Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 12	No. 1	pp. 93-98	2013

Original Research Paper

Impact of Textile-Dyeing Industry Effluent on Some Haematological Parameters of Freshwater Fish *Oreochromis Mossambicus*

G. K. Amte and Trupti V. Mhaskar
Department of Zoology, B.N.N. College, Bhiwandi-421301, Distt. Thane, Maharashtra, India

Nat. Env. & Poll. Tech.
Website: www.neptjournal.com
Received: 21-6-2012
Accepted: 27-8-2012

Key Words:
Textile-dyeing effluents
Haematological parameters
Oreochromis mossambicus

ABSTRACT

Haematological analysis was carried out in experimental fish *Oreochromis mossambicus* exposed to various concentrations of textile-dyeing effluents (both untreated and treated). Effluent samples of various concentrations were taken in order to perform acute toxicity studies with the test organism, *Oreochromis mossambicus* for the period of 96 hours. Hematological data were evaluated for parameters such as Hb, RBCs, WBCs, PCV, MCH and MCHC of the test species. The alterations of these parameters are discussed in the paper.

INTRODUCTION

Textile-dyeing industry is one of the most important and rapidly developing industrial sectors. It has a high importance in terms of its environmental impact, since it consumes considerably high amounts of processed water and produces highly polluted discharge water in large amounts (Neeta et al. 2001, Yusuff & Sonibare 2004). Pollutants in wastewater from textile industry vary greatly and depend on the chemicals and treatment processes used. Pollutants that are likely to be present include suspended solids, biodegradable organic matter, toxic organic compounds (e.g. phenols), and heavy metals (URL 1).

Many studies have been published on water pollution from textile operations. Brown & Anliker summarized the effects of textile effluents on the environment and the toxicity with respect to fish and other aquatic organisms (URL 2). The present investigation is launched to identify systematically the impact of textile dyeing industry effluents on some of the hematological parameters in freshwater fish *Oreochromis mossambicus.* A number of hematological indices such as haematocrit (Hct) haemoglobin (Hb), RBCs, and so on are used to assess the functional status of the oxygen carrying capacity of the blood stream and have been used as indicators of pollution (Gill & Epple 1993, Usha 1996, Shah & Altindog 2004, Soni et al. 2006, Seriani et al. 2011, Mgbenka & Oluah 2003).

MATERIALS AND METHODS

For the present study, effluent was collected from a textile-dyeing industry in Bhiwandi, Maharashtra. The effluent was collected at a fixed point where the discharges from all the stages of processing are released into the effluent treatment plant (referred as untreated effluent hereafter). Similarly, the effluent was collected after the treatment process (hereafter referred as treated effluent). The effluents were collected in a sterile polythene container and stored in refrigerator. The physico-chemical properties of the effluent were analysed by following standard methods given in APHA (2005).

For bioassay studies, the fish were collected from the nearby water reservoir. The fish were acclimatized for 14 days to the laboratory condition. They were fed on artificial food during the study period. Feeding was stopped prior to 24 hours before the commencement of the experiments. Only healthy animals (average length 12-14 cm; average weight 35-50 g) were selected for the experiment. Desired concentrations of the effluents were obtained by diluting them with aged tap water. The acute toxicity test was conducted in triplicate. The mortality rate was recorded at 24, 48, 72 and 96 hours exposure to the effluent (both untreated and treated). The percentage for corrected mortality was calculated using the Abbott's formula (Abbott 1925).

$$\% \text{ Corrected mortality} = \frac{\% \text{ living in control} - \% \text{ living in treatment}}{\% \text{ living in control}} \times 100$$

The corrected mortality data were analysed to determine the LC_{50} values. The LC_{50} values were obtained by probit regression line, taking test concentrations and corresponding % mortalities on log value and probit scales respectively. By graphical interpolation LC_{50} values were fixed and their fiducial limits 95% upper and lower confidence limits were

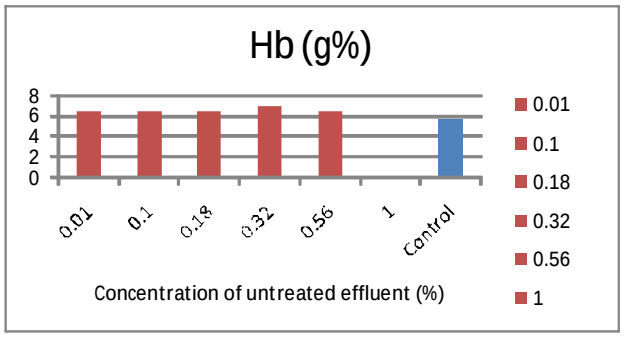

Fig. 1: Change in haemoglobin content in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

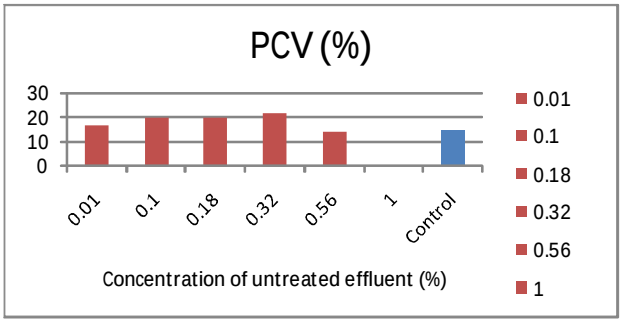

Fig. 2: Change in PCV in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

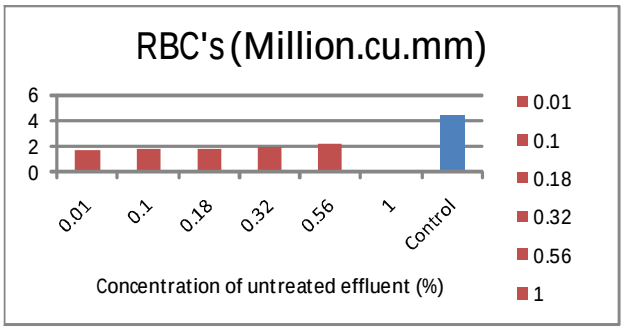

Fig. 3: Change in RBC level in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

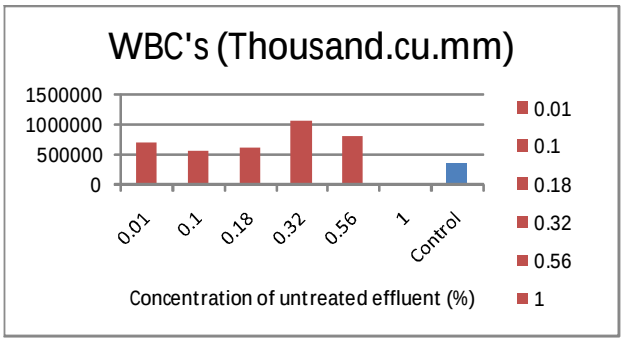

Fig. 4: Change in WBC level in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

also determined (Litchfield & Wilcoxson 1949).

At the end of 96 hours, fish from control and experimental tanks were sacrificed for studies of hematological parameters. Blood was drawn from cardiac region by cardiac puncture using disposable syringe fitted with 26 gauge needle, which was already moisturized with EDTA, an anticoagulant. Blood, collected from the different groups of animals, was stored in the separate plastic vials and placed immediately in ice. These blood samples were used for determining haematological parameters (Dacie & Lewis 1982, Wintrobe 1967).

RESULTS AND DISCUSSION

The results of the study are given in Tables 1-3 and Figs. 1-12. Hematological elements were selected for the present study because blood reflects all the life processes in the body and serves as an indicator of its general condition or metabolic defects. It is widely accepted that the excessive environmental stress causes a variety of detectable, recognizable changes in blood of fish. Table 3 (A) & (B) show the changes in the hematological parameters such as haemoglobin (Hb), packed cell volume (PCV), RBCs, WBCs, mean corpuscular haemoglobin concentration (MCHC) in a freshwater teleost *Oreochromis mossambicus* exposed to various (lethal and sub-lethal) concentrations of textile-dyeing effluents (both untreated and treated) for the period of 96 hours.

Haemoglobin: The control fish showed mean value of 5.7 gm% for haemoglobin. The fish exposed to the various concentrations of the untreated effluents showed the haemoglobin mean values of 6.3, 6.5, 6.5, 7.0 and 6.5 gm% respectively. The values mentioned above showed a significant increase in the haemoglobin levels when compared to the control group of fish. The mean values of the haemoglobin levels of the fish exposed to treated effluents were 5.0, 6.6, 6.5, 6.0 & 5.2 gm% respectively. The values quoted above

Table 1: LC_{50} values of test species *Oreochromis mossambicus* exposed to untreated and treated effluents.

