Consequences of Fame (Flubendiamide 480 sc) Exposure on Haematological Parameters of the Fish *Oreochromis Mossambicus*

Ampili, M

PG and Research Department of Zoology, N.S.S.Hindu College, Changanassery, Kottayam, Kerala, India

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Abstract- The haematological parameters such as Total Erythrocyte Count (TEC), Total Leucocyte Count and Differential leucocyte count (TLC and DLC), Haemoglobin Content (Hb), Packed Cell Volume (PCV), the Erythrocyte constants like Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) and Enzymes (AST/SGOT and ALT/SGPT) were estimated in the fish *Oreochromis mossambicus* exposed to sub-lethal concentration (10ppm) of FAME (Flubendiamide 480 SC) pesticide for four weeks. Studies in fish exposed to this chemical pesticide (amide derivative) indicated significant reduction in the blood parameters except WBC throughout the experiment. Total leucocytes showed significant increase throughout the experiment. The enzyme profile showed significant increase after 4weeks of exposure confirming the significant impact of the pesticide on the organism.

Index Terms- flubendiamide, haematological, *Oreochromis mossambicus*, sub-lethal concentration

I. Introduction

Seasonal utilization of paddy fields for fish culture is quite common in Kerala and West Bengal. In recent years, with the advent of high yielding varieties of paddy, the use of pesticide has become very popular. Agricultural inputs in terms of pesticides/insecticides are increasing day by day and its residues are being drained off in to water bodies. Use of pesticides in agriculture sector and its ultimate discharge in to aquatic ecosystem have a potential toxicological concern to biota of the ecosystem including fishes (Tilak *et al*, 1980). Environmental pollution is one of the serious plights of the modern world. During the last decade, due to the significant increase in the environmental pollutants and lack of precautionary measure or observance of the environmental regulations, it has become the global problem (Bondarenko *et al.*, 2004, Devi *et al.*, 2008, Sachar and Raina, 2014). Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, because they are sprayed or spread across entire agricultural fields (Gaafar *et al*., 2010, Saeed *et al.* 2012; Shankar *et al.*, 2013). Pesticides in the aquatic environments can negatively affect the ecosystem.

Haematological parameters are closely related to the response of the animal to the environment, an indication that the environment where fishes live could exert some influence on the haematological characteristics (Gabriel *et al*., 2004, Kavitha *et al*., 2010). Blood offers important profile to study the toxicological impact on animal tissues. Different blood parameters are often subjected to change depending upon stress condition and various other environmental factors (Goel *et.al*., 1985, Goel and Sharma 1987, Suvetha *et al*., 2010; Chaudhary *et al*., 2015; Prasad *et al*., 2015). Fishes are very sensitive to a wide variety of toxicants in water; various species of fish show uptake and accumulation of many contaminants or toxicants such as pesticides (Herger *et al.*, 1995). Accumulation of pesticides in tissues produces many physiological and biochemical changes in the fishes and freshwater fauna by influencing the activities of several enzymes and metabolites (Nagarathnamma and Ramamurthi, 1982). Bouck and Ball (1966), Johnson (1968) and Srivastava *et al.* (2010) stated that fish severs as a bio indicator species as it responds with great sensitivity to changes in the aquatic environment and has an important role in the monitoring of water pollution. Blood analysis is crucial in many fields of Ichthyologic research, fish farming and in toxicology and environmental monitoring as an indicator of physiological and pathological changes in fishery management and disease investigation (Adedejii *et al*., 2000).

