

Effect of heavy metal pollution of water on total plasma proteins and serum protein profiles of Common Carp fish (*Cyprinus carpio*)

M Saxena, H Saxena, G Sangha, K Kaur

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Abstract

Two groups of six Common Carp fish each were exposed to a combination of various compounds of eight heavy metals in water for two months. The concentration of the metals in the water was the same as found in the polluted water of Buddha Nallah, a drain of Ludhiana which flows through the heart of the city and joins the river Satluj. Levels of total plasma proteins and serum protein profiles of normal and pollutant – exposed fish were analyzed. The mean value of total plasma proteins was lower (though non – significantly) in case of pollutant – exposed fish. Serum protein profiles on SDS – PAGE showed that the proteins p63 and p25 disappear while p56 and p22 appear in the sera of fish on exposure to heavy metal polluted water.

INTRODUCTION

The normal functions of fish are susceptible to adverse changes in water quality. Occurrence of aquatic pollutants (such as heavy metals) has been correlated to alterations in the fish immune system and the incidence of infectious diseases. Even very low sub lethal doses of certain heavy metals can have profound effects upon the structure and / or functions of the immune system that could be almost as harmful as direct toxic doses. Ludhiana has a large number of industries for manufacturing bicycle parts, Nickel – Chrome plating, dyeing and woolen hosiery etc. The heavy metal Chromium is often found in the effluents of many industries especially Chrome plating and Chrome tanning industries which are a major source of pollution of surface and ground water. Pollution of water with heavy metals may adversely affect the immune system of fish leading to decreased production, increased susceptibility to diseases and mortality. The effect of heavy metals on immunity of common carp fish was, therefore, evaluated in this study.

MATERIALS AND METHODS

Experimental fish: The present studies were conducted on Common Carp (*Cyprinus carpio*) 20 cm long and weighing 250 gm available at GADVASU Fish Farm, Ludhiana.

Exposure of fish to heavy metals: Fishes were divided into two groups of 10 fish each and kept in plastic tanks of size 160 x 110 x 110 cm. Aerators and ample daylight were

provided in the tanks and the water temperature was maintained at 30 0 C. The fishes were acclimatized under lab conditions for two weeks and then exposed to 8 heavy metals in the concentration (mg/L) as found in the polluted water of Buddha Nallah (Iron – 35.86; Zinc – 2.75; Manganese – 0.166; Nickel – 0.090; Chromium – 0.065; Copper – 0.045; Lead – 0.044; Cadmim – 0.025, respectively). The fish were fed daily with normal fish feed @ 1% of their body weight.

Estimation of plasma total protein levels: Estimation of total protein levels in the plasma of normal and pollutant – exposed fish was done by Lowry's method.

Serum protein profiles: Serum protein profiles were studied by SDS Polyacrylamide gel electrophoresis (SDS PAGE) as per the standard method using 5% gel for stacking and 12.5% gel for resolving of proteins.

RESULTS

Levels of total proteins in plasma: The total protein concentrations in the plasma of normal and pollutant – exposed fish were determined. The mean \pm SE value of concentration of proteins (μ g/ml) in the plasma was 396.17 ± 26.50 in normal fish and 323.00 ± 18.41 in pollutant – exposed fish. Although the mean value was lower in case of pollutant – exposed fish, it did not differ significantly from that of normal fish (Table 1).

Figure 1

Table 1: Protein concentration in plasma of normal and pollutant - exposed fish

S. no.	Protein concentration in plasma (µg/ml)	
	Normal fish	Exposed fish
1	324	306
2	354	373
3	338	276
4	463	326
5	431	379
6	467	278
Mean ± SE	396.17 ± 26.50	323.00 ± 18.41

Serum protein profiles: The serum protein profiles of 5 normal and 5 pollutant - exposed fish were studied by SDS-PAGE. The protein p63 present in the sera of 60% (3 of 5) of normal fish could be detected in only 20% (1 of 5) of exposed fish. The proteins p56 and p22 present in the sera of 80% (4 of 5) of exposed fish was detected in the sera of only 40% (2 of 5) of normal fish. The protein p25 present in the sera of 80% (4 of 5) of normal fish, was detected in the sera of only 40% (2 of 5) of pollutant - exposed fish. Thus, the levels of proteins p63 and p25 diminish while those of p56 and p22 increase in the serum of fish as a result of exposure to heavy metal polluted water (Tables 2 & 3, Fig. 1).

Figure 2

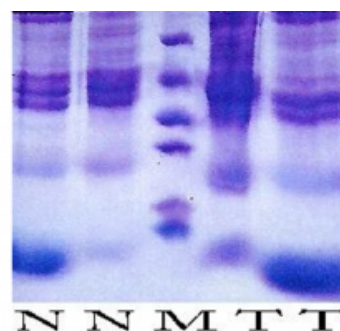
Table 2: Serum protein profiles of normal and pollutant - exposed fish

S. N.	Protein (kDa)	Normal fish					Pollutant - exposed fish				
		N1	N2	N3	N4	N5	T1	T2	T3	T4	T5
1	18	+	+	-	-	-	+	-	+	-	+
2	22	+	+	-	-	-	+	+	+	-	+
3	25	+	+	+	-	+	-	-	+	-	+
4	28	+	+	+	-	-	+	-	+	-	+
5	32	+	+	+	-	+	+	+	+	+	+
6	35	+	+	+	+	+	+	-	+	+	-
7	40	+	+	+	-	-	+	+	+	+	+
8	45	+	+	+	+	+	+	-	+	+	+
9	56	+	-	+	-	-	+	+	+	-	+
10	63	+	+	-	+	-	-	-	+	-	-
11	71	+	+	+	+	-	+	-	+	+	+
12	79	+	-	+	+	-	+	-	+	+	+
13	89	+	+	+	+	+	+	+	+	+	+
14	100	+	+	+	+	+	+	-	+	+	+
15	112	+	+	+	+	+	+	+	+	+	+

Figure 3

Figure 1: SDS-PAGE Serum protein profiles of normal and

pollutant - exposed fish



N = normal fish, T = pollutant - exposed fish, M = molecular weight markers

DISCUSSION

It is evident from the results that exposure of fish to pollutants decreased the concentration of plasma proteins. The immunity is also adversely affected in fish on exposure to water contaminated with heavy metals. This is supported by the earlier reports that humoral immunity is depressed in pollutant - exposed fish. However, the significance, biochemical nature and functions of proteins p63 and p25 found in this study to be down regulated on exposure of fish to heavy metals, is unclear. Similarly, the cause and consequence of proteins p56 and p22 found to be upregulated in pollutant - exposed fish need to be explored further.

References

Author Information

Madhu Saxena

College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU)

H.M. Saxena

Department of Veterinary Microbiology, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU)

Gurpreet Kaur Sangha

Department of Zoology, COBS&H, Punjab Agricultural University

Kamaldeep Kaur

College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU)