Biospectra : Vol.9(1), March, 2014. pp 31-38
An International Biannual Refereed Journal of Life Sciences

Animal Sciences

ISSN : 0973-7057

Study of the haematological changes of *Channa punctatus* (Bloch) exposed to lethal and sublethal concentration of biocide "furadan".

Ravi Kumar[a]*, Ashok Kumar[b] & Dheeraj Kumar Singh[c]

[a]*Saran Academy, Chapra, Bihar, India.

[b]Dept. of Zoology and Industrial Fish & Fisheries, Ganga Singh College, J.P. University, Chapra, Bihar, India.

[c]D.B.S.D. Degree College, Rampur, Kadna, Garkha, Saran

Received 22nd September, 2013; Revised 26th October, 2013

Abstract : Blood takes part directly or indirectly in almost all the activities of the vertebrates and hence fish cannot be an exception to it & therefore the blood is regarded as a good indicator of stress condition. In this study the fish *Channa punctatus* (both male & female) were exposed to lethal concentration (60mg/l) and sublethal concentrations (3.0&075mg/l) of furadan at selected days of exposure in which the haemoglobin content, haematocrit value, TEC (Total erythrocyte count) gradually decreased in both male & female fish and TLC (Total Leucocyte Count) increased, while the Hb content, Ht value, TEC & TLC were more in females than the males in normal conditions during maturing (February to April) and mature or spawning (June to August) phases.

Key words: Gonadal cycle, Maturing & Mature phases, Haemoglobin concentration, Haematocrit value, Total erythrocyte count (TEC), Total leucocytes count (TLC), Furadan biocide, Exposure period.

INTRODUCTION

India is one of the fast developing nations having large population and vast area. The most vital issue for such countries is that how to feed its fast growing population. Though, various sources of food has been taken into account including fish to combat malnutrition.

In recent years use of various synthetic pesticides/ insecticides has increased manifolds in agriculture and public health programmes; which badly affected many non-target organisms including fish, **Larson *et al*.1976, Woo *et al*, 1993, Kumar, 1999, Tiwari & Singh, 2004**). Due to frequent use of pesticide furadan (a member of carbamate group of pesticies) which is known to be an inhibitor of cholinesterages, the fish *Channa punctatus* (Bloch) became one of the immediate targets of such biocides, as they are known to be more sensitive to biological doses than that of terrestrial animals. Therefore, for maintaining healthy stock of fish in our inland waters, water quality objectives have to be determined, which can ensure that the species present are not adversely affected in any way. As the most common air breathing fish *Channa punctatus* (Bloch) is mainly consumed by the people of the lower strata of our society for getting protein, such pesticide affected fish would adversely affect their health,**Sheela & Muniandy (1992), Mushitaq & Nagrajan (1992**).

Looking a bird's eye view, this work is destined to know the haematological changes in the blood composition of *Channa punctatus* (Bloch) commonly called "Garai" exposed to lethal (60mg/l) and sublethal (3.0&0.75mg/l) concentrations at selected hours of exposures in different selected concentrations.

*Correspondent author :
Phone : 09471424608
E-mail : drravi9835@gmail.com

MATERIALS AND METHODS

Sufficient number of healthy male & famale specimens of *Channa punctatus* (Bloch) of around 35.58±2.40gm weight groups were collected and acclimatized in the laboratory condition of Industrial Fish & Fisheries department of Ganga Singh College, Chapra (Bihar). Thereafter, the acclimatized fish were placed in 6.0, 3.0 & 0.75 mg furadan /l concentrations alongwith a set of control fish. At selected hours of exposures i.e. 10,20,30,40,50,&60 days of exposure in different selected concentrations, five sets of the fish of each sex were taken out from each concentration and after blotting the trunk with the filter paper, fresh blood samples were collected separately (for males & females) from the caudal artery by severing the tail and/or by direct puncture of heart without using anesthesia or any anticoagulant except for haematocrit analysis for which heparinised capillary tubes were used in between 8 A.M. to 10 A.M. Five blood samples of each sex alongwith control were prepared.

(a) Haematological Parameters:- The haemoglobin content in the blood was estimated by sahili's acid haematin method. Haematocrit percent was determined by microhaematocrit centrifuge (REMI, India) using heparinised capillaries; total RBC & WBC counts were done under microscope using neubaur haemocytometer (Germany).

OBSERVATIONS

The effect of lethal and sublethal concentrations of furadan i.e. 0.8^{th}, 0.4^{th} & 0.1^{th} of 96 hr Lc_{50} value (6.0, 3.0 & 0.75 mg furadan/l) on the haemoglobin content, haematocrit percentage and total number of RBC and WBC in the blood of male & female *Channa punctatus* (Bloch) exposed for 10, 20, 30, 40, 50 & 60 days along with controls during February to April and June to August were presented in table 1.1(A) & 1.1 (B) and table 1.2 (A) & 1.2 (B) respectively. The weight of the fish was kept around 35.58±2.40gm.

(A) Haemoglobin content : The haemoglobin content in normal male *Channa puntatus* varied in between 12.70±0.22 to 13.52±0.2gm/dl during February to April and in between 12.12±0.18 to 12.50±0.22gm/dl during June to August months (Table 1.1 (A) & 1.2 (A); whereas in female fish, it was recorded to be 14.26±0.32 to 15.42±0.29 gm/dl during February to April and from 12.80±0.12 to 13.92±0.15gm/dl during June to August (Table 1.1 & 1.2) & it indicated that the haemoglobin content was comparatively more during maturing than the mature or spawning phases in both sexes; whereas, the females had comparatively more haemaglobin in their blood than the males during normal conditions.

The fish exposed to lethal & sublethal concentrations of furadan showed a decreased trend in their haemoglobin content in both sexes, which depended on the concentration of the pesticide & exposure period. In males the decline in Hb content (11.45±0.28) on 20^{th} day, with maximum decline upto 10.16±0.18 gm/dl on the 30^{th} day of exposure was recorded.

Similar decrease was also recorded on 50^{th} & 60^{th} day of exposure to 3.0 mg furdan/l (11.90±14gm/dl) and 11.76±0.17 gm/dl at an exposure to 0.75 mg furadan/l during February to April months. Further a significant decline was recorded on 20^{th} and 30^{th} day of exposure at 6.0mg/l furadan (11.25±0.23 & 10.41±0.21gm/dl respectively) and on 50^{th} & 60^{th} day of exposure to 3.0 & 0.75 mg furadan/l, which were recorded to be 10.46±0.19 and 10.65±0.15 gm/dl) respectively.

In female fish, the Hb content exposed to 6.0 mg furadan /l showed a significant decline on 30^{th} day of exposure (12.13±0.26gm/dl), while such a decline was recorded on 50^{th} day which was 12.91±0.26gm/dl in 3.0 mg furadan /l concentration and on 60^{th} day in 0.75mg/ furdan/l, it was 13.00±0.24gm/dl during February to April. Further a significant decline was recorded during June to August on 20^{th} day, which was 12.53±0.12 gm/l; with a maximum decrease upto 11.28±0.11gm/dl on 30^{th} day of exposure at 6.0 mg furadan/l concentration and on 40^{th} day of exposure it was 13.61±0.13gm/l with a maximum on 50^{th} day which was 12.46±0.14 gm/dl in the fish exposed to 3.0 mg furdan/l while at a concentration of 0.75 mg furadan/l on 60^{th} day of exposure the value of Hb content was recorded 11.96±0.3 gm/dl).

(B) Haematocrit percentage: The haematocrit percentage in normal male fish during February to April and from June to August varied in between 41.24±1.31 to 43.10±1.31% and from 38.54±1.27 to 41.00±1.32 respectively; whereas in females it varied from 45.32±1.35 to 46.52±1.37% and 42.75±1.29 to 43.58±1.35% during

February to April and June to August respectively. Thus the haematocrit percentage was recorded more during maturing than the mature phase in both sexes.