Several researchers studied the effect of various toxicants on the haematology of fishes such as hemato-biological characteristics of *Heteropneustes fossils* under the stress of Zinc (Goel *et al*., 1985), effect of zinc sulphate on haematology of dog fish (Flos *et al*., 1987). Ramanujan and Mohanty (1977) studied the effect of sub-lethal concentration of Endosulphan on the haematological parameters of *H.fossilis*. Srivastava and Mishra (1979) have reported anaemia associated with erythropenia in *Iolisa faciatas* after exposure to lead. The significant increase in RBC number and percentage haemoglobin could be ascribed to enhanced erythropoiesis which is triggered as a typical stress response (Gill and Pant, 1985). Goel *et al.* (1992) reported that the results of reduced activities of AST, ALT, ACP, ALP, LDH in various organs of fish (*Pontius conchonius*) exposed to mercury in implies destruction in the tissues of the animals. Serum AST and ALT are important diagnostic tools in medicine and clinics, and are used to detect the toxic effects of various pollutants (Nelson and Cox, 2000). Roy and Bhattacharya (2005) noted significant changes in SGOT (AST) and SGPT (ALT) in

Channa punctatus exposed to As_2O_3 and indicated that the changes may be due to histopathological lesions in liver. Kallagadda *et al.*, (2016) observed marked changes in behavioural morphology and haematological parameters in *L.rohita* exposed to flubendiamide.

Haematological parameters can be detected rapidly and hence can be used for prediction and diagnosis of pesticide toxicity. Haematologic indices are important parameters for the evaluation of fish physiological status, the changes in which depend on fish species, age, sexual maturity of spawners and disease (Zhitenera *et al*, 1989, Luskova, 1997). These indices have been employed in effectively monitoring the response of the fishes to the stressors and thus their health status under such adverse conditions. The haematological indices were widely used by fish biologists and researchers (Adhikari *et al.*, 2004; Cazenave *et al.*,2005; Kori-Siakpere *et al.*, 2006; Ali and Rani, 2009; Sharaf *et al.*, 2010; Kori-Siakpere and Ikomi, 2011 and Nte,2011). Sequel of pesticides on haematological factors of a number of fish species have been investigated by several researchers: in *Cyprinus carpio* (Satyanarayan *et al*., 2004; Salvo *et al*., 2008); in *Clarias batrachus* (Patnaik and Patra, 2006; Kharat and Kothavade, 2012; Summarwar and Verma, 2012); in *Oreochromis mossambicus* (Ali and Rani, 2009; Desai and Parikh, 2012); in *Heteropneustes fossilis* (Deka and Dutta, 2012; Chaudhary *et al*., 2015; Prasad *et al*., 2015), and in *Puntius mesopotamicus* (Saxena and Seth, 2002; Carraschi, 2012).

Present study was carried out to analyse the effect of sub-lethal concentration of amide derivative pesticide, flubendiamide on the haematological parameters of the fish *Oreochromis mossambicus* and to estimate the impact of long term use of pesticide on the vital organ such as liver of fish by analyzing the liver marker enzymes.

II. MATERIALS AND METHODS

Oreochromis mossambicus weighing 20-30 g from the local fish farm were used for the experiment. The fish were acclimatised to the laboratory conditions in a glass aquarium filled with aerated de-chlorinated water under natural photo period for one week. The fish were fed every day. Water in the tank was renewed every day. Only healthy and active fishes of similar size were randomly selected from the aquarium tanks and used for haematological studies.

96 hour LC_{50} value for the pesticide was determined using bioassay methods proposed by Doudoroff *et al*. (1951). From the LC_{50} value a sub-lethal concentration ($1/10^{th}$ of LC_{50}) was calculated for the pesticide and was fixed as the experimental concentration. Fish were exposed to sub-lethal concentration (10ppm) of fame (Flubendiamide) for a period of 28 days (4week), and blood samples were taken by severing the caudal vein of the fish. Haematological parameters like Total Erythrocyte count (TEC), Haemoglobin Count (Hb gm %), Packed cell volume (%), Total and differential Leucocyte Count (TLC and DLC) and erythrocyte constants (MCV, MCH, MCHC) were determined by standard methods. Blood samples were also used for the analysis of enzymes such as Alkaline transaminase (ALT/SGPT) and Aspartate aminotransferase (AST/SGOT).

III. RESULT

Data on haematological parameters such as Total Erythrocyte count (TEC), Total Leucocyte Count (TLC), Haemoglobin Count (Hb), Packed cell volume or Haematocrit (PCV) and erythrocyte constants such as Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) of *O.mossambicus* exposed to sub-lethal concentration (10 ppm) of pesticide FAME (Flubendiamide 480 SC) for a duration of 24 hrs to 4 weeks are represented in Tables 1 and II. Table III delineates the enzyme profile after exposure of 4 weeks. Data is represented as mean values ± Standard Error.

IV. DISCUSSION

Water pollution is recognized globally as a potential threat to both human and other animal populations that interact with aquatic environments. Any alteration in the environment upsets homeostasis. Basically all toxicants produce adverse effect on some physiological functions in aquatic organisms. According to studies conducted by Shayeghi *et al*. (2001) and Honarpajouh (2003), traces of insecticides were detected several months after spraying. Peripheral haematological parameters are a reliable indicator of physiological status of fish and an effective parameter to assess the background effects of environment perturbation (Natarajan *et al*., 1998). At sub-lethal concentrations, the fish survive even after prolonged periods of exposure (Natarajan, 1984). Prolonged exposure in sub-lethal concentrations of the toxicant may cause a strict decline in many of haematological parameters.

The red blood cells have the important function of carrying oxygen to all tissues in the body via haemoglobin in erythrocytes. The decreased red blood cell number following exposure to pesticide could be as a result of haemolysis or destruction of red blood cells. In the present study, the total RBC count was decreased significantly on the last day of the experiment. The decrease found in total RBC might be due to the disruptive action of pesticide on the erythropoietic tissue (Larsson *et al*., 1985). Similar result has been reported by previous studies in *Cyprinion watsoni* due to malathion exposure (Khattak and Hafeez, 1996), in *Piaractus mesopotamicus* due to trichlorphon exposure (Tavares *et al*., 1999) and in carp due to chlorpyrifos (Ramesh and Saravanan, 2008, Vani *et al*. 2011 and Yonar *et al.*, 2012). It has been widely reported that many pollutants denature or oxidise the haemoglobin by inhibiting glycolysis or hexose monophosphate shunt resulting in anaemia (Buckley *et al*., 1976). In our study too Hb content is reduced. The significant decrease of TEC and Hb during four weeks of exposure is the result of decreased erythropoetic activity.

Haematocrit is used to determine the ratio of plasma to corpuscles in the blood as well as the oxygen carrying capacity of the blood. The findings of present study agree with the previous results (Larsson *et al*., 1985) in which recorded a decrease in haematocrit level in brown trout after exposure to diclofanac for 7 days. The haematocrit values decrease when a fish loses its appetite or diseased (Blaxhall, 1973) or poisoned by pesticides (Gill and Pant, 1985). The reduction in packed cell volume (PCV) of *C. c. var. communis* may also be due to decreased rate of erythropoiesis as well as haemolysis as observed in the *Flounder pleuronectus flesus* when subjected to cadmium toxicant (Larsson, 1975). In the present study a gradual decline in blood parameters like haemoglobin content and PCV were noticed with increased exposure period. Same observations were made by Ramanujan and Mohanty (1977) while studying the effects of pesticide endosulphan on *Heteropneustes fossilis*. Thus it appears that the fish experienced a mild anaemia due to haemolysis and haemorrhage of blood cells. Similar observations were reported earlier by Tilak *et al*. (2001), Saravanan *et al*. 2010 and Saeed *et al*. (2012). Decreased haemoglobin content leads to decreased O_2 content, which affects the physiological state of the fish in an unhealthy way. Simultaneously increase in MCV reported in this study can be correlated with erythrocyte swelling, probably resulting from plasma acidosis and a reduction in plasma ions as given in earlier studies of Wood *et al*. (1989) and Milligan and Wood (1982).

Increase in TLC in the test fish could be due to stimulated lymphopoiesis and enhanced release of lymphocyte. Such lymphocyte response might be due to the presence of toxic substances or may be associated with the pollutant induced tissue damage as opined by Haniffa (1991). Increased WBC count established leucocytosis, which is considered to be of an adaptive value for the tissue under chemical stress. This also helps in the removal of cellular debris of necrosed tissue at a faster rate (Rivas, 1986). According to Sudha (2012) the increase in WBC count can be correlated with a natural response of the fish against toxic invasion. The findings of present study are also in tune with the results of previous studies.

But the increased MCV values from 24 Hrs to 4 week of exposure indicate cellular swelling and consequent macrocytosis and decrease of value due to the iron deficiency *etc* and thus lower haemoglobin concentration. The decreased PCV value (24 Hrs to 4 week) and MCHC (24 Hrs to 4weeks) indicates the occurrence of microcytic anaemia and due to the deficiency of iron and reduction in haemoglobin synthesis and the value increased due to haemolysis. The values of blood cell indices were enhanced after the exposure and this tune with the findings of earlier studies (Ko:pru:s *et al*.,2006, Rao, 2010, Kallagadda *et al*.,2016).

The liver function tests, analysis of serum AST/SGOT and ALT/SGPT, are widely used to demonstrate liver function or toxicant-induced hepato-toxicity (Yang and Chen, 2003; Dutta *et al*. 1993, 1996 and 2006). Roy and Bhattacharya (2005) noted significant changes in serum, SGOT and SGPT in *Channa punctatus* exposed to As_2O_3, and indicated that the changes may be due to histopathological lesions in liver. After sub-chronic dietary, Cu exposure for 40 days increased serum AST and ALT concentrations with increasing time and dose were observed in the rockfish, *Sebastes schlegeli* (Kim and Kang, 2004). In the present study, the significant increase in AST and ALT levels in Fame treated fish indicates hepatic damage due to accumulation of the toxicant, which in turn releases these enzymes into the bloodstream.

The study suggested that, the perturbations in these haematological indices attributes to a defence reaction against toxicity of FAME through the stimulation of erythropoiesis or may be due to the disturbances that occurred in both metabolic and haemopoietic activities of fish exposed to sub-lethal concentration. The toxicant induced haematological disturbance could lead to the impairment of the fish's ability to combat diseases, reduce its chances for survival and potential for growth and reproduction.

V. CONCLUSION

Among pesticides, amide derivative pesticide like FAME (flubendiamide 480 SC) plays an important role in polluting the aquatic ecosystem. Fish were exposed to sub-lethal concentration (10 ppm) of flubendiamide 480 SC for 4 weeks. Haematological parameters like TEC, TLC & DLC, Hb and PCV were recorded after 24 Hrs to 4 weeks of exposure. Haematological constants like MCV, MCH and MCHC were obtained for control and experimental fishes. The TEC was recorded a significant decrease in the value at 24 Hrs to 4 week. The PCV and Hb values also showed a decreasing trend. The MCV values fluctuated during the study period. The MCH values showed decrease at 24 Hrs to 4 week. The MCHC showed a fluctuating trend from 24 Hrs to 4 week of exposures.MCH is mostly associated with haemoglobin concentration. The decreased values indicated iron deficiency and reticulocytosis and increased value may be due to haemolysis. The observations on haematological indices have provided valuable information on the fish health and its stress response.

REFERENCES

[1] Adedejii,O.B., Taiwo,V.O, and Agbede,S.A. 2000. Comparative haematology of five Nigerian fresh water fish species. *Nigerian Vetinary Journal*, 21:75-84

[2] Adhikari S and Sarkar B. 2004. Effects of cypermethrin and carbofuran on certain haematological parameters and prediction of their recovery in a freshwater teleost, *Labeo rohita* (Ham). *Ecotoxicol.Environ.saf.*, 58:220-226.

[3] Ali, J. and Rani, V.J. 2009. Effect of phosalone on haematological indices in the tilapia, *Oreochromis mossambicus*. *Turk. J. Vet. Anim. Sci*., 33: 407-411.

[4] Blaxhall, P.C. and Daisley, K.W. 1973. Routine haematological methods for use with fish blood. *J. Fish. Biol*., **5:** 771 – 781.

[5] Bondarenko,S., Ga, .J., Haver, D.L.,and Kabashima, J.N. 2004.Persistance of selected organophophates and carbonate insecticides in water from a coastal watershed. *Environ.Toxicol.Chem*., 23(11):2649-2654.

[6] Bouck, G. R. and Ball, R. C. 1966. Influence of capture methods on blood characteristics and mortality in rainbow trout (*Sulmo gairdneri*). *Trans. Fish. Sco*., 95: 170-176.

[7] Buckley, J.A., Whitemore, C.M. and Matsuda, R.I.1976. Changes in blood chemistry and blood cell morphology in coho salmon, *Oncorhynchus kisutch* following exposure to sub-lethal levels of total residual chlorine in municipal waste water. *J. Fish. Res. Board Canada*, 33:776-782.

[8] Carraschi, S.P. 2012. Histopathological biomarkers in Pacu (*Piaractus mesopotamicus*) infected with *Aeromonas hydrophila* and treated with antibiotics. *Ecotoxicology and Environmental Safety*, 83: 115-120.

[9] Cazenave, J., Wunderlin, D.A., Hued, A.C. and Angeles Bistoni, M.D.L. 2005. Haematological parameters in a neotropical fish, *Corydoras paleatus* (Jenyns, 1842) (Pisces, Callichthyidae), captured from pristine and polluted water. *Hydrobiologia*, 537: 25-33.

[10] Chaudhary, A., Prakash, C. and Srivastav, S.K. 2015. Biochemical changes in blood of freshwater catfish *Heteropneustes fossilis* exposed to microcystin-LR. *Int. J. Zool. Invest.*, 1: 72-76.

[11] Deka, C. and Dutta, K. 2012. Effects of Cypermethrin on some haematological parameters in *Heteropneustes fossilis* (bloch). *The Bioscan*, 7: 221-223.

[12] Desai, B. and Parikh, P. 2012. Impact of Curzate (fungicide) on Haematological Parameters of *Oreochromis mossambicus*. *Int. J. Scient. Engin. Res.*, 3:12-45.

[13] Devi, P., Baruah, D., Baruah, B.K. and Borkotoki, A. 2008. Impact of endosulfan on some haematological parameters of *Channa punctatus* (Bloch). *Poll. Res.,* 27(3): 485-488.

[14] Doudoroff , P., Anderson, B. O, Burdick, G. E., Galtsoff, P. S., Hart, W. B., Parick, R., Strong, E. R., Surber, E. W. and Vanhorn, W. M. 1951. Bioassay methods for the evaluation of acute toxicity of industrial wastes to fish, *Sewage Industry Wastes*, 23:1380-97.

[15] Dutta, H. M., Munshi, J. S. D., Roy, P. K., Singh, N. K., Adhikari, S.and Killius, J. 1996. Ultrastructural changes in the respiratory lamellae of the catfish, *Heteropneustes fossilis* after sub-lethal exposure to malathion. *Environ. Pollut*., 92: 329-341.

[16] Dutta, H.M., Adhikari, S., Singh, N.K., Roy, P.K. and Munshi, J.S.1993. Histopathological changes induced by malathion in the liver of a freshwater catfish, *Heteropneustes fossilis* (Bloch). *Bull Environ Contam Toxicol*., 51:895–900.

[17] Dutta, H., Misquitta, D. and Khan, S. 2006. The effects of endosulfan on the testes of bluegill fish, *Lepomis macrochirus*: A histopathological study. *Archives of Environmental Contamination and Toxicology*. 51: 149-156.

