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Research Article

INFLUENCE OF CHROMIUM TOXICITY ON THE HAEMATOLOGICAL PARAMETERS OF ANABAS SCANDENS FINGERLINGS

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ABSTRACT

Heavy metals are the major pollutants in the aquatic environment. It may affect the aquatic organisms directly and indirectly and causes significant changes in the physiological parameters. Finally, it affects the ecological imbalances in food chain. The main aim of the current research is to study the haematological parameters of fresh water fish *Anabas scandens* exposed to sublethal concentrations of chromium. When the fishes were exposed to the heavy metal chromium in shows significant alteration in the haemotological parameters such as the red blood cells (RBC), white blood cells (WBC), haemoglobin (Hb), haematocrit (Ht), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) were assessed.

Keywords: *Anabas scandens*, Chromium, Haematology, RBC, WBC, Haemoglobin.

INTRODUCTION

In aquatic environments, fishes are usually regarded as organisms of choice for assessing the effects of environmental pollution on aquatic ecosystems. The fish is in huge demand in the North Eastern part of India, particularly in West Bengal, Assam, Odisha and Bihar for its high nutritional value. It contains more percentage of protein and iron as compared to other edible freshwater fish species. In eco toxicology, heavy metals have gained significant consideration because of their boost in toxicity and amassing tendency in the aquatic fauna. Heavy metals concentration has been increased recently as a result of domestic, industrial as well as agricultural activities and poses greatest threat to the ecosystem. Toxicity with heavy metals is due to disrupt the function of essential biological molecules such as protein, enzymes and DNA as metals lead to the displacement of an essential metal cofactor of the enzyme and interaction of the metallic ions with DNA which proven to be carcinogenic to animals and humans. The most important heavy metals in water pollution are zinc, copper, lead, cadmium, mercury, chromium and nickel chloride (Abel, 1989; Seymore, 1994; Viljoen, 1999). Heavy metal causes behavior response, alterations in hepatocytes, enzymatic reaction and proteomic studies in fishes (as a biomarker). It has been useful in environmental pollution monitoring (Sabullah *et al.,* 2015). Metal uptake in aquatic organisms can be achieved n two-phase process, primarily it involves rapid adsorption or surface binding, and second phase can be a slower transport into the entire parts of the tissue or organs. Transport of metals into the intracellular section may be aided by either diffusion of the metal ion across the cell membrane or by active transport by a carrier protein (Brezonik *et al.*, 1991; Wepener *et al.*, 2001). The cellular damage of fish erythrocytes on treatment with heavy metals leads to physiological malfunctioning and hence these metals, consider as a sensitive indicator of pollution Paul and Ramanujam (2016).

Industrial effluent containing heavy metals, on entering aquatic environment causes biochemical disturbances in the fingerlings. The heavy metals are constantly polluting natural waters and the adverse effects are manifold on living organisms including economically important fingerlings. They are also responsible for various disturbances in physiological and biochemical parameters of fingerlings (Shaffi, 1979; Ayoola *et al.,* 2014). The rapid

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pace of industrialization and anthropogenic inputs have contaminated many ecosystems (Gayathri *et al*., 2008) especially the aquatic ecosystem, which receives a wide range of pollutants. Chromium is one of the heavy metals and first element in Group VI. The main sources of chromium (VI) come from hydrogenation chromate dye industry and paint factories, motor vehicle, aircraft industry, printing and in some cases the chemical industry. It has melting point. High exposure of chromium affects the growth and reproductive capacity. Further it affects distortion of seminiferous tubules, disorganization of spermatogonia, spermatocytes and spermatids with cytoplasmic vacuolization and nuclear pycnosis. (Claramma Johnson and Radhakrishnan**,** 2016).

Heavy metals released into aquatic ecosystems, are responsible for several fingerlings' physiology irregularities (Sehgal and Saxena, 1986). They can also disturb the ion regulatory mechanism in aquatic organisms (Hansen *et al.*, 1996). All of these effects of heavy metal, usually affect fingerlings negatively leading to stress and eventually, in most cases, death (Shiv Shankar *et al*., 2015). From the above review of literature, it is evident that the effect of heavy metal, Chromium (VI) on the freshwater fingerlings of *Anabas scandens* is still scanty and obscure. Hence, the work has been programmed to investigate the Chromium (VI) intoxication on the histological, biochemical and enzymological changes on the freshwater fingerlings of *Anabas scandens.*

MATERIALS AND METHODS

Healthy fingerlings of *Anabas scandens* in the size range of 10-13 cms of the same stock of a given season were procured from seed fish india (P) Ltd., Budhur, Trivellore (Taluk), Chengai M.G.R. District, Tamilnadu. The fish stocks were fed after acclimatization and the feeding was stopped one day prior to experimentation. According to Sprague (1971) one-tenth of the 96h LC_{50} values represent the lower sub lethal concentrations. Hence, the one-tenth (27.25ppm for chromium (VI)) of the 96 hr LC_{50} values of chromium (VI) was selected for the present investigation as sub lethal concentration. The experimental fingerlings were exposed to sub lethal concentrations of chromium for the period of 28 days. The control and experimental fingerlings were dissected at the end of 5, 10, 15 and 20 days of exposure and the blood samples were also collected for determining the hematological parameters. Experiments were done on the control, earlier (5 days) and final exposure days (20 days).

Collection of blood samples

Blood samples were collected from the control and experimental fingerlings from the ductus Cuvier with the help of 24 guage needle and stored in heparinized glass tube. The haematological parameters such as total Red blood corpuscles (RBC), White blood corpuscles (WBC), Haemoglobin (Hb), Haematocrit (Ht), Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were determined by adopting the method of Dacie and Lewis (1984).

RESULTS AND DISCUSSION

The red blood cells of fingerlings *Anabas scandens* exposed to sub lethal concentrations of chromium and control were given in the Figure 1. The RBC counting in the control group was 1.58 $X10^6$ cells per cubic mm of blood. In chromium treated fingerlings, they were 1.48, 1.35, 1.08 and 1.01 million/blood Cu mm in the fish exposed to 5, 10, 15 and 20 days of exposure periods respectively. The RBC count was decreased in chromium treated experimental fingerlings. The decreased count of RBC at all the exposure periods was statistically significant at $p< 0.05$ level. The white blood cells of fingerlings *Anabas scandens* exposed to sub lethal concentrations of chromium and control were given in the Figure 2. In the control group of fingerlings the WBC count was 7.89 $X10^3$ per cubic mm of blood. In chromium treated fingerlings, the WBC counts were 6.56, 6.05, 5.75 and 4.25$X10^3$ Cu mm in the fish exposed to 5, 10, 15 and 20 days of exposure. The WBC count was decreased in the chromium exposed fingerlings. The decreased number of WBC at all the exposure periods were statistically significant at $p<0.05$ level.

The level of hemoglobin was given in the Figure 3. The hemoglobin level in the control group was 14.80 mg/100 ml. In chromium treated fingerlings, the haemoglobin was 13.72, 12.54, 11.95 and 9.56 for the 5, 10, 15 and 20 days of exposure during chromium treatment. The hemoglobin level was decreased in all the exposure blood of fingerlings. The decreased level of hemoglobin at all the exposure periods was statistically significant at $p<0.05$ level. The Haematocrit values of fingerlings *Anabas scandens* exposed to sub lethal concentration of chromium were decreased in all the exposed periods. The haematocrit in the control group was 32.05 %. In chromium treated fingerlings, haematocrit values were 28.74, 27.32, 25.45 and 18.65 % for the 5, 10, 15 and 20 days of exposure periods respectively (Figure 4). The decreased haematocrit at all the exposure periods were statistically significant at $p<0.05$ level. The Mean cell volume of *Anabas scandens* exposed to sub lethal concentration chromium and control was given Figure 5. The MCV in the control group was 19.04 μm^3. In chromium treated fingerlings they were 18.54, 17.35, 16.95 and 13.87 μm^3 for the 5, 10, 15 and 20 days of exposure periods respectively. The decreased MCV were statistically significant at all the exposure periods at $p<0.05$ level.

The Mean cell haemoglobin of control fingerlings was 88.57 Pg. In chromium treated fingerlings, the MCH were 92.44, 91.08, 105.23 and 98.75 Pg for the 5, 10, 15 and 20 days of exposure of periods (Figure 6). The MCH were increased after 5 days exposure and then decreased in 10 days exposure. Same as again increased in 15 days exposure, then decreased in 20 days exposure. The increased MCH were statistically significant at $p<0.05$ level at all the exposure periods. The Mean cell haemoglobin concentration of fingerlings *Anabas scandens* exposed to sub lethal concentration chromium and control was given Figure 7. The MCHC in the control group was 45.21%. In chromium treated fingerlings, the MCHC was increased 46.58 and 51.45 % for the 5 and 20 days of exposure of chromium and decreased 45.96 and 46.87 % for the 10 and 15 days of exposure. ($p < 0.05$ level).

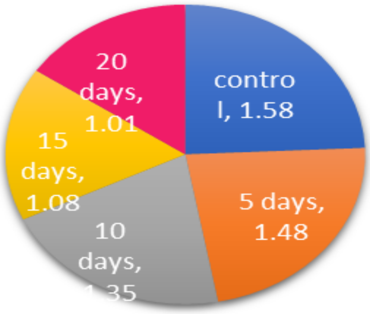

Figure 1. Impact of Chromium on RBC of freshwater fish *Anabas scandens*

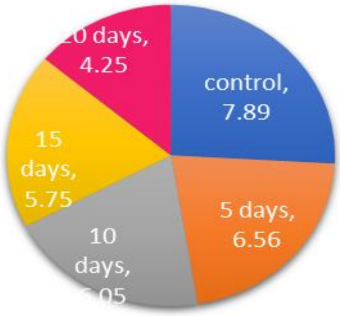

Figure 2. Impact of Chromium on WBC of freshwater fish *Anabas scandens*

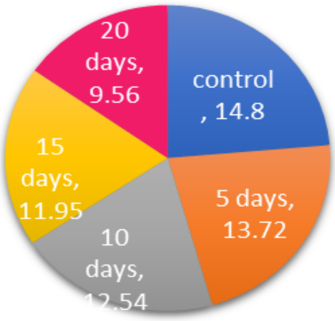

Figure 3. Impact of Chromium on haemoglobin of freshwater fish *Anabas scandens*

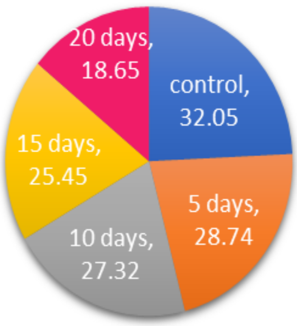

Figure 4. Impact of Chromium on haematocrit of freshwater fish *Anabas scandens*

Figure 5. Impact of Chromium on MCV of freshwater fish *Anabas scandens*

Figure 6. Impact of Chromium on MCH of freshwater fish *Anabas scandens*

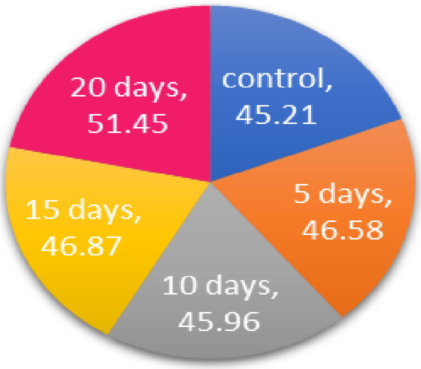

Figure 7. Impact of Chromium on MCHC of freshwater fish *Anabas scandens.*

The most common hematological parameters determined during stress included red and white blood cells count, hemoglobin content, and haematocrit value and red blood cell indices. Fingerlings hematological parameters are often determined as an index of their physiological status (Oshode *et al.,* 2008). The blood parameters have been used as a sensitive indicator of stress in fingerlings exposed to different water pollutants and toxicants, such as metals, biocides, pesticides, chemical industrial effluents, etc. These metallic ions are the probable major cause of the physiological abnormalities in fingerlings. In the present study, the white blood cell count, mean cell hemoglobin and mean cell hemoglobin concentration have increased at sub lethal concentration of chromium in *Anabas scandens* for 5, 10, 15 and 20 days. In chromium treated fingerlings, they were 1.48, 1.35, 1.08 and 1.01 million/blood Cu mm in the fish exposed to 5, 10, 15 and 20 days of exposure periods respectively. In chromium treated fingerlings, the WBC counts were 6.56, 6.05, 5.75 and 4.25X10^3 Cu mm in the fish exposed to 5, 10, 15 and 20 days of exposure. The WBC count was decreased in the chromium exposed fingerlings.

Thangam *et al.,* (2016) the toxicity of inorganic mercury in *C. carpio*, the hemoglobin content in the exposed fish found to be decreased. WBC count end of exposure increased. In chromium treated fingerlings, the haemoglobin was 13.72, 12.54, 11.95 and 9.56 for the 5, 10, 15 and 20 days of exposure during chromium treatment. Same as, in the haematocrit values were 28.74, 27.32, 25.45 and 18.65 % for the 5, 10, 15 and 20 days of exposure periods respectively. The hemoglobin and haematocrit levels were decreased in all the exposure blood of fingerlings. The MCV in the control group was 19.56 μm^3. The MCV in the control group was 19.04 μm^3. In chromium treated fingerlings they were 18.54; 17.35, 16.95 and 13.87 μm^3 for the 5, 10, 15 and 20 days of exposure periods respectively. The MCH values were 92.44, 91.08, 105.23 and 98.75 Pg for the 5, 10, 15 and 20 days of exposure of periods The MCV values were decreased but alterations observed in MCH values. In chromium treated fingerlings, the MCHC was increased 46.58 and 51.45 % for the 5 and 20 days of exposure of chromium and decreased 45.96 and 46.87 % for the 10 and 15 days of exposure. Dharmlata *and joshi* (2002) suggested that heavy metal exposure also decreased the RBC, Hb% and PCV% due to impaired intestinal absorption of iron. The most common hematological variables measured during stress included red and white blood cells count, hemoglobin content, and hematocrit value and red blood cells indices. Due to destruction of haemopoietic tissue (Patil and Dhande, 2000) and Fingerlings hematological parameters are often determined as an index of their health status (Oshode *et al.,* 2008). A similar response was noted in common carp and other freshwater fingerlings exposed to the acute toxicity level of pesticides (Svoboda *et al*., 2001). The increase in MCHC% can be correlated to the decrease in the haemoglobin concentration.

CONCLUSION

Paul and Ramanujam (2016) assessed about the deleterious effects of heavy metals, cadmium and copper on the structural alterations of RBCs of a freshwater air-breathing catfish, *H. fossilis.* Decrease in RBC, Hb and increase in WBC have been reported in *C. punctatus* exposed to zinc for 135 days (Srivastava *et al*, 2005). The difference in hematological changes in most of the fingerings after exposure to different pollutants shows variability in their respective responses to stress causing pollutants. Venkatachalam and Natarajan, (2014) exposure of *L. rohita* to Cr (III) and Cr (VI) toxicity, the haematological parameters mean corpuscular hemoglobin concentration (MCHC). In the present study there is a significant change in the above haematological parameters are apparent in the fish exposed to the heavy metal chromium.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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