in control 24, 48, 72 and 96 hrs respectively. The level of haemoglobin in the fish, *Catla catla* on exposed to 24, 48, 72 and 96 hrs was found to contain 2.8, 2.2, 1.7, 1.4 gm% and mean control was found to be 3.7 gm %. The value of MCV in fishes exposed to 0.13 ml electroplating effluent for 24, 48, 72 and 96 hrs was found to contain 22.5, 19.4, 13.2, 9.0 μm^3 and mean control was found to be 25.00 μm^3. The amount of MCH in the blood of the fishes exposed to 0.13 ml electroplating effluent 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, 16.1, 14.7, 12.0 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 0.13 ml Electroplating effluent for 24, 48, 72 and 96 hrs was found to contain 18.2, 16.0, 14.3, and 11.0 and mean control was found to be 19.6 %.

Table.1. Effect of Electroplating effluent on haematological parameters in blood of the fresh water fish, Catla catla

Sample (mg/g wet tissue)	EXPOSURE PERIODS				
	CONTROL	**24HRS**	**48HRS**	**72HRS**	**96HRS**
RBC	3.5 ± 0.45	3.0 ± 0.53	2.4 ± 0.41	2.0 ± 0.35	1.7 ± 0.17
't' value		0.929ns	2.181*	2.3*	2.525*
% Change		-14.28	-31.42	-42.85	-51.42
WBC	29 ± 1.10	35 ± 2.18	47.0 ± 0.35	54.00 ± 3.45	78.00 ± 3.11
't' value		6.472**	8.048**	19.347**	47.15**
% Change		11968.96	16106.89	18520.68	26796.55
HB	3.7 ± 0.58	2.8 ± 1.09	2.2 ± 0.52	1.7 ± 0.35	1.4 ± 0.45
't' value		1.283ns	1.961*	13.01**	6.53**
% Change		-24.32	-40.54	-54.05	-62.16
PCV	19.6 ± 1.28	18.2 ± 1.15	16.0 ± 0.74	14.3 ± 1.12	11.0 ± 0.83
't' value		1.89^{ns}	6.21**	6.53**	10.97**
% Change		-7.14	-18.36	-27.04	-43.87
MCV	25 ± 1.56	22.5 ± 1.24	19.4 ± 0.84	13.2 ± 1.10	9.0 ± 0.53
't' value		2.83*	6.621**	8.53**	11.97**
% Change		-10	-22.40	-47.2	-64
MCH	18 ± 1.19	16.4± 1.02	14.2 ± 0.75	12.0 ± 0.47	8.2 ± 0.64
't' value		2.47*	4.65**	6.83**	31.97**
% Change		-8.88	-21.11	-33.33	-54.44
MCHC	19.5 ± 1.27	18.2 ± 1.03	16.1 ± 0.82	14.7 ± 0.42	12.0 ± 0.79
't' value		1.452^{ns}	5.621**	9.48**	14.42**
% Change		-6.66	-17.43	-24.61	-38.46

Results are mean (±SD) of 5 observations

% = Parenthesis denotes percentage increase/decrease over control.

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 RBC count coupled with low haemoglobin content may be due to destructive action of pollutants on erythrocytes. The anaemic condition in fish may be detected using haematocrit [10].

Increase in WBC count can be correlated with an increase in antibody production which helps in survival and recovery of fishes exposed to toxicants. The significant increase in total leucocyte count might be due to immunological reaction to produce more antibodies to cope with the stress induced by the toxicant [11].

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 [12]. Prolonged reduction in haemoglobin content is deleterious to oxygen transport and any blood dyscrasia and degeneration of the erythrocytes could be described as pathological condition in fishes exposed to toxicants [13].

The decrease in MCH and MCHC in the present study clearly indicates that the concentration of haemoglobin in RBC is reduced. MCH is a good indicator of RBC swelling [14]. 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 hypochronic microlytic anaemia.

IV. Conclusion

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

Acknowledgements

The authors are grateful to Department of Zoology, Kongunadu Arts and Science College for guiding and providing necessary help for conducting this research studies.

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