[18] Flos, R., Tort, L. and Balacch, J. 1987. Effects of Zinc Sulphate on haematological parameters in the dogfish (*Scyliohinus canicula*) and Influence off MS 222. *Mar. Environ. Res*., 21:289-298.

[19] Gaafar, A.Y., El-Manakhly, E.M., Soliman, M.K.,Soufy H., Mona, S., Z.,Mohamed, S.G. and Hassan, S.M. 2010. Some pathological, biochemical and haematolocal investigations on Nile Tilapia (*Oreochromis niloticus*) following chronic exposure to edifenphos pestiside. *Journal of American Scienc*, 6(10): 542-551.

[20] Gabriel, U.U., Ezeri, G.N.0. and Opabunmi, O.O. 2004. Influence of sex, source, health status and acclimation on the haematology of *Clarias gariepinus*. *African J Biotech.,* 3 (9): 463-467.

[21] Gill, T. S. and Pant, J. C. 1985. Mercury induced blood anomalies in the fresh water teleost, *Barbus conchonius*. *Wat. Air Soil Pollut*., 24: 165 - 171.

[22] Goel, K.A., Tyagi, S.K. and Awasthi, A.K. 1992.Effect of malathion on some haematological values in *Heteropneustes fossils*. *Comp. Physcio Ecol.*, 7:259-261.

[23] Goel, K.A., Gupta, K. and Sharma, M.L.1985. Haematological characteristic of *Heteropneustes fossilis* under the stress of zinc. *Indian J. Fish.*, 32: 186-188.

[24] Goel, K.A. and Sharma, M.L.1987. Some haematological characteristics of *Clarias batrachus* under metallic stress of arsenic. *Compar. Physiol. Ecol*., 12:63-66.

[25] Haniffa, M. A. and Selvan, S. A. 1991. Hematological and biological effects of textile mill effluent on the freshwater fish, *Oreochromis mossambicus* (Trewavas). *U. P. J. loot,* 11(1): 62 - 66.

[26] Herger, W., Jung, S.J. and Peter, H. 1995. Acute and prolonged toxicity to aquatic organisms of new and existing chemicals and pesticides. *Chemosphere,* 31: 2707-2726.

[27] Honarpajouh, K. 2003. Study and Identification of OP pesticides residues (Azinphosmethyl and Diazinon) in the Mahabad and Siminerood Rivers, M.Sc. Thesis, Tehran University of Medical Science. Tehran, Iran, pp. 95.

[28] Johnson, W. D. 1968. Pesticides and fishes: a review of selected literature. *Trans. Ameri. Fish. Soc.*, 97: 398-424.

[29] Kallagadda, N., Anil Kumar, K., Lalitha, V. and Venkata Rathnamma, V. 2016. Toxicity evaluation and haematological studies of flubendiamide on freshwater fish *Labeo rohita*. *ejpmr*, 3(6):345-348.

[30] Kavitha, C., Malarvizhi, A., Kumaran, S.S., Ramesh, M., 2010. "Toxicological Effects of Arsenate Exposure on Hematological, Biochemical and Liver Transaminases Activity in an Indian Major Carp, *Catla catla*". *Food and Chemical Toxicology*, 48, 2848-2854.

[31] Kharat, S. and Kothavade, S. 2012. Hematological study of *Clarias batrachus* with reference to Trypanosomiasis. *Trends in Fisheries Research*, 1(1) : 6-9.

[32] Khattak, I.U.D. and Hafeez, M.A. 1996. Effect of Malathion on blood parameters of the fish, *Cyprinion watsoni*. *Pak. J. Zool.*, 28: 45-49.

[33] Kori-Siakpere, O. and Ikomi, U. 2011. Alterations in some haematological parameters of the African Snakehead *Parachanna africans* exposed to Cadmium. Not. Sci. Biol., 3(4): 29-34.

[34] Kim, S.G. and Kang, J.C.2004. Effect of dietary copper exposure on accumulation, growth and hematological parameters of the juvenile rockfish, *Sebastes schlegeli*. *Mar. Environ. Res*. 58: 65-82.