Exposure duration	Untreated effluent	Treated effluent
24 hours	0.9%	46%
48 hours	0.4%	44%
72 hours	0.4%	0.57%
96 hours	0.16%	0.56%

Table 2: Physico-chemical characteristics of untreated and treated textile dyeing effluents.

Parameters		pH	TSS mg/L	BOD 27°C 3 days mg/L	COD mg/L	Oil and Grease mg/L	A.B.S (Detergent) mg/L	Residual chlorine mg/L	Ammonical N (TAN) mg/L
Jan-10	Untreated	8.7	180	226	790	4.9	4.6	3.1	4.8
	Treated	7.4	78	82	264	3.1	2.4	1.6	3.1
Feb-10	Untreated	9.5	158	180	816	3.2	2.6	2.8	3.8
	Treated	7.1	64	80	240	2.5	1.9	1.1	2.5
Mar-10	Untreated	8.6	184	176	760	3.8	2.8	2.6	4.1
	Treated	7.2	82	70	252	2.4	1.5	1.2	2.7
April-10	Untreated	9.1	164	158	614	3.4	2.3	2.3	3.5
	Treated	7.4	77	62	264	2.1	1.2	1.1	2.2
May-10	Untreated	9.0	144	164	568	2.1	2.4	2.1	5.2
	Treated	7.2	74	72	260	1.2	1.0	0.7	3.1
June-10	Untreated	8.9	184	192	718	3.2	2.91	1.4	6.2
	Treated	7.0	77	84	262	1.9	1.8	0.8	1.0
July-10	Untreated	8.4	174	188	658	3.8	3.4	2.1	4.8
	Treated	7.3	84	6	254	1.4	1.5	1.1	1.2
Aug-10	Untreated	7.9	190	14	548	4.0	2.9	1.9	6.4
	Treated	7.4	62	68	252	1.7	1.8	0.5	3.6
Sep-10	Untreated	8.9	172	186	660	3.5	3.2	1.6	5.8
	Treated	7.1	8	82	262	1.4	2.1	1.0	3.4
Oct-10	Untreated	8.2	180	168	16	3.9	2.4	1.4	3.9
	Treated	7.3	84	6	254	2.1	1.1	0.9	2.6
Nov-10	Untreated	8.9	128	220	60	3.2	2.0	1.9	5.6
	Treated	7.2	76	620	2.4	1.6	1.6	1.2	4.2
Dec-10	Untreated	9.2	148	188	588	4.2	2.6	1.5	4.8
	Treated	7.3	88	78	244	1.8	1.3	1.1	3.1
Jan-11	Untreated	9.4	186	160	786	2.6	4.0	2.3	4.4
	Treated	7.1	49	72	260	1.9	1.6	0.9	2.6
Feb-11	Untreated	9.1	162	188	668	3.2	4.4	2.1	5.2
	Treated	7.3	62	78	252	1.6	2.1	1.0	2.5
Mar-11	Untreated	9.1	160	182	220	2.6	3.0	1.3	5.4
	Treated	7.8	75	86	236	2.0	1.8	0.9	4.0
April-11	Untreated	9.0	124	144	512	3.8	4.1	1.9	4.9
	Treated	7.0	68	72	260	2.3	1.9	0.3	3.2

Table 3(A): Changes in the haematological parameters in freshwater teleost *Oreochromis mossambicus* exposed to various concentrations of untreated textile-dyeing effluents.

Sr.No.	Parameters	Concentration of untreated effluent						
		0.01%	0.1%	0.18%	0.32%	0.56%	1%	Control
1	Hb (g%)	6.3	6.5	6.5	7.0	6.5	-	5.7
2	PCV (%)	16.8	19.48	19.50	21.80	13.75	-	14.9
3	RBCs (million.cu.mm)	1.76	1.81	1.82	1.96	2.26	-	4.42
4	WBCs (thousand/cu.mm)	704000	569600	627200	1056000	806400	-	349600
5	MCH (dl)	35.79	35.91	35.71	35.70	35.71	-	22.09
6	MCHC (mg.cc/l)	37.50	33.38	33.33	32.11	32.72	-	38.32

showed that the Hb levels decreased initially in comparison to the control, then increased with increasing concentration of the effluent and again showed sharp decline in the higher concentration.

