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ORIGINAL ARTICLE

EFFECT OF HEAVY METAL ARSENIC ON HAEMATOLOGICAL PARAMETERS OF FRESH WATER FISH, *TILAPIA MOSSAMBICA*

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ABSTRACT

The present study is aimed to investigate the haematological parameters such as haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV),mean cell heamoglobin (MCH) and mean cell heamoglobin concentration (MCHC) in the blood of fresh water fish, *Tilapia mossambica* exposed sublethal concentration of Arsenic trioxide. The present study shows the level of heamoglobin,red blood cells and packed cell volume were significantly decreased and simultaneously the white blood cells, mean cell heamoglobin and mean cell heamoglobin concentration were significantly decreased due to arsenic exposure. The present study concludes that the arsenic compound affect the hematological parameters of fish of *Tilapia mossambica.*

Keywords: Arsenic, *Tilapia mossambica*, Blood, Haematological parameters

1.INTRODUCTION

Heavy metal pollution of water is a major environmental problem facing the modern world (Dushenkov *et al.*, 1995). Heavy metals polluted water may lead to the destruction of beneficial species either indirectly through breaking the biological food chain or directly by affecting the aquatic forms of life. Heavy metals enter into aquatic habitats by a number of routes and cause hazardous effect on their morphology and physiology. Heavy metal constitute a serious type of pollution in fresh water and being stable compounds, they are not readily removed by oxidation, precipitation or other processes and affect the activity in recipient animal (Nammalwar, 1985). Heavy metals such as chromium, mercury, lead and arsenic are non essential elements and are toxic to the aquatic organisms even at low levels. The cumulative concentration of pollutants along the food chain poses a threat to both human and animal health.

Arsenic is a natural and ubiquitous element that presents in many environmental compartments. Arsenic contamination in natural water is a world wide problem and has become a challenge for world scientist. Arsenic is being a potent environmental toxic agent and considered as a human carcinogen leads to development of various hazardous effects on human health. Chronic arsenic toxicity due to drinking of arsenic contaminated water has been reported from many countries. Recently, large population in West Bengal in India and Bangladesh has reported to be affected with arsenic (Smith *et al.*, 2000).

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Fishes are relatively sensitive to changes in their surrounding environment. Fish health may thus reflect, and give a good indication of the health status of a specific aquatic ecosystem. Early toxic effects of pollution may, however, only be evident on cellular or tissue level before significant changes can be identified in fish behavior or external appearance. Natural water reservoirs are traditionally being used for aquaculture and they contribute significantly to total fish production across the globe.

Blood plays a decisive role in the regulation of life processes to make them function properly. An organism must be able to keep its blood composition relatively constant under normal conditions and must also have the ability to change it under extreme conditions such as stress situations. Changes occurring in the haematological characters of fishes provide a sensitive measure to assess the health of fish fauna. Further, the fish blood is a valuable diagnostic tool for the investigation of diseases and physiological or metabolic alterations. Haematological techniques including measurements of Haematocrit, White Blood Corpuscles, Red Blood Corpuscles and Haemoglobin have proved valuable study for fishery biologists in assessing the health status of fish and monitoring stress response.

2.MATERIALS AND METHODS

The fresh water fish *Tilapia mossambica* were collected from fish farm at Puthur, Tamil Nadu, India. The collected fish were acclimated to laboratory condition for 15 days . They were checked thoroughly for injury and disease conditions, and only healthy fishes were used for this study. After

washing with 0.01% KMnO4 solution for 15 min, they were placed in nine plastic pools (500 L) containing non-chlorinated water. Prior to the start of the experiment, the fishes were acclimatized to the food and laboratory conditions with 12 h dark and 12 h light cycles, pH range of 6.95 to 7.60 and temperature ranging from 16 to 24 °C for 15 days. Fishes were divided into two equal groups each comprising of 10 fishes. Each group was kept in separate plastic tanks. The first group was kept as negative control; the fishes were maintained in water containing normal water without any treatment. The fishes of test group was exposed to a sub-lethal concentration of Arsenic added in the water for 21 days. Solutions were renewed once daily after exposure period, animals (n=20/group) were sacrificed and the blood was collected and used for hematological parameters by using the method of Dacie and Levies (1984).

3.RESULTS

The amount of Hb was 7.01±1.26 cells in the blood of normal fish. During the arsenic treatment, the amount of Hb in the treated fish was 6.34±1.30 for 21days. The percent change over the control was 9.55.The number of RBC was 1.84±1.07 in the normal blood. During the arsenic treated fish blood the number of RBC was decreased upto 1 1.73±1.0 for 21days . The percent change over the control was 5.97.In the normal fish blood the amount of WBC was 18.91±1.62. at the sublethal concentration of arsenic the number of WBC was 17.08±1.21 21 days. The percent change over the control was 9.67.The amount of PCV was 17.98±1.21 in the normal blood of fish. During the 15 and 30 days of exposure of arsenic the amount of PCV was 17.18±1.47. The percent change over the control was 4.44.The amount of MCH was 38.09±1.04 in the normal blood. During the sublethal concentration of arsenic the amount of MCH was ere 36.43±1.07 for 21. The percent change over the control was 4.35.The amount of MCHC was 38.98±1.47 in the control fish. At sublethal ciontration of arsenic the amount of MCHC was 36.90±1.54 for 21. The percent change over the control was 5.34.

Table 1: Level of haematological parameters in blood of *Tilapia mossambica* exposed to arsenic

Tissues	Control	21 days	% COC
Hb (%)	7.01 ± 1.26	6.34 ± 1.0	9.55
RBC (cumm^3)	1.84 ± 1.07	1.73 ± 1.4	5.97
WBC (cumm^3)	18.91 ± 1.62	17.08 ± 1.21	9.67
PCV (%)	17.98 ± 1.21	17.18 ± 1.47	4.44
MCH (pq)	38.09 ± 1.04	36.43 ± 1.07	4.35
MCHC (%)	38.98 ± 1.47	36.90 ± 1.54	5.34

Mean ± S.D. of six individual observations;* Significance ($p<0.05$) Group I compared with group II;%COC-Percent change over the control

4.DISCUSSION

Blood acts as an internal transport and is an important tool to assess the toxicant of organisms and it is one of the major routes of absorption of environmental pollutions [Joshi *et al*, 2002]. Hematological parameters are most important parameters for evaluation physiological status of fish in warm blooded animals. These parameters more related the response of the whole organisms Blood parameters are important in diagnosing the functional status of animals exposed to toxicants. Anemia is one of the most sensitive pathological conditions developed as a result of heavy metal poisoining [Joshi *et al*, 2002].

In the present study, the haematological parameters Haemoglobin, Red blood cells, white blood cells, packed cell volume, mean cell haemoglobin and mean cell haemoglobin level were observed in *Tilapia mossambica* when exposed with sublethal concentration of arsenic for 21 days. The toxicity of arsenic on the haematological parameters such as Hb, RBC, and PCV were significantly decreased because the arsenic affect the animals and lead to anaemia. Anupama Tyagi and Srivastava (2005) have reported that the haematological parameters of *channa punctatus* exposed to zinc. Saravanan and Harikrishnan (1999) have reported that pollutants generally cause changes in the haematological parameters of the fishes. Iqbal *et al*, (1997) have also observed that reduced level of RBC, Hb, and PCV in the *Arrhina mrigla* when the fish treated with lead.

In the present study the MCH and MCHC increased in the blood of *Tilapia mossambica* exposed to arsenic. The attended amount of MCH and MCHC indicate the hydrochronic microcytic anaemia. It may be due to decreased amount of haemolobin in the arsenic intoxicated animals. Berlin and Ulberg, (1963) have also reported that the accumulation of mercuric chloride induced anemia in the blood of animals.

Arjun *et al*, (2002) reported that reduction in RBC may be caused by the inhibition of erythropoiesis or by destruction of red cells. They also reported that these changes may be due to anemic condition and hemolysis caused by heavy metals. The another reason for decreased amount of Hb and RBC might be due to hypocromic microcytic anemia which is contributed to the lack of iron or its decreased utilization for erythrogenesis [Natarajan, 1981]. A significant decrease in erythrocyte RBC counts, Hb, and an increase in WBC in *C. Puntatus* can be related to pollution due to the effluents [Rao and Hymavathi, 2000]. Hax and Larsson (1984) have reported that the high concentration of cadmium decreased the PCV in the blood of rainbow trout. Tort *et al*, (1987) have observed erythrocyte swelling in *Scyliohinus canicula* exposed to copper.

Goel *et al*, (1985) reported that the reduction in Hb, RBC and PCV in *Heteropenustes fossilis* exposed zinc. Similarly the decreased amount of RBC, Hb, and PCV could be corroborated with previous investigations in *Oreochromis mossambicus* exposed copper and zinc (Sampath *et al*, 1998]. Pamila et *al.*, (1991) have reported that the reduction in Hb content might be due to the inhibitory effect of toxic substance on the enzymes systems which involved in the synthesis of hemoglobin. Joshi *et al*, (2002) have reported that heavy metal exposure decreased the RBC, Hb, PCV due to impaired intestinal absorption of iron. Karuppasamy et *al*, (2005) observed that the significant decrease in Hb, RBC, PCV, MCHC in *channa punctatus* exposed to cadmium.

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In the present study, the white blood cell count, mean cell hemoglobin and mean cell hemoglobin concentration have

increased at sub lethal concentration of arsenic in *Tilapia mossambica* for 30 days. This result may be due to a compensatory erythropoisis due to stimulatory effects. The enhancement of WBC could be due to stimulate lymphoiesis and enhanced release of lymphocytes from lympoid to tissues. The increase in lymphocyte number is also probably for the removal of cellular debris of necrotic tissue at a quicker rate [Mcleay and Brown, 1974]. Shanthi *et al,* (2003) reported a significant increase in WBC channel exposed to selenium.

The present investigation noted that the WBC and MCHC were significantly increased. An increase in WBC suggestes a compensatory erythropoiesis due to stimulatory effects. The enhancement of WBC in mice could be due to stimulated lymphoiesis and/or enhanced release of lymphocytes from lymphoid to tissues. The increase in lymphocyte number of intoxicated mice is also probably for the removal of cellular debris of necrosis tissue at a quicker rate (Mcleay and Brown, 1974). Saraswathi *et al.* (2002) have observed the haematological response of *Cyprinus carpio* to sublethal sodium nitrate exposure. It has been reported that cadmium, lead and mercury caused anemia in fish (Fletcher and White, 1986; Houston *et al.,* 1993).These observations are in agreement with those of Goniakowska-Witalinska and Witalanski (1976) who reported changes in RBC shape and size in *Triturus alpestris* and *Rana esculenta* treated with Quabin.

A significant decrease in erythrocyte (RBC) counts, haemaglobin (Hb), an increase of White Blood Corpuscles (WBC), in the fresh water fish *Channa punctatus* from polluted waters can definitely be related to the pollution due to slaughter house wastes (Rao and Hymavathi, 2000). The reduction in RBC and Hb, in *Labeo rohita* after exposure to arsenic trioxide has been suggested by Pazhanisamy, (2002). A point of interest noticed in the present investigation is the increase in WBC count after Rogor (Dimethoate) 30 per cent EC treatment.

Shanthi et al. (2003) have reported decrease in RBC count with an increase in WBC and Hb level after chronic exposure (28 days) of Cyprinus carpio to sublethal concentration of sodium selenite. The difference in haematological changes in most of the fishes after exposure to different pollutants shows variability in their responses to respective stress causing pollutants. Reduction in RBC counts in Barbus conchonius under the impact of chronic lead poisoning reflects a severe anemic state casually related to prolonged exposure to sublethal dose of lead (Gill et al., 1991).

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