[35] Ko¨pru¨cu¨, S., Ko¨pru¨cu, K., Ural, M.S.I., Spir, U. and Pala, M. 2006. Acute toxicity of organophosphorous pesticide diazinon and its effects on behavior and some hematological parameters of fingerling European catfish (*Silurus glanis L*.). *Pestic Biochem Phys*., 86: 99– 105.

[36] Kori-Siakpere, O. and Ikomi, U. 2011. Alterations in some haematological parameters of the African Snakehead *Parachanna africans* exposed to Cadmium. *Not. Sci. Biol*., 3(4): 29-34.

[37] Kori-Siakpere, O., Ake, J.E.G. and Avworo, U.M. 2006. Sublethal effects of Cadmium on some selected haematological parameters of *Hetero clarias* (A Hybrid of *Heterobranchus bidorsalis* and *Clarias gariepinus*). *Int. J. of Zoological Research*, 2: 77-83.

[38] Larsson, A.1975. Sublethal effects of toxic chemicals on Aquatic animals. 3-13pp. J. H. Koemen and J. J. T. W. A. Strick (Ed.) Elsevier Scientific publishing company, Amesterdam.

[39] Larsson, A., Haux, C. and Sjobeck, M. 1985. Fish physiology and metal pollution, Results and experiences from laboratory and field studies, *Ecotoxicol. Environ Saf*., 9: 250.

[40] Luskova, V. 1997. Annual cycles and normal values of hematological parameters in fishes. *Acta Sc. Nat. Brno*., 31(5): 70-78.

[41] Milligan, C.L. and Wood, C.M. 1982. Disturbances in hematology, fluid volumedistribution and circulatory function associated with low environmental pH in the rainbow trout (*Salmo gairdneri*). *J. Exp. Biol*., 99: 397-415.

[42] Nagratnamma, R. and Ramamurthi, R. 1982. Metabolic depression in the fresh water Teleost *Cyprinus carpio* exposed to an organophosphate pesticide. *Curr. Sci*., 51(B): 668-669.

[43] Natarajan, G.M., Mallikaraj, D., Vijayalakshmi, P., Pushparani, R., Parthi, N. and Rajalingam. R. 1998. Impact of pesticide on the Haematoenzymological changes in fish. In: Pesticides, Man and Biosphere (Edn. Shukla, O.P., Omar and Kulshrestha, A.K). *APH Pub. Copn*. New Delhi, pp 337 – 350.

[44] Natarajan, G.M. 1984. Effect of sublethal concentration of metasystox on selected oxidative enzymes, tissue respiration and haematology of the freshwater air breathing fish, *Channa striatus*. *Pest. Biochem. Physiol*., 21:194 – 198.

[45] Nelson, D.L. and Cox, M.M.2000. Lehninger Principles of Biochemistry, New York, *Worth Publishers*, pp. 623-658.

[46] Nte, M.E. and Akinrotimi, O.A. 2011. Biochemical Changes in Black Jaw Tilapia (*Sarotherodon melanotheron*) treated with sub lethal Levels of Industrial Effluents. *Sci. Edu. Develop. Inst*., 1: 25-33.

[47] Patnaik, L. and A.K. Patra, 2006. Haematopoietic alterations induced by carbaryl in *Clarias batrachus* (Linn.). *J. Applied Sci. Environ. Manage*., 10: 5-7.

[48] Prasad, M., Kumar, A., Suzuki, N. and Srivastav, A.K. 2015. Botanical pesticide *Nerium indicum* alters prolactin cells of stinging catfish *Heteropneustes fossilis*. *Int. J. Zool. Invest.* 1:77- 84.

[49] Ramanujam, S.N. and Mohanty.1977. Thiodane, lindane sublethal response on haematological parameters of *Heteropneustes fossilis*. *Jour. of Life Sciences*. 2:8-13.

