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Fig 1: Probit mortality of *Cyprinus carpio* in relation to different concentations of Electroplating industry effluent exposed for 24, 48, 72 and 96 hours

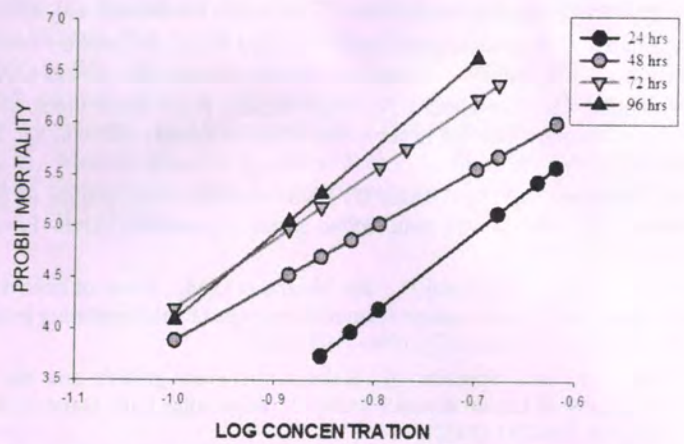

Table 2. *Acute toxicity test results of electroplating industrial effluent to Cyprinus carpio.*

Hours	Lethal concentration values (ppm)							95% Fiducial limits of LC_{50}		Probit Regression Equation	Chi-Square Values		
	LC5	LC10	LC16	LC50	LC84	LC90	LC99	Lower	Upper	Y= a + b x	Observed	Table	Significance
24	0.125	0.139	0.151	0.203	0.271	0.295	0.399	0.185	0.222	Y= 10.47 + 7.88 x	13.75	9.49	S
48	0.080	0.093	0.105	0.158	0.239	0.269	0.413	0.146	0.172	Y= 9.47 + 5.59 x	16.45	12.59	S
72	0.075	0.085	0.094	0.132	0.184	0.203	0.289	0.117	0.148	Y= 10.99 + 6.81 x	25.61	11.07	S
96	0.082	0.091	0.098	0.128	0.168	0.182	0.241	0.102	0.161	Y= 12.57 +8.49 x	14.27	5.99	S

S – Significant

Many workers have conducted experiments to determine the LC_{50} value of different industrial effluents to freshwater fish. The 96hr LC_{50} values of 6.09, 8.35 and 8.25% of paper mill effluent were reported for *Anabas testudineus, Channa punctats and Clarias batrachus* respectively [19], 0.018% detergent effluent to *Clarias gariepinus* [7], 7.07% tannery effluent to *Labeo rohito* [20], 4% electroplating industrial effluent to *Oreochromis mossambicus* [17] and 6% electroplating industrial effluent to *Labeo rohita* [21]. This clearly indicates that freshwater fish are sensitive to several industrial effluents, and based on our results *C. carpio* is sensitive to electroplating industrial effluent.

Indiscriminate discharge of electroplating effluent would be deleterious to aquatic life even at low concentration. Hence effluent treatment measures have to be implemented properly to keep our environment clean. For the removal of toxic metals, industrial effluents can be subjected to coagulation by ferric salt [22], membrane processes [23], polyaluminium chloride, chitosan and montmorillonite [24] and flocculation [25] in addition to biosorption [26].

4. Conclusion

C.carpio was sensitive to even low concentrations of the electroplating industry effluent because of excessive levels of total dissolved solids, sodium, copper, chromium and nickel. Hence the effluent has to be treated before its discharge in to the environment.

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Acute toxicity of effluent from electroplating industry to the Common carp, *Cyprinus carpio* Linn.

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Abstract: *Effluent samples from electroplating industry were collected and brought to the laboratory immediately for the analysis of physico-chemical characteristics. The analyzed parameters were compared with the Central Pollution Control Board (CPCB) standards. Static acute toxicity test was performed for a period of 96 hours using different concentrations of effluent of electroplating industry with the objective of evaluating the acute toxicity to the fresh water fish, Cyprinus carpio. The 24, 48, 72 and 96 hr LC_{50} values were 0.203, 0.158, 0.132, and 0.128% respectively. The need of toxicity evaluation assay for confirming the quality of effluent from the point of effective environmental safe limits and to ensure integrity of aquatic environment is stressed.*

Keywords: *Acute toxicity, Common Carp, Cyprinus carpio, Electroplating industry effluent, LC_{50}.*

1. Introduction

Water, a universal solvent, is an essence for life on earth and hence, discharge of various toxic chemicals and substances into water makes life difficult. Fishes are aquatic and poikilothermic animals and their existence and performance is influenced by the quality of their environment [1]. With the advent of agricultural and industrial revolution, most of the water sources are becoming contaminated [2]. Uncontrolled discharge of industrial effluents containing toxic and hazardous substances, including heavy metals [3-4], led to severe impact on ecological balance and appreciable environmental deterioration. The indiscriminate discharge of effluents from electroplating industries into the natural aquatic systems poses a serious threat to the flora and fauna including fish [5]. Heavy metals are among the pollutants which build up in the food chain and they are responsible for the adverse effects and finally death of aquatic organisms [6-7]. When hazardous substances are released into the environment, an evaluation is necessary to determine the possible impact of these substances on human health and other biota [6-7]. Physico-chemical parameters are generally used for evaluation of effluent quality. However, these parameters alone cannot give a quantitative measure of the impact of pollution. Toxicity evaluation is an important and cost effective tool in wastewater quality monitoring as it provides the complete response of test organisms to all the compounds in a cumulative way [8-9]. Therefore the ultimate aim of toxicity evaluation is to predict the acceptable levels of toxicants in the environment to the biota. The objective of this study was to evaluate the acute toxicity of the electroplating effluent to *C. carpio*. *C. carpio is* having commercial importance and is a known bioindicator in toxicological testing [10-11].

2. Materials and Methods

Healthy *Cyprinus carpio*, irrespective of sex were collected from a local fish farm and they were acclimatized to laboratory conditions in well aerated dechlorinated tap water for fifteen days in fibre tanks (150 liter capacity). The water was changed once in two days to remove the metabolic wastes. After acclimatization, those with an average weight of 25-30g were selected for the study and the feeding was suspended two days before start and throughout the experiment. The effluent from electroplating industry was collected and transported immediately to the laboratory and stored in a refrigerator and the physico-chemical parameters of the effluent sample were estimated adopting standard methods [12].

Preliminary screening test was carried out to ascertain the range of the effluent concentrations before the actual bioassay. The definitive concentrations used for the acute toxicity test were 0.1, 0.13, 0.14, 0.15, 0.16, 0.17, 0.20, 0.21, 0.23, 0.24, 0.3, 0.4, 0.5 and 0.6% in addition to the control. Ten fish were exposed to each concentration and the acute test was conducted for 96 hours. The mortality of fish after 24, 48, 72 and 96 hours exposure was recorded and subjected to probit analysis. The median lethal concentration (LC_{50}) values for 24, 48, 72 and 96 hours were calculated with the 95% fiducial limits.

3. Results and Discussion

The physico-chemical characteristics of the electroplating effluent are shown in Table 1. The pH was highly acidic and the levels of dissolved solids, chromium, nickel, lead, phosphates, sodium, potassium, iron, magnesium, and calcium were very high. The results of the analysis however implicated the effluent to be unsafe and deleterious to aquatic organisms when compared with the permissible limits of [13-14].

Table 1. *Physico-chemical Parameters of the Electroplating Industrial Effluent*

S.No	Parameters	*CPHEEO/CPCB permissible level	Electroplating effluent
1	pH	6.0 to 9.0	< 1
2	Turbidity (NTU)	2.5 NTU	< 1
3	Total dissolved solids (mg/l)	500	105320
4	Chlorides (mg/l)	200	291
5	Sulphates (mg/l)	200	3571
6	Fluoride (mg/l)	1	400
7	Sodium (mg/l)	–	4491.95
8	Copper (mg/l)	3.0	335
9	Cadmium (mg/l)	1.0	< 0.05
10	Chromium (mg/l)	2.0	36756
11	Lead (mg/l)	0.05	11.64
12	Nickel (mg/l)	3.0	27562
13	Potassium (mg/l)	–	289.35
14	Manganese (mg/l)	–	0.94
15	Iron (mg/l)	0.3	16.48
16	Aluminium (mg/l)	–	9.84
17	Calcium (mg/l)	70	265
18	Magnesium (mg/l)	0.4	107

*CPHEEO-Central Public Health Environment Engineering Organization

CPCB-Central Pollution Control Board

The LC_{50} values based on probit analysis were found to be 0.203, 0.158, 0.132 and 0.128% respectively for 24, 48, 72 and 96 hours (Fig 1; Table 2). There was a decline in LC_{50} values from 24 hours to 96 hours. The data indicated a decrease in LC_{50} value with the increase in duration of exposure. Similar result was obtained in *Channa striatus* [15], in the freshwater fish, *Rasbora daniconius* [16], in *Mystus cavasius* [5] and in *Oreochromis mossambicus* [17]. The LC_{50} of effluent for 96 hours (0.128%) was 1.59 times less than the LC_{50} of 24hrs (0.203%). The mortality rate of *C. carpio* remained directly proportional to duration of exposure, concentration and toxicity factor as already observed in *C. carpio* [18].