Red blood corpuscles (RBCs): The erythrocyte count of healthy control animal showed a mean value of 4.42 million.cu.mm. The fish exposed to the different concentration of untreated effluent showed mean values of RBCs as 1.76, 1.81, 1.82, 1.96 and 2.26 million.cu.mm. The values mentioned above showed a significant decrease when compared to the control. The animals exposed to various concentrations of treated effluent showed mean values as 4.30, 6.33, 6.24, 5.76 and 4.80 million.cu.mm. Thus, the fish exposed to the treated effluent showed an opposite trend where the RBC levels increased in all the concentrations as compared to the control.

Table 3(B): Changes in the haematological parameters in freshwater teleost *Oreochromis mossambicus* exposed to various concentrations of treated textile-dyeing effluents.

Sr.No.	Parameters	Concentration of untreated effluent						
		0.01%	0.10%	0.18%	0.32%	0.56%	1%	Control
1	Hb (g %)	5.0	6.6	6.5	6.0	5.2	--	5.7
2	PCV (%)	11	18	17	14	12	-	14.9
3	RBCs (million.cu.mm)	4.80	6.33	6.24	5.76	4.80	-	4.42
4	WBCs (thousand/cu.mm)	185600	38000	124800	144500	336000	-	349500
5	MCH (dl)	10.41	10.42	10.40	10.41	10.40	-	22.09
6	MCHC (mg.cc/l)	45.45	36.66	38.23	42.85	42.66	-	38.32

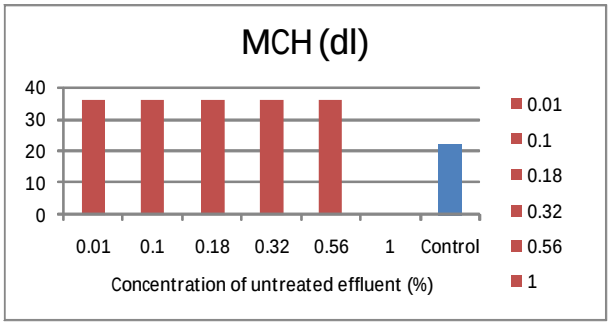

Fig. 5: Change in MCH (dl) content in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

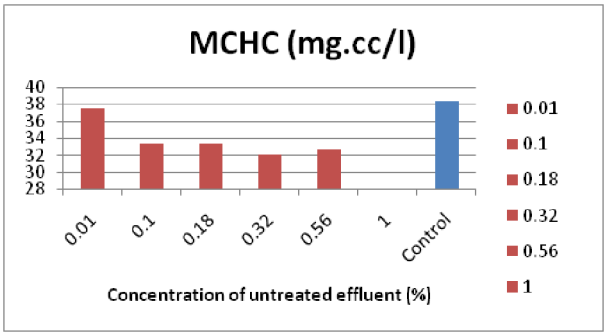

Fig. 6: Change in MCHC (mg.cc/l) content in *Oreochromis mossambicus* exposed to various concentrations of untreated textile dyeing effluent.

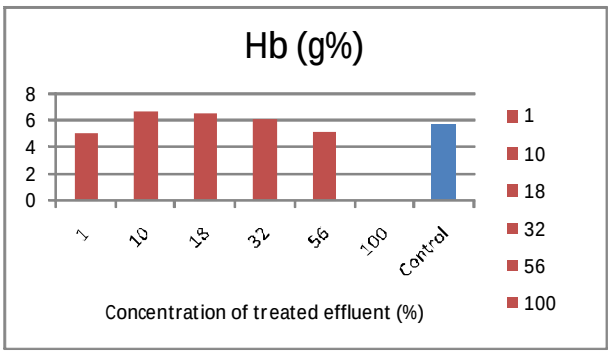

Fig. 7: Change in haemoglobin content in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