[50] Ramesh, M. and Saravanan, M. 2008. Haematological and biochemical responses in a freshwater fish *Cyprinus carpio* exposed to Chlorpyrifos. *Int. J. Integr.Biol*., 3: 80–83.

[51] Rao, D.S. 2010. Carbaryl induced changes in the haematological, serum biochemical and immunological responses of common carp, *Cyprinus carpio* (L.) with special emphasis on herbal extracts as immunomodulators. Ph. D. Thesis, Andhra University, India, pp. 235.

[52] Rivas, L. R. 1986. Systematic review of the perciform fishies of the genus *Centropomus*. *Copeia*, 3:579–611.

[53] Roy, S. and Bhattacharya, S. 2005.Arsenic induced histopathology and synthesis of stress proteins in liver and kidney of *Channa punctatus*. *Ecotoxicol. Environ. Saf.*, 65: 218-229.

[54] Sachar, A. and Raina, S. 2014.Effect of lindane on immune organs of the fish Aspidoparia morar. International Journal of Innovative Research in Science, Engineering and Technology, 3(1): 8510-8515.

[55] Saeed, M., Habib, V.R., Abasali, Z., Elham, M. and Rizvan,K. 2012. The effects of diazinon on behavior and some hematological parameters of fry Rainbow trout *Oncorhynchus mykiss*. *J. Fish Marine Sci*., 4(4): 369-375.

[56] Salvo, L.G., Sinhorini, I.L., Malucelli, B.E., Klemz,C., Sanchez, D.O., Nicaretta, L., Malucelli, M.I.C., Bacila, M. and Assis, H.C.S.2008. Effects

of Endosulfan sub lethal concentrations on carp (*Cyprinus carpio*, Linnaeus, 1758): morphometric, histologic, ultrastructural analyses and cholinesterase activity evaluation. *Brazilian J. Vet. Res. Anim. Sci.,* 45: 87-94.

[57] Saravanan, T.S., Aneez Mohamed, M. and Harikrishnan, R. 2010. Studies on effects of chronic exposure of endosulphan to *Labeo rohita*. *J. Environ. Bio*. 31: 755-758.

[58] Satanarayan, S., Bejankiwar, R.S., Chaudhari, P.R., Kotangale, J.P, Satyanarayan, A. 2004. Impact of some chlorinated pesticides on the haematology of the fish *Cyprinus carpio* and *Puntius ticto*. *Environ. Sci*., 16(4): 631-634.

[59] Saxena, K.K. and Seth, N.2002. Toxic effects of cypermethrin on certain hematological aspects of fresh water fish *Channa punctatus*. Bull. Environ. Contam. Toxicol., 69:364-369.

[60] Shankar, K.M., Kiran, B.R., and Venkateshwarlu, M. 2013. A review on toxicity of pesticides in Fish. *J. Sci.Res.* 1(1): 15-36.

[61] Sharaf, S., Khan, A., Khan, M.Z., Aslam.F., Saleemi, M.K. and Mahmood, F. 2010. Clinico-haematological and micro nuclear changes induced by cypermethrin in broiler chicks: Their attenuation with vitamin E and selenium. *Exp. Toxicol. Pathol*. 62: 333– 341.

[62] Shayeghi, J. M., Shahtaheri, S. J. and Selseleh, M. 2001. Phosphorous insecticides residues in Mazandaran River Waters, Iran. *Iran. J. Public Health*. 30(1): 115-118.

[63] Srivastava, A.K. and Mishra, S. 1979. Blood dyscrasia in a teleost, *Colisa fasciatus* after acute exposure to sublethal concentrations of lead. *J. Fish Biol*. 24: 199-103.

[64] Srivastava, A. K., Mishra, D., Shrivastava, S., Srivastav, S. K. and Srivastav, A. K. 2010. Acute toxicity and behavioural responses of *Heteropneustes fossils* to an organophosphate insecticide, Dimethoate. *International Journal of pharma and Bio Sