Bull. Environ. Contam. Toxicol. (1999) 63:499-502

Bulletin of Environmental Contamination and Toxicology

Impact of Mixture of Nickel and Chromium on the Protein Content of Flesh and Liver of *Cyprinus carpio* During Spawning and Post-Spawning Phases

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Received: 31 January 1999/Accepted: 15 July 1999

The metal works industries release a good amount of heavy metals like mercury, cadmium, manganese, nickel and chromium which ultimately fall in the water bodies. Heavy metals are known to cause alterations in various tissues of fish at the biochemical level. As the water bodies receive a wide variety of metals , their interaction can produce unexpected results,hence the need to pay attention to the effect of mixture of metals on fish. Reports are available regarding the effect of individual metals on the biochemistry of fish (Katti and Sathyanesan 1983; Jana and Bandhopadhyay 1987; Virk and Dhawan 1997). However, no information is on record concerning the combined effect of metals on the biochemical composition of fish. The objective of the present work was to observe the effect of mixture of nickel and chromium on flesh and liver of common carp, *Cyprinus carpio.*

MATERIALS AND METHODS

Test fish, *Cyprinus carpio* were collected from Fish Farm of Punjab Agricultural University, Ludhiana during spawning and post-spawning phases and specimens having 40.0 ± 2.5 g weight were selected and acclimated to laboratory conditions for 15 days. The fish were fed on rice bran and oil cake (1: 1) *ad libitum*. Experiments were conducted in triplicate in glass aquaria (95x45x45 cm) having water capacity of 150 L. Dechlorinated tap water having pH (7.3±0.2), temperature (22±2°C), dissolved oxygen (5.5±0.5 mg/L) and hardness (272+2 mg/L as $CaCO_3$) was used to run the experiments and control. Safe (SC) and sublethal SLZ) concentrations of nickel ($NiCl_2 6H_2O$) and chromium ($CrCl_3 6 H_2O$) were determined by conducting bioassay experiments (Virk and Sharma 1995). Ten specimens were exposed to a mixture of 7.5 mg Ni/L + 10.0 mg Cr/L (safe concentration) and 15.0 mg Ni/L + 20.0 mg Cr/L (sublethal concentration) in aquaria having 100 L water for 60 days each during spawning (Feb.-March) and post-spawning phases(April-May). At the time of exposure, three fish were sacrificed and analysed for proteins of flesh and liver (Lowry et al. 1951) which served as the initial control. Water of both the experimental and control aquaria was changed twice a week after feeding. At the end of each experiment, three fish were sacrificed and their flesh and liver were analysed for proteins.

Significant differences ($p < 0.05$) were calculated using one way ANOVA.

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RESULTS AND DISCUSSION

Exposure to mixture of safe (SC) and sublethal (SLC) concentration of nickel and chromium for 60 d each during spawning and post-spawning phase caused significant decline in flesh proteins in *Cyprinus carpio* as compared to control (Table 1). However, the difference between the two treatments was not significant during post-spawning phase. The per cent depletion in proteins was higher during spawning phase (47.69) as compared to post-spawning phase (37.14) following exposure to sublethal concentration. The depletion in flesh proteins may be due to increased rate of catabolism caused by elevation in the level of aminotransaminases as reported in *Clarias batrachus* exposed to dimethoate (Begum and Vijayaraghavan 1996). Aminotransaminases play an important role in the utilisation of amino acids for oxidation and/or for gluconeogenesis (Rodwell 1988). Decline in protein content of flesh has also been reported in *Channa punctatus* exposed to 12 mg/L of zinc sulphate (Shukla and Pandey 1986)and to 0.5, 1.0, 2.0 and 5.0 mg/L of magnesium, arsenic, cadmium and copper, respectively(Jana and Bandhopadhyay 1987) and in *Cyprinus carpio* exposed to 0.1 mg/L of mercury (SivaramaKrishna and Radhkrishnaiah 1998).

Table 1. Protein content (mg/100 mg wet tissue) of flesh and liver of *Cyprinus carpio* exposed to mixture of nickel and chromium.

Phases	Treatments				
	C	SC	% change over control	SLC	% change over control
Flesh					
Spawning	13.42^{a} ±.69	8.88^{b} ±.39	-33.83	7.02^{c}	-47.69 ±.40
Post-spawning	14.33^{a} ±.40	10.52^{b} ±.81	-26.68	9.62^{b}	-37.14 ±.36
Liver					
Spawning	5.13^{a} ±.30	3.45^{b} ±.36	-32.74	3.02^{b} ±.15	-41.13
Post-spawning	6.52^{a} ±.38	3.80^{b} ±.37	-41.72	3.85^{b} ±.92	-40.95

C-control, SC-Safe concentration, SLC-Sublethal concentration.
Each value is average (x±S.D.) of three observations.
Values a,b,c indicate significant difference.

Proteins in liver were reduced significantly during both the reproductive phases, in both the treatments as compared to control (Table 1). However, the two treatments did not show significant difference. Depletion in liver proteins as observed in the present study may be due to increase in their utilisation to overcome stress created by the heavy metals (Sivakami et al. 1994) or it may be due to necrosis of hepatocytes (Verma and Tonk 1983). Kondal et al. (1988) attributed the decrease in the protein content of liver of *Heteropneustes fossilis* exposed to vegetable oil factory effluent to the decrease in the availability of

energy required for the synthesis of proteins because of the decreased level of key enzymes (isocitrate dehydrogenase and malate dehydrogenase) and/or due to enhanced catabolism of amino acids as a result of increased activity of glutamate dehydrogenase. Virk (1995) also reported decline in the liver proteins in *C. carpio* exposed to safe and sublethal concentration of nickel (7.5, 15.0 mg/L) and chromium (10.0, 20.0 mg/L), separately.

Table 2. Per cent change over control in the protein content of flesh and liver of *Cyprinus carpio* exposed to Ni and Cr.

Reproductive phases	Treatments				
	Ni		Cr		Reference
	SC	SLC	SC	SLC	
Flesh					
Spawning	-30.45	-26.50	+6.39	+0.56	Virk and Dhawan,
Post-spawning	-22.62	-23.75	-15.15	+0.56	1997
Liver					
Spawning	-30.67	-37.11	-26.68	-15.64	Virk, 1995
Post-spawning	-13.00	-19.10	-3.04	+1.60	

C-control, SC-Safe concentration, SLC-Sublethal concentration.

In the present studies, the flesh and liver of *C. carpio* exposed to a mixture of safe and sublethal concentration of nickel and chromium showed more. deterioration during spawning phase as compared to post-spawning phase. However, the sublethal concentration caused more damage than the safe concentration. Comparison of the present study showing the effect of mixture of safe and sublethal concentration of nickel and chromium (Table 1) with that of individual metals (Table 2) (Virk 1995 and Virk and Dhawan 1997) shows that the mixture of metals is more toxic than nickel followed by chromium, thus indicating synergistic effect of the metals. Similar studies have been conducted by James et al (1995) who have reported that the flesh and liver of *Heteropneustes fossilis* incurred greater loss of proteins when exposed to copper + mercury as compared to fish exposed to copper and mercury individually. However, such studies need to be further investigated.

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