Both male and female fish *Channa punctatus* exposed to lethal and sublethal concentrations of furadan showed a decrease in their haematocrit percentage during February to April and June to August months that their respective normal values. The male fish exposed to 6.0 mg furadan/l concentration showed a significant decrease on 20th day with the maximum decrease 30.80±1.17% in February & 30.31±1.22% in August on 30 days of exposure, whereas the fish exposed to 3.0 and 0.75 mg furadan /l concentration, the significant decline was observed on 40th day 37.24±1.25% onwards and on 60th day 37.42±1.24% respectively during February to April and June to August. The significant decline was observed on 40th day onwards with maximum decrease on 50th day i.e. 30.24±1.27% in 3.0mg furadan/l concentration and with maximum decline on 60th day 30.88±1.20% in 0.75mg furadan/l concentration respectively, when compared with their respective normal values.

The pesticide induced female fish also showed the same trend as that of males. In this case also, the female fish exposed to 6.0 mg furadan/l concentration showed a significant decline on 20th day with a maximum decline on 30th day in both lots i.e. February to April and June to August which was 37.96±1.31 and 34.87±1.21% respectively; whereas, the fish exposed to 3.0 & 0.75 mg furadan/l concentration the declines were found statistically significant on 40th & 60th day of exposure during June to August respectively Table 1.1 (B) & 1.2 (B), when compared with that of their respective normal value.

(C) Total Erythrocyte count (TEC) : In normal condition, the TEC value in male varied in between 2.76±0.02 to 2.96±0.03x10^{6}/mm^{3} and from 2.50±0.04 to 2.65±0.050x10^{6}/mm^{3} during February to April and June to August, whereas, in females it varied in between 3.10±0.03 to 3.32±0.04x10^{6}/mm^{3} and from 2.96±0.05 to 3.08±0.04x10^{6}/mm^{3} during February to April and June to August respectively (Table 1.1(A) & 1.2(A). It indicated that females had more TEC value than the males comparatively more during maturing than the mature phases.

The male fish exposed to 6.0mg furadan/l concentration showed a significant decrease in TEC value on 20th day with maximum decline on 30th day of exposure & the value was recorded 2.54±0.02x10^{6}/mm^{3} during February & 2.16±0.04x10^{6} during June. Almost similar conditions were observed in the fish exposed to 3.0 & 0.75mg furadan concentrations as the declines were significant from 30th & 40th day of exposure onwards with a maximum decline on 50th day (2.40±0.03 & 2.56±0.02x10^{6}/mm^{3}) in February to April and 2.26±0.04&2.36±0.03x10^{6}/mm^{3} in June to August months, when copared with their respective normal values (Table 1. 1A& 1.2A)

The female fish exposed to 6.0mg furadan/l concentration showed statistically significant decrese on 20th day with a maximum on 30th day of exposure during February 2.86±0.03x10^{6}/mm^{3} and also during June 2.62±0.05x10^{6}/mm^{3} while in sublethal concentration i.e. 3.0&0.75 mg furadan/l the declines were found significant on 30th day onwards with a maximum on 50th day 2.78±0.05 & 2.86±0.03x10^{6}/mm^{3} during February to April and on 60th day 2.50±0.05x10^{6}/mm^{3}, in 3.0mg/l and on 60th day 2.52±0.03x10^{6}/mm^{3} in 0.75mg/l furadan concentration during June to August when compared with that of their respective normal values. (Table 1.1B & 1.2B).

(D) Total Leucocyte Count (TLC): In normal condition, the TLC value of male fish varied in between 11.36±0.16 to 12.10±0.10x10^{3}/mm^{3} during February to April and from 11.64±0.16 to 12.10±0.13x10^{3}/mm^{3} during June to August, whereas in females it varied in between 13.64±0.12 to 14.40±0.14x10^{6}/mm^{3} and from 12.88±0.11 to 13.40±0.13x10^{6}/mm^{3} during February to April and June to August months respectively. Thus it appeared that TLC is slightly more in mature phase than the maturing phase in males but comparatively more TLC value were found during maturing than the mature female fish (Table 1.1A & 1.2A).

