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Study of growth and Haematology of the Fish *Oreochromis mossambiccus* Grown in the Kullursandhai Reservoir water of Virudhunagar District, India under the Cadmium Chloride Stress

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Abstract

Growth and Haematological parameters of fish Oreochromis mossambiccus were assessed in the Kullursandhai reservoir water. Growth was noticed both in the unstress and cadmium chloride stress. Length and weight on 30th day was measured as 7.5cm and 27.4 gms in unstress condition. In stress condition it was recorded as 7.40cm and 26.8gms respectively. No much significance difference was noticed between stress and unstress fishes. All haematological parameters showed increasing trend with heavy increase in the number of Lymphocyte in the stress fishes. This increase in the lymphocyte number induced the immune system of the fishes. Therefore it was revealed from the present study that the heavy metal cadmium chloride of concentration 1µgm do not have any deleterious effect on the food fish Oreochromis in the Kullursandhai reservoir particularly in the monsoon season.

Keywords: Kullursandhai, reservoir, cadmium chloride, haematology, RBC, WBC, haemoglobin, haemocytometer, haemometer, micrometry.

Introduction

Living organisms on the earth can survive only with the necessary abiotic factor that is water. Requirement for the freshwater is more owing to the human population explosion, industrialization and technology up gradation[1]. Freshwater is classified as stocking water or lentic systems such as reservoir, ponds, lakes, swamps and pools as well as lotic system comprising river, streams and springs[2]. Pisciculture is the most important components of aquaculture. Aquaculture offers various methods and possibilities for the fish production, mussel and prawn culture to meet with the demand increasing animal protein production.

The fishery management was warned for the death of fishes, a major change in the fishery department due to environmental pollution by domestic sewage[3]. Freshwater fishery is an important cultural practices for the economic development of a country. In India inland fishery was given priority for the upgradation of life of the rural people.

Fish blood being studied predominantly in the field of toxicological research and environmental monitoring, as a possible indicator of physiological and pathological changes in the fishes for the betterment of fishery management. Assesment of seasonal variations in water quality[4] and physico chemical parameters for testing water have been done by Patil P.N., Sawant D.N. and Deshmukh R.N.[5] were enormous, but the analysis of haematological parameters of a reservoir will enhance the fishery management in the reservoir for the betterment of common people. Many work have been done on the fish haematology to the effect of heavy metal[6-8].

One of the predominant food fish in the Kullursandhai reservoir in Virudhunagar town is *Oreochromis mossambiccus*. Kullursandhai reservoir for its full capacity to fill up heavily depends on the rainfall. Along with the dumping of the industrial wastage and sewage water the reservoir is polluted with heavy metals. Dissolving capacity of Cadmium chloride in the water is high and an increase of 1 µgm of this heavy metal increases 2µgm in the water and the body fluid of the organism living in the water[9]. This prompted me to conduct the study the effect of Cadmium chloride on the growth and haematology of fish *Oreochromis mossambiccus* experimented with the Kullursandhai reservoir water in the laboratory condition. Kullursandhai reservoir reaches its maximum water capacity only during the monsoon season. Therefore the water from the reservoir was collected during the month of October to undergo the investigation. Monsoon season for Virudhunagar town falls during the month of September, October and November.

Material and Methods

Deep body fish *Oreochromis mossambicus* with prominent head, large straight mouth, nonfringed lips and strong dorsal fin was selected for the present study. Commonly called as Tilapia fish was sturdy, disease resistance and physiologically high captivity fish. Fishes were caught from the reservoir with the help of fishermen in the early morning. Trawling shore net was used by the fishermen for the fish catch. In three hours of

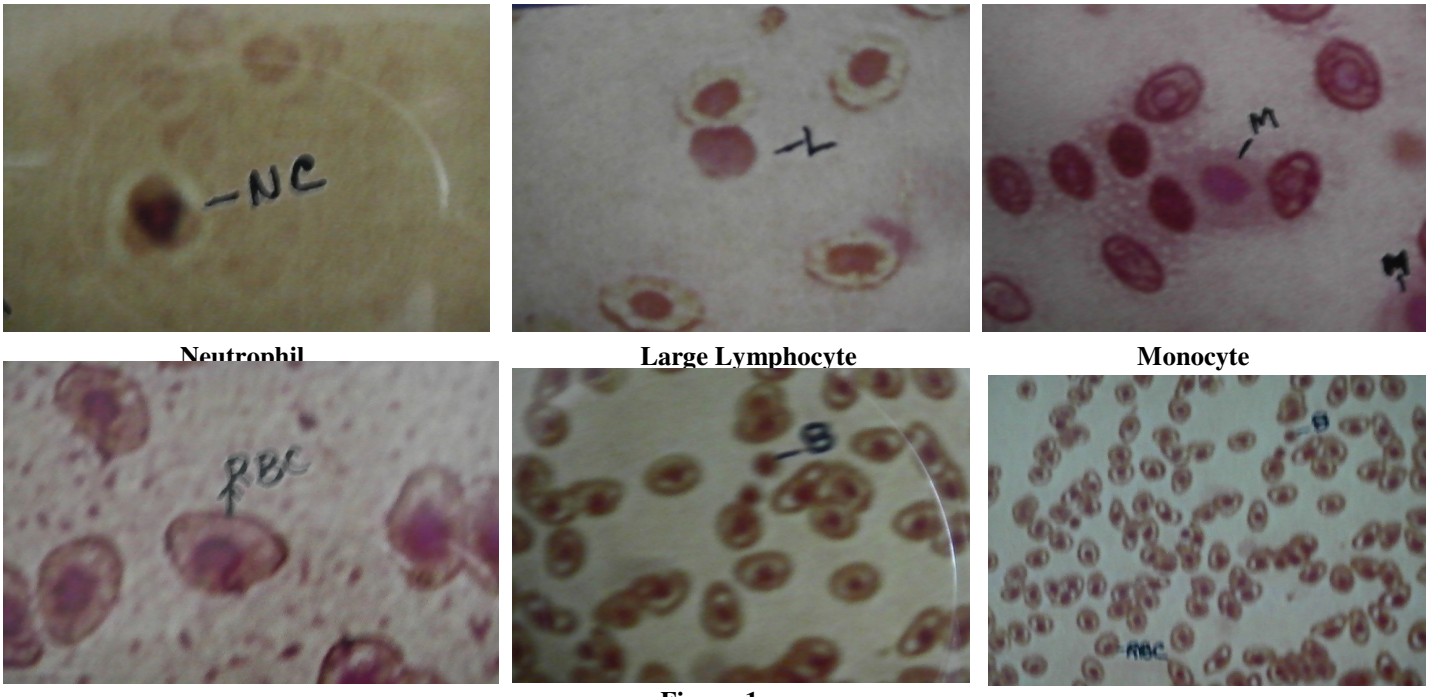
fishing 100 fishes were caught and brought to the Zoology laboratory of VHNSN college for acclimatization in 100 litres water tank.

Acclimatised fishes were divided into two groups. 50 healthy test animals in the weight of around 24 grams and length of 5cm were selected and grown for 3 days in the Kullursandhai reservoir water. 30 uniform sized active fishes were isolated and their activity was tested. 15 fishes were maintained in 3 troughs of 5 fishes each in the reservoir water sample for 10, 20 and 30 days respectively. This is regarded as Set – I. Another 15 fishes were maintained in another 3 troughs of 5 each in the reservoir water sample dissolved with 1µgm of Cadmium chloride ($CdCl_2$). This is considered as Set – II maintained for the same experimental period. Water was changed twice a day. Shivakumar J.[10] reported the Lc 50 value of *Oreochromis mossambiccus* to Cadmium chloride was 1µgm and hence this concentration was fixed to do the present work.

Length of the fishes was measured using graphical scale background. Fishes were weighed in a digital weigh balance accurately on every 10^{th} day 20^{th} day and 30^{th} day. Haematological study of the fish was carried out following the method of Yokayama H.O.[11]. Fishes were handled carefully by netting and anaesthetised with acetone dimethyl ketone reagent and the blood was bled from the branchial vein in the opercular chamber with a heparin coated 25 gauge x 0.5 in. needle attached to a 1 ml syringe. Blood cell was studied in the Daisleys fluid[12] and counted using Naeubeur counting Haemocytometer. Quantity of the Haemoglobin in the fish blood was estimated with the help of an instrument Haemoglobinometer. Blood smear was prepared, stained with Leishman stain and was analysed under the power of 400 magnification in Nikon Photo microscopy. Blood cells from the smear was photographed (figure 1) and the blood smear was analysed with the help of photographs (figure–2). Each RBC was analaysed for their RBC cell length, RBC width and RBC cell nucleus by adopting Micrometry technique. Blood cells were identified with the help of findings by Rey G. and Guerrero G.A.[13].

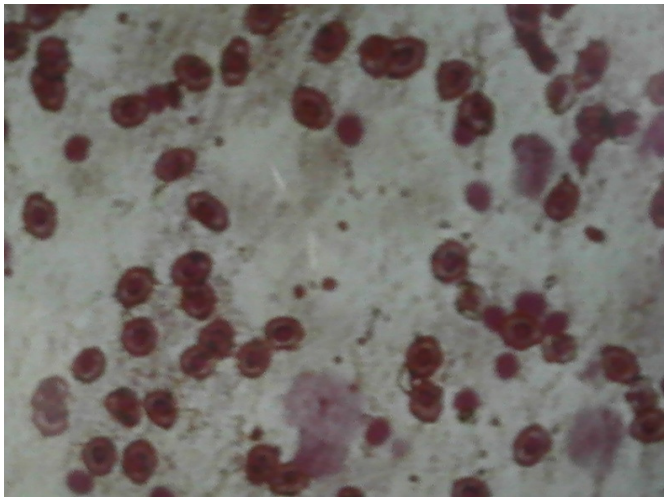
Results and Discussion

Length - weight parameters of the fishes determines the nutrient status of the reservoir . Length of the fish *Oreochromis mossambiccus* from 10^{th} day to 30^{th} day gradually increased both in unstress and Cadmium chloride stress condition. Maximum length of the fish under unstress and stress condition was 7.8cm and 7.4 cm respectively. Weight of the fish was 27.4gms and 26.8gms in the unstress and stress condition respectively on 30^{th} day. There is no much difference between the unstress and stressed fishes. This may be due to the higher dissolved oxygen during the monsoon season which favors the growth of the fish[14]. Therefore increase in the length is directly proportional to increase in the weight of the fishes throughout the study. During the monsoon season in the reservoir various factors like temperature, salinity, food, dissolved oxygen and plankton growth will be in improved status and this will favor the shape and fatness of the fish is a good supportive evidence for the present findings[15].

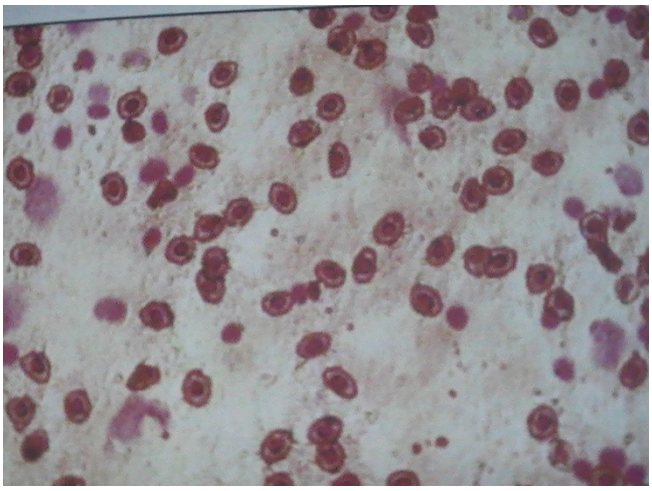


Neutrophil **Large Lymphocyte** **Monocyte**

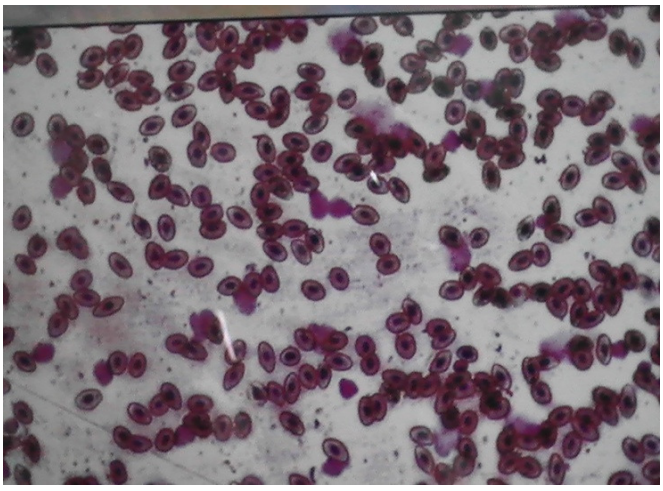
Figure-1
Haemocytes of Fish *Oreochromis mossambiccus* (400 Magnification)



