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Effect of Nickel and Hexavalent Chromium on the Haematology of the Common carp, *Cyprinus carpio*

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Abstract

Fingerlings of common carp were exposed to 2.5, 5.0 and 10.0 ppm of nickel and 15, 30 and 60 ppm of hexavalent chromium for 10, 20 and 30 days. Both the metals induced altera¬tion in the Red and White blood cell pattern of fish. Influence of metal concentration and exposure period on the blood cell pattern was studied applying two way analysis of variance.

Keywords: Cyprinus Carpio; Nickel; Chromium; RBC Count; WBC Count; Haematology

Introduction

In mammalian toxicology, clinical methods are well estab¬lished to evaluate the physiological effects of toxicants. The use of such methods is based upon a good knowledge of normal clinical values and of the relationship between physiological and biochemical alterations, and important whole animal responses. Similar knowledge has not been gained yet in fish toxicology and work is going on in transferring of various clinical methods from medical and veterinary science to fish physiology and toxicology [1]. Haematological procedures are used in the diagnosis of diseases and parasite attacks in fish. They are altered by both environmental and endogenous factors. Several toxicants induce disturbances in the red and white blood cell pattern in fish including heavy metals, pesticides, industrial effluents and other chemicals. In the present work, an attempt has been made to study the effect of nickel and hexavalent chromium on the red and white blood cell count of common carp after chronic exposure.

Materials and Methods

Common carp fingerlings weighing 5+0.2 g were brought from a private farm and acclimatized in the laboratory for a week. Based on the 96h LC50 values of nickel and chromium, 47 and 347 ppm respectively, to common carp, sub lethal concentrations of nickel 2.5, 5 and 10 ppm and of chromium 15, 30 and 60 ppm were chosen. Fish were exposed to the above mentioned concentrations for 30 days. During acclimatization and experimentation, fish were fed with artificially prepared diet. After 10, 20 and 30 days blood was taken from the caudal peduncle of fish exposed to each one of the concentrations. Both in the control and experimental fish both RBC and WBC count were esti¬mated following Johansson-sjobeck and Larsson [2]. The given values represent the mean of three observations. A computerized two-way analysis of variance [3] was applied to find out the signifi¬cance of variation caused by metal concentration and exposure period on RBC and WBC count.

Results

Both nickel and chromium treatment resulted in the decline of RBC count in common carp. But among the test concentrations, decrease in RBC count was more pronounced with the increase in concentration for nickel while the opposite trend was observed for chromium. For nickel treatment, in general, 20 days of expo¬sure produced more pronounced effect than 10 or 30 days of expo¬sure. For chromium treatment, after 30 days of exposure, decline in RBC count was noticed with the increase in chromium concentration (Fig.1 and 2). Decline in WBC count was observed

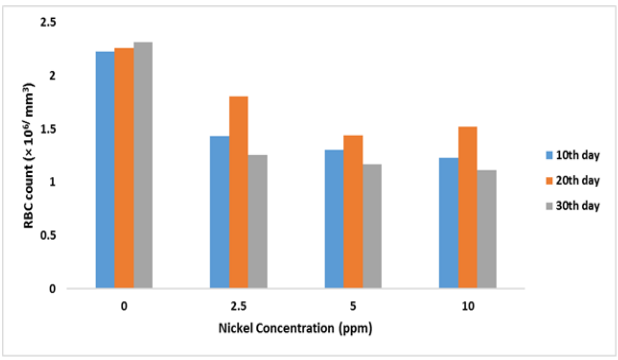

Figure 1: Effect of nickel on the RBC count of *C. carpio communis*

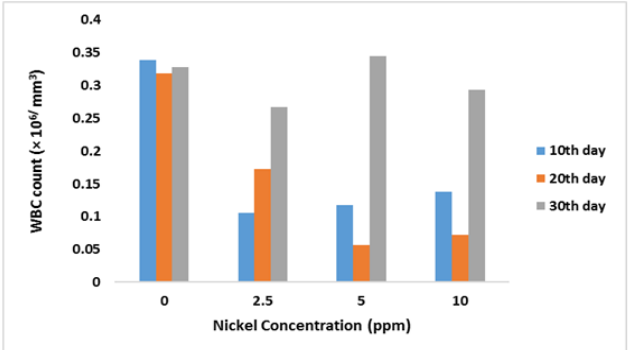

Figure 2: Effect of nickel on the WBC count of *C. carpio communis*

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for both nickel and chromium treatment. But among the test concentrations, in general, WBC count was directly proportional to concentration and exposure period. After 30 days of exposure, WBC count in fish exposed to chromium approached normal values. (Fig.3 and 4).

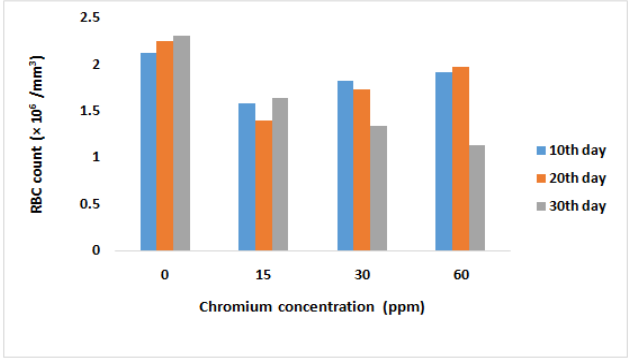

Figure 3: Effect of chromium on the RBC count of *C. carpio communis*

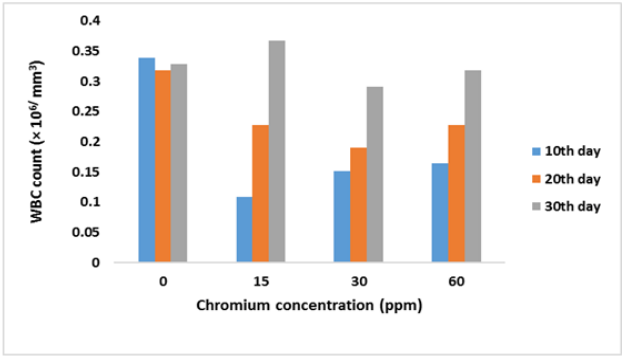

Figure 4: Effect of chromium on the WBC count of *C. carpio communis*

Discussion

A definite decline in RBC and WBC count in fish blood was observed due to nickel and chromium exposure. Similar observations were reported in Coho salmon due to zinc and pulp mill effluent treatment [4]. Reduction in RBC count was also noted in Anabas testudineus treated with textile mill effluent [5], and *Puntius conchonius* [6], *Pleuronectes flesus* [7], *Colisa fasciatus* [8] and *Sarotherodon mossambicus* [9-10] treated with cadmium. The reasons that can be attributed for the reduction in RBC count are inhibition of erythrocyte production, increase in the rate of erythrocyte destruction [11], haemodilution [12-13] due to gill damage or impaired osmoregulation [1] and destruction of haemato- poietic tissues [14].

In contrast, increase in blood cell count was observed in *Mystus vittatus* exposed to copper and zinc [15]. They predicted the reason as over compensation of the fish erythropoietically to make good the reduced oxygen carrying capacity of blood caused by Cu and Zn exposure. It is also reported metal ions stimulating erythropoiesis [16]. Similar reports were given by Larsson *et al.* [17], Haniffa and Isaiarasu [18] and Haniffa *et al.* [19].

Table 1: Two-way Analysis of Variance (ANOVA): Variations due to exposure period and concentration for the factors RBC count and WBC count during nickel and chromium exposure individually

Heavy Metal	Factor	Variables	ss	df	MS	Calculated F Value	Table Value at 5% level	Level of Significance
Nickel	RBC count	Exposure period	0.18	2	0.09	5.32	5.14	S
		Exposure concentration	1.92	3	0.64	37.19	4.75	S
	WBC count	Exposure period	0.06	2	0.03	5.66	5.14	S
		Exposure concentration	0.05	3	0.02	3.65	4.76	NS
Chromium	RBC count	Exposure period	0.16	2	0.08	1.04	5.14	NS
		Exposure concentration	0.87	3	0.29	3.74	4.76	NS
	WBC count	Exposure period	0.04	2	0.02	6.08	5.14	S
		Exposure concentration	0.02	3	0.008	2.58	4.76	NS

S-Significant; NS – Not significant

In the present study both nickel and chromium were found to induce decline in RBC and WBC count of common carp. But in the long—term treatment with both nickel and chromium, WBC count approached normal values. Similar changes were seen in the physiological behavior of fish like food intake, appetite and growth. Due to toxicant induced stress initially but later fish could acclimate at least to sub lethal concentrations of toxicants [20-21]. Evidences for acclimatory trends for toxicant induced changes in numerous blood parameters have also been documented [22-23]. Nickel induced more conspicuous alterations both in RBC and WBC count of common carp than chromium. Hence this type of haematological techniques can be used as diagnostic tools to reveal physiological effects of toxicants at sub lethal levels.

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