The male fish exposed to 6.0mg furadan/l concentration showed an increased TLC value, which were found statistically significant on 20th day with maximum on 30th day in February 14.65±0.13x10^{3}/mm^{3} and on 30th day in June 13.60±0.13x10^{3}/mm^{3}, whereas, the fish exposed to 3.0 & 0.75 mg furadan/l concentrations, the significant increase in TLC value were recorded on 30th & 40th day of exposure with maximum increase on 50th &

60th day of exposure 13.15±0.12 & 13.06±0.14x10^3/mm^3 during June to August respectively, when compared with that of their respective normal values (Table 1.1A & 1.2A).

The female fish exposed to 6.0mg furadan/l concentration also showed a significantly increased value on 20th day with maximum on 30th day of exposure 15.16±0.14x10^3/mm^3 during February and on 30th day of exposure 14.26±0.15x10^3/mm^3 during June, whereas in the fish exposed to 3.0 & 0.75 mg furadan/l concentrations, the significant increase were observed on 40th & 50th day with maximum on 50th & 60th day 14.86±0.16x10^3/mm^3 & 15.36±0.13x10^3/mm^3 respectively during February to April and also a maximum increase on 50th & 60th day 14.46±0.13 & 14.36±0.14x10^3/mm^3 in 3.0 & 0.75mg furadan/l concentrations respectively during June to August months, when compared with their respective normal values (Table 1.1B & 1.2B).

CONCLUSION

The fish *Channa punctatus* (both male & female) exposed to lethal concentration (6.0mg/l) and sublethal concentration (3.0&0.75mg/l) of furadan at selected days of exposure during maturing (February to April) and mature/spawning (June to August) phases along with respective controls showed the following changes in their haematological parameters of the blood.

(a) The haemoglobin in the blood during normal conditions were more in females than the males and also during maturing than the mature phase.

(b) The haemoglobin content gradually decreased in both male & female fish in both phases of gonadal cycle exposed to lethal & sublethal concentrations depended on the concentration & exposure period as it was recorded significantly decreased on 20th to 30th day of exposure to lethal and on 40th to 50th day onwards in sublethal concentrations in both sexes & in both phases, when compared with that of their respective normal values. The dicrease was due to pesticide's interference with haemopoietic organ which may result hypochromic microcytic anaemia, which is attributed to deficiency of iron & it's decreased utilization for Hb synthesis as suggested by Koundinya & Murthi (1979)

(c) The haematocrit value was also recorded more in females than the males and in maturing than the mature phase during normal condition of the fish; whereas in furadan exposed fishes,a gradual decrease were observed, which was found statistically significant between 20th & 30th day in lethal and on 40th onwards in sublethal concentrations depended on concentration & exposure period, when compared with their respective normal values. The decrease in Ht value is attributed to alteration of cell membrane by hydrolysis of acetyl choline in body fluids by cholinesterases of the R.B.C. (Mc. Farlane & Robbsmith, 1961)

(d) The TEC during normal condition were more in female than the male and during maturing than the mature phase. It showed a decreasing trend in both sexes exposed to furadan, which were recorded to be signification between 20th to 30th days in lethal concentrations and from 30th to 60th day of exposure in sublethal concentrations depended on the concentration of the pesticide & exposure period.

(e) The TLC were recorded more in females than the males but negligible increase/decrease during maturing & mature phases in normal condition. Both male and female fish exposed to different concentrations of furadan showed an increase in TLC which was recorded statistically significant between 20th to 30th day of exposure to lethal and from 30 to 40 days onwards in sublethal concentrations depended on concentration & expousure period. The increase in TLC might be due to toxicity by leucocytosis or lymphocytosis as suggested by Kumar & Banerjee (1991). The rise may also be due to the immunological defence of the fish or it may be due to the aseptic reaction caused by necrosis of liver or other organ.

The decrease in Hb,Ht & TEC in pesticide induced fishes might be due to pesticide interference with haemopoietic organs. The decreased Hb & TEC may result hypochromic microcytic anaemia and or alteration of cell membrance by hydrolysis of acetylcholine in body fluids by cholinesterases of the erythrocytes; whereas the increase in TLC might be due to toxicity by leucocytosis and lymphocytosis or might be due to immunological defence of the fish or due to aseptic reaction caused by necrosis of liver or other organs. Further the increasing tendency also shows failure of the fish to attain the normal value against prolonged stress.

Table-1.1(A): Changes in Haematological parameter of male *Channa punctatus* exposed to lethal & sublethal concentrations of Furadan at selected days of exposure during February to April alongwith control values.

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
Control	10	12.74±0.18	41.24±1.31	2.76±0.02	11.36±0.16
6.0		12.00±0.22	39.76±1.26	2.68±0.03	12.04±0.13
3.0		12.67±0.24	40.85±1.22	2.74±0.02	11.70±0.12
0.75		12.76±0.25	41.10±1.34	2.76±0.02	11.36±0.11
Control	20	12.70±0.22	41.46±1.27	2.80±0.03	11.42±0.13
6.0		11.45±0.28*	35.65±1.21*	2.62±0.03	12.46±0.14**
3.0		12.58±0.19	40.48±1.29	2.71±0.02	11.84±0.12
0.75		12.67±0.20	41.20±1.30	2.74±0.02	11.55±0.13
Control	30	12.82±0.21	42.00±1.25	2.82±0.03	11.48±0.11
6.0		10.16±0.18**	30.80±1.17**	2.54±0.02**	14.65±0.13**
3.0		12.42±0.26	39.63±1.30	2.68±0.03*	12.70±0.12**
0.75		12.55±0.24	41.18±1.24	2.72±0.03	11.86±0.10
Control	40	12.96±0.19	42.48±1.32	2.88±0.05	11.54±0.13
6.0		-	-	-	-
3.0		12.26±0.20	37.24±1.25*	2.64±0.04*	12.87±0.12**
0.75		12.37±0.18	40.42±1.27	2.69±0.03*	12.18±0.13**
Control	50	13.25±0.16	42.74±1.28	2.92±0.03	11.80±0.12
6.0		-	-	-	-
3.0		11.90±0.14**	34.58±1.26*	2.40±0.03**	13.05±0.14**
0.75		12.15±0.23*	38.36±1.30	2.56±0.02**	12.47±0.12**
Control	60	13.52±0.20	43.10±1.31	2.96±0.03	12.10±0.10
6.0		-	-	-	-
3.0		-	-	-	-
0.75		11.76±0.17**	37.42±1.24*	2.45±0.03**	13.00±0.13**

Table-1.1(B): Changes in Haematological parameter of female *Channa punctatus* exposed to lethal & sublethal concentrations of Furadan at selected days of exposure during February to April.

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
Control	10	14.26±0.32	45.32±1.35	3.10±0.03	13.64±0.12
6.0		13.85±0.33	42.17±1.40	2.98±0.04	14.10±0.15
3.0		14.22±0.31	44.96±1.24	3.06±0.03	13.75±0.14
0.75		14.20±0.25	45.13±1.30	3.08±0.03	13.60+0.13
Control	20	14.32±0.27	45.50±1.29	3.16±0.03	13.69+0.14
6.0		13.25±0.30	39.64±1.33	2.94±0.04*	14.38+0.15*

Table continued

Table continued

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
3.0		14.10±0.26	44.28±1.31	3.02±0.05	14.00+0.12
0.75		14.06±0.31	44.92±1.23	3.06±0.04	13.84±0.12
Control	30	14.48±0.25	45.64±1.38	3.22±0.05	13.75±0.13
6.0		12.13±0.23**	37.96±1.31*	2.86±0.03	15.16±0.14**
3.0		13.69±0.27	43.39±1.28	2.98±0.05	14.12±0.15
0.75		13.84±0.21	44.47±1.34	3.06±0.04	14.15±014
Control	40	14.75±0.30	46.05±1.41	3.24±0.05	13.90±0.14
6.0		-	-	-	-
3.0		13.40±0.21*	40.57±1.25*	2.86±0.04**	14.94±0.12*
0.75		13.65±0.24	43.10±1.32	2.98±0.03*	14.32±013
Control	50	15.10±0.33	46.34±1.40	3.30±0.04	14.25±017
6.0		-	-	-	-
3.0		12.91+0.26**	39.40±1.17*	2.78±0.05**	15.40±0.15**
0.75		13.34±0.31*	41.50±1.24	2.86±0.03**	1486±0.16*
Control	60	15.42±0.29	46.52±137	3.32±0.04	14.40±0.14
6.0		-	-	-	-
3.0		-	-	-	-
0.75		13.00+0.24**	39.28+1.22*	2.80+0.05	15.36+0.13**

Table-2.1(A): Changes in Haematological parameter of male *Channa punctatus* exposed to lethal & sublethal concentrations of Furadan at selected days of exposure during June to August.

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
Control	10	12.12±0.18	38.54±1.27	2.50±0.04	11.64±0.16
6.0		11.68±0.24	36.39±1.40	2.44±0.06	11.98±0.12
3.0		11.94±0.23	37.90±1.26	2.46±0.04	11.78±0.11
0.75		12.08±0.19	38.18±1.33	2.46±0.05	11.70±0.12
Control	20	12.17±0.21	38.76±1.32	2.54±0.06	11.70±0.14
6.0		11.25±0.23*	33.62±1.28*	2.30±0.03*	12.31±0.16*
3.0		11.78±0.18	37.27±1.31	2.44±0.05	12.02±0.15
0.75		11.86±0.23	37.85±1.40	2.46±0.04	11.95±0.13
Control	30	12.30±0.16	39.10±1.36	2.58±0.03	11.76±0.11
6.0		10.41±0.21**	30.31±1.22**	2.16±0.04**	13.60±0.13**
3.0		11.65±0.25	36.85±1.25	2.42±0.06	12.20±0.12
0.75		11.72±0.27	37.46±1.32	2.44±0.05	12.70±0.13

Table continued

Table continued

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
Control	40	12.35±0.23	39.80±1.29	2.58±0.04	11.84±0.12
6.0		-	-	-	-
3.0		11.41±0.21*	34.13±1.32*	2.36±0.04*	12.44±0.11*
0.75		11.64±0.18	36.90±1.28	2.40±0.05*	12.32±0.14
Control	50	12.42±0.20	40.35±1.35	2.62±0.03	11.92±0.11
6.0		-	-	-	-
3.0		10.46±0.19**	30.24±1.27**	2.26±0.04**	13.15±0.12**
0.75		11.24±0.21*	34.10±1.19*	2.36±0.03**	12.61±0.14*
Control	60	12.50±0.22	41.00±1.32	2.65±0.05	12.10±0.13
6.0		-	-	-	-
3.0		-	-	-	-
0.75		10.65±0.15**	30.88±1.20**	2.28±0.03**	13.06±0.14**

Table-2.1(B): Changes in Haematological parameter of female *Channa punctatus* exposed to lethal & sublethal concentrations of Furadan at selected days of exposure during June to August.