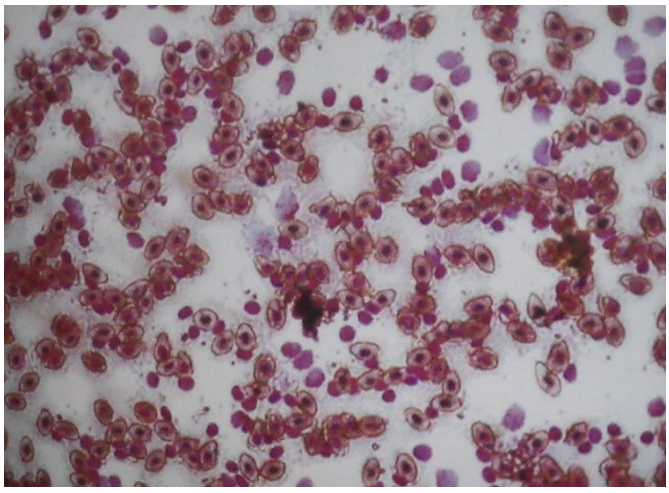
10th Dayunstress Blood Smear



30th Day – Unstress Blood Smear



10th Day CdCl2 Stress



30th Day CdCl2 Unstress

Figure-2
Blood Smear of Fish Oreochromis mossambicus Under Unstress and Cadmium Chloride Stress (400 Magnification)

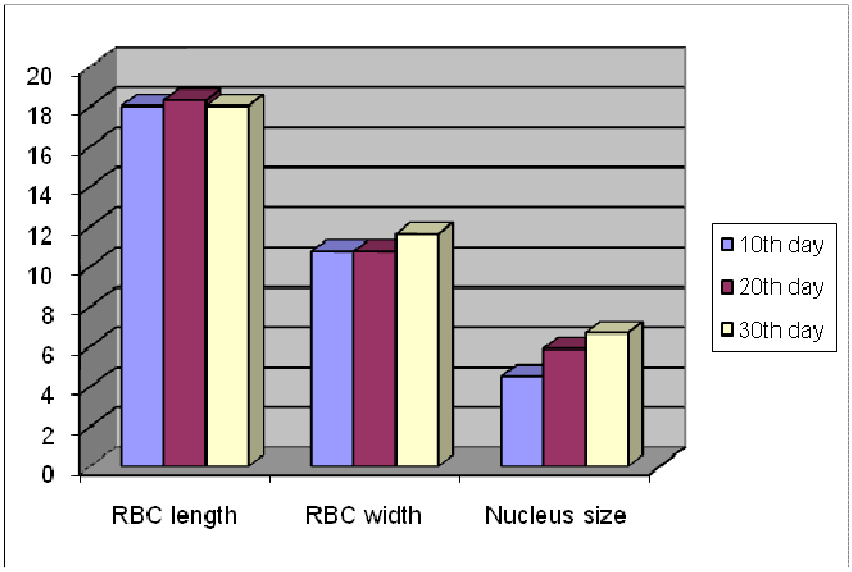
Number of RBC declined from the 10th day to 30th day in both the conditions (Graph – 1 and Graph – 2). In unstress fishes it was recorded as 1.93 to 1.26 x 10^6/mm^3 from 10th to 30th day and in stress fishes RBC number was reduced from 1.23 to 1.07 x 10^6/mm to 1.07 x10^6/mm Nagarajan[16] obtained a trend with relation to the reduction in RBC number. To the chemical exposure the anemic conditions was experienced in the fishes due to the inhibition of erythropoeisis[17]. This was revealed in the present work by the reduction in RBC number. However it was compensated by higher amount of haemoglobin in unstress as well as in stressed fishes throughout the experimental period that is 8.26% to 8.7% in unstress fishes and 7.33% to 7.80% in stressed fishes. Similar findings was reported by Sakthivel M.[18].

In both the unstress condition and Cadmium chloride stress condition, fishes thrived well without any sort of discomfort may be due to the better sized RBC length, width and RBC nuclear size throughout the experimental period. This is clearly evident from the table – 3. All parameters related to RBC from 10th to 30th day showed increasing trend may be the causative factor for the higher haemoglobin amount in the stress condition. There is no significant effect on the fish *Oreochromis mossambiccus* by the effect of Cadmium chloride can be substantiated by the larger production of lymphocytes by the fishes in all the experimental conditions.

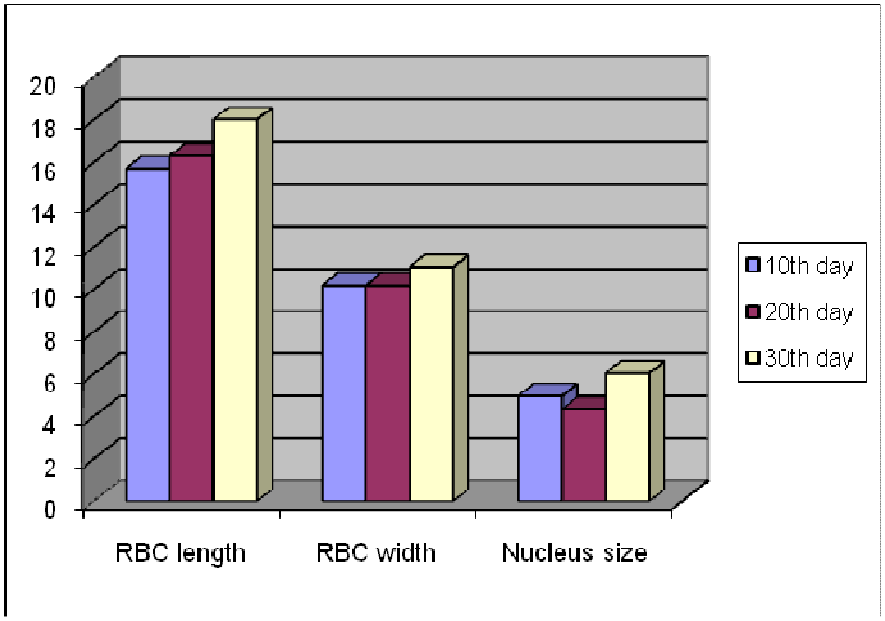
Table – 2 reveals the differential leucocyte count highlighted the higher synthesis of Basophils, Eosinophils, Lymphocytes and Monocytes in the unstress and stress fishes. Reduction in the erythrocyte count associated with larger production of

leucocytes might have triggered the immune system totally in the fishes due to the stress of chemicals[19]. Differential count of leucocytes compensated the number of RBC count thereby improving the length and weight of fishes in the present investigation.

Table - 4 reveals the Correlation coefficient between the different blood parameters of the fish *Oreochromis mossambiccus* in 30 days of exposure to unstress condition. All parameters showed positive correlation of r value 1. Therefore the blood parameters gradually becomes better and better in th unstress condition in the reservoir water sample. Table – 5 explains the negative correlation by the neutrophil parameter to all the other differential leucocyte counts. Other parameters are found to be positively correlated with the'r' vale as 1. Negative correlation may be due to the slight stress caused by the Cadmium chloride which had its effect on neutrophil. However this did not affected the growth of the fish in the present investigation. Correlation coefficient of the blood parameters showed high degree of positive and therefore this may be the reason for the better growth of the fish *Oreochromis mossambiccus* in the present study.



Graph-1
RBC detail of the blood of Oreochromis mossambiccus under unstress condition



Graph-2
RBC details of Oreochromis mossambiccus under Calcium chloride stress

Table-1

Haematological and Growth of the fish *Oreochromis mossambiccus* in Unstress condition and Cadmium chloride stess

	RBC 10^6/mm^3 **US**	RBC 10^6/mm^3 **S**	WBC 10^6/mm^3 **US**	WBC 10^6/mm^3 **S**	Hb gm % **US**	Hb gm% **S**	Length cm **US**	Length cm **S**	Weight gm **US**	Weight gm **S**
10th day	1.93± 0.15	1.23± 0.33	47.00± 1.45	51.66± 0.38	8.26± 0.15	7.33± 0.21	5.5± 0.5	5.5± 0.6	24.00± 0.5	23.8± 0.9
20th day	1.96± 0.2	1.10± 0.02	48.6± 0.88	51.6± 0.33	8.5± 0.3	7.03± 0.3	7.2± 0.6	6.8± 0.5	25.2± 0.8	24.00± 0.7
30th day	1.26± 0.4	1.07± 0.33	50.0± 1.0	54.8± 0.38	8.7± 0.7	7.80± 0.9	7.80± 1.0	7.40± 1.0	27.4± 1.0	26.8± 0.9

Mean ± SD of 5 replicates, US - Unstressed condition, S – Cadmium chloride stress

Table-2

Differential Leucocyte count of the fish *Oreochromis mossambiccus* in Unstress condition and Cadmium chloride stress

(Unit for each value is 10^3/mm^3)

	Eosinophil US	**Eosinophil S**	**Basophil US**	**Basophil S**	**Neutrophil US**	**Neutrophil S**	**Lymphocyte US**	**Lymphocyte S**	**Monocyte US**	**Monocyte S**
10th day	7.00± 0.6	6.33± 0.33	15.33± 1.45	15.33± 0.38	16.33± 0.80	13.66± 0.33	21.33± 0.80	23.66± 0.43	7.00± 0.50	7.00± 0.06
20th day	7.33± 0.66	7.00± 0.1	16.00± 0.5	18.0± 0.58	17.66± 0.80	11.33± 0.33	23.33± 0.88	225.33± 0.88	8.66± 0.92	8.00± 0.04
30th day	9.33± 1.00	8.00± 0.03	18.66± 0.78	20.66± 0.58	20.66± 0.35	9.00± 0.66	25.66± 0.37	28.72± 1.15	9.33± 0.19	9.00± 0.02

Mean ± SD of 5 replicates, US - Unstressed condition , S - Cadmium chloride stress

Table-3

RBC details of fish Oreochromis mossambiccus during 30 days period under Unstress and Stress condition

	Days	**RBC Length (µm)**	**RBC Width (µm)**	**Nucleus size (µm)**
UNSTRESS	10th day	18.04±0.37	10.76±0.19	6.40±0.66
	20th day	18.33±0.18	10.76±0.22	6.59±0.20
	30th day	19.04±0.13	11.64±0.24	6.69±0.10
$CdCl_2$ STRESS	10th day	15.07±0.22	10.18±0.11	4.97±0.09
	20thday	16.03±0.11	10.26±0.09	4.35±o.23
	30th day	16.50±0.18	10.43±0.13	4.29±0.10

Table–4

Correlation matrix between the blood parameters of Oreochromis mossambiccus from 10th to 30th day under Unstress conditon

	RBC	**WBC**	**Hb**	**Eosinophil**	**Basophil**	**Neutrophil**	**Lymphocyte**	***Monocyte***
RBC	1							
WBC	1	1						
Hb	1	1	1					
Eosinophil	1	1	1	1				
Basophil	1	1	1	1	1			
Neutrophil	1	1	1	1	1	1		
Lymphocyte	1	1	1	1	1	1	1	
Monocyte	1	1	1	1	1	1	1	1

Table-5
Correlation matrix between the blood parameters of Oreochromis mossambiccus from 10th to 30th day under stress condition

Column1	RBC	WBC	Hb	Eosinophil	Basophil	Neutrophil	Lymphocyte	*Monocyte*
RBC	1							
WBC	1	1						
Hb	1	1	1					
Eosinophil	1	1	1	1				
Basophil	1	1	1	1	1			
Neutrophil	-1	-1	-1	-1	-1	1		
Lymphocyte	1	1	1	1	1	-1	1	
Monocyte	1	1	1	1	1	-1	1	1

Conclusion

Concentration of 1µgm level of Cadmium chloride have no deleterious effect on the growth of the fish *Oreochromis mossambiccus* during the monsoon season in Kullursandhai reservoir. Therefore it was concluded that the monsoon season is an apt season for the fish culture inspite of the chemicals dissolving in the reservoir.

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