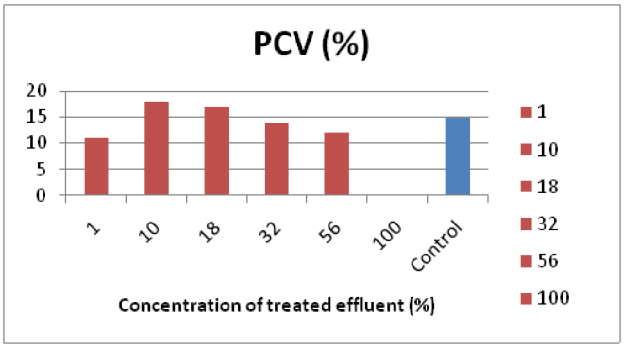

Fig. 8: Change in PCV in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

White blood corpuscles (WBCs): Leucocytes count is useful for detecting the lethal and sub lethal effects in fish caused by toxic effluents. In this study, a significant increase in the leucocyte (WBCs) count resulted in leucocytosis in the fish exposed to untreated effluent samples which is an adaptation made to cope up with the stressful condition due to the effluents. The significant decrease in the WBCs count in the fish exposed to the treated effluent samples may also be due to generalized adaptive stress response. The results are in agreement with the reports published by Ruparelio et al. (1990).

PCV, MCH and MCHC: The PCV and MCH levels increased in the untreated groups throughout the study period. However, the MCHC levels decreased in comparison to the control group of fish.

In the fish exposed to the treated effluent samples the MCH levels decreased when compared with the control group of fish. The PCV and MCHC levels decreased initially then increased with increasing concentration of the effluent and again declined in the higher concentration.

CONCLUSION

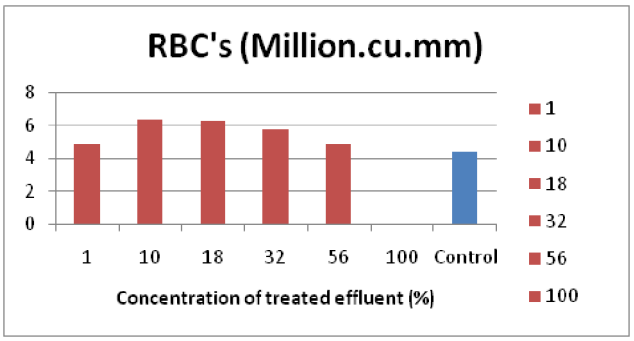

Fig. 9: Change in RBC level in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

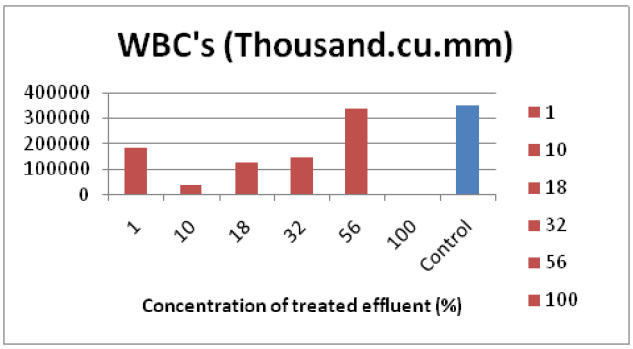

Fig. 10: Change in WBC level in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

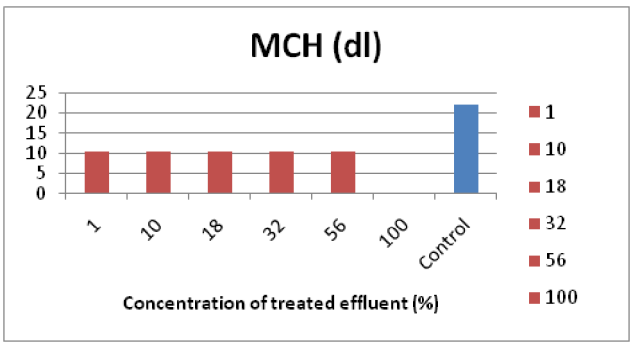

Fig. 11: Change in MCH (dl) content in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

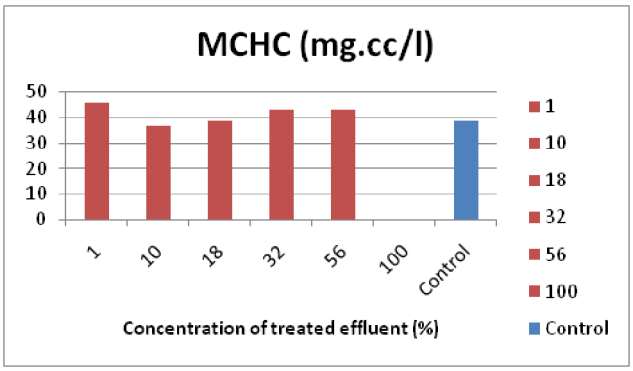

Fig. 12: Change in MCHC (mg.cc/l) content in *Oreochromis mossambicus* exposed to various concentrations of treated textile dyeing effluent.

Textile-dyeing effluents are highly toxic containing high concentration of various salts, heavy metals and unspent dyes. Pollutants such as salt and metallic compounds present in effluents are toxic to all living organisms. The fish *Oreochromis mossambicus* was sensitive to the toxic ingredients present in both untreated and treated effluent. It also suggests the need to improve the effluent treatment process.

ACKNOWLEDGEMENT

The authors are grateful to the Management of Padmashri Annasaheb Jadhav Samaj Unnati Mandal, Bhiwandi, Principal of B.N.N. College and Head, Department of Zoology, B.N.N. College, Bhiwandi for their valuable support.

REFERENCES

Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ, Entomol., 18: 265-264.

APHA 2005. Standard Methods for the Examination of Water and Wastewater. 21st Ed., American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, DC.

Dacie, J.V. and Lewis, S.M. 1982. Practical Haematology. 6th Ed. Churchill Livingstone, London, UK.

Gill, T.S. and Epple, A. 1993. Stress- related changes in the haematological profile of the American eel, *Anguilla roskata*. Ecotoxicology and Environmental Safety, 25: 227-235.

Litchfield and Wilcoxson, F. 1949. A simplified method for evaluating dose effect experiments. J. Pharmac. Exp. Ther., 96: 99-113.

Mgbenka, B.O. and Oluah, N.S. 2003. Effect of Gammalin 20 (Lindane) on differential white blood cell counts of the African catfish, *Clarias albopunctalus*. Bull of Environmental Contamination Toxicol., 71: 248-254.

Neeta, P., Mohabansi, P.V. Tekade and Bawankar, S.V. 2011. Physico-chemical and microbiological analysis of textile industry effluent of Wardha region. Water Research & Development, 1(1): 40-44.

Ruparelio, S.G., Verma, Y. Saiyed, S.R. and Rawal, U.M. 1990. Effect of cadmium on blood of Tilapia, *Oreochromis mossambicus* (Peters), during prolonged exposure. Bull. Environ. Contam. Toxicol., 45: 305-312.

Seriani, R., Abessa, D.M.S., Kirschbaum, A.A., Pereira, C.D.S., Romano, P. and Ranzani-Paiva, M.J.T. 2011. Relationship between water toxicity and hematological changes in *Oreochromis niloticus*. Braz. J. Aquat. Sci. Technol., 15(2): 47-53.

Shah, S.L. and Altindag, A. 2004a. Hematological parameters of tench (*Tinca tinca* L.) after acute and chronic exposure to lethal and sublethal mercury treatments. Bull. Environ. Contam. Toxicol., 73: 911-918.

Soni, Pratima, Sharma, Subhasini, Sharma, Shweta, Suresh Kumar and Sharma, K.P. 2006. A comparative study on the toxic effects of textile dye wastewaters (untreated and treated) on mortality and RBC of a freshwater fish *Gambusia affinis* (Baird and Gerard). J. of Environ. Biology, 27(4): 623-628.

URL 1. http.//water.nr.state.ky.us/ww/waterres.htm.
URL 2 http.//www.tve.org/ho/doc.cfm?aid=1634&lang=English.
Usha A. Pradhan 1996. Effect of an Organophosphours Pesticide on the Metabolism of Freshwater Teleost *Oreochromis mossambicus* (Trewavas). Ph.D Thesis submitted to the University of Bombay.
Wintrobe, M.M. 1967. Clinical Hematology. 6th Edn., Lea and Febiger, Philadelphia, Library of Congreas, Print USA.
Yusuff, R.O. and Sonibare, J.A. 2004. Characterization of textile industries effluents in Kaduna, Nigeria and pollution implications. Global Nest: The Inst. J., 6(3): 212-227.