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC (x 10^6/mm^3)	TLC (x10^3/mm^3)
Control	10	12.80±0.12	42.75±1.29	2.96±0.05	12.88+0.11
6.0		12.65±0.13	40.48±1.40	2.86±0.06	13.36±0.12
3.0		12.72±0.14	42.27±1.38	2.92±0.04	13.17±0.11
0.75		12.80±0.13	42.59±1.41	2.94±0.05	12.98±0.13
Control	20	13.00±0.11	42.86±1.34	2.98±0.06	12.94±0.15
6.0		12.53±0.12*	37.59±1.32	2.77±0.04*	13.55±0.14*
3.0		12.68±0.13	41.90±1.40	2.90±0.05	13.45±0.17
0.75		12.75±0.14	42.14±1.44	2.94±0.03	13.40±0.16
Control	30	13.16±0.19	42.92±1.37	3.00±0.04	13.10±0.13
6.0		11.28±0.11**	34.87±1.21*	2.62±0.05**	14.26±0.15**
3.0		12.65±0.16	40.36±1.34	2.84±0.06	13.63±0.17
0.75		12.70±0.14	41.74±1.45	2.90±0.04	13.46±0.15
Control	40	13.30±0.17	43.08±1.32	3.02±0.05	13.16±0.13
6.0		-	-	-	-
3.0		12.61±0.13*	38.95±1.28	2.76±0.04*	13.82±0.14*
0.75		12.68±0.16	41.28±1.36	2.86±0.03	13.64±0.12

Table continued

Table continued

Concentration (mg/l)	Exposure period (Day)	Haemoglobin (gm/dl)	Haematocrit (%)	TEC ($x\ 10^6/mm^3$)	TLC ($x10^3/mm^3$)
Control	50	13.64±0.16	43.12±1.28	3.04±0.06	13.25±0.12
6.0		-	-	-	-
3.0		12.46±0.14**	37.30±1.31*	2.50±0.05**	14.46±0.13**
0.75		13.02±0.13*	38.63+1.27	2.72±0.06*	13.81±0.14*
Control	60	13.92±0.15	43.58±1.35	3.08±0.04	13.40±0.13
6.0		-	-	-	-
3.0		-	-	-	-
0.75		11.96±0.13**	35.42±1.21*	2.52±0.03**	14.36±0.14**

REFERENCES

1. **Koundinya, R.P. & Murthi, R.R. 1979:** Effect of organophosphate pesticide, Sumithion on some aspect of Carbohydrate metabolism in a fresh water fish, *Tilapia mossambica* (Pet.) Experientia, 35: 1632-1633.
2. **Kumar, N. 1999**: Effect of few insecticides on the gills of an air breathing fish. Ph.D. Thesis, L.N.M. Univ. Darbhanga., India.
3. **Kumar, B. & Banerjee, V. 1991**: Alterations in haematological parameters of *Clarias batrachus* (L.) on exposure to lethal & sublethal concentrations of BHC. J. Freshwater. Biol., 3(1): 71-80.
4. **Larson, A., Bengstone, B.F. & Svanberg, O. 1976**: Some haematological & biochemical effects of cadmium in fish. In, "Effects of pollutants on aquatic organisms". (Ed. Lockwood, A.P.M.). Cambridge Univ. Press. London, N.Y. pp. 35-45.
5. **Mc Farlane, R.G. & Robbsmith, A.H.T., 1961**: "Functions of the Blood." Academic Press, N.Y. pp. 635.
6. **Mushitaq, M. & Nagarajan, K. 1992**: Altered physiological parameters due to the pesticide ekalux in the fish, *Catla catla.* Environ. Ecol., 10(2): 445-447.
7. **Sheela, M. & Muniandy, S. 1992:** Impacts of pesticide dimethoate on the body composition, acid & alkaline phosphatases in different tissues of the fish, *Lepidocephalichthys thermalis.* Environ. Ecol., 10(1): 220-223.
8. **Tiwari, S. & Singh, A. 2004:** Toxic & Sublethal effect of oleandrin on bio chemical paramenters of freshwater airbreathing murrel, C. *punctatus.* Ind. J. Exp. Biol. 42(413-418).
9. **Woo, P.T.K., Sin, Y.M. & Wong, M.K. 1993**: The effects of short term acute cadmium exposure on blue Tilapia, *Oreochramis aureus.*Environ. Biol. Fish., 37(1): 67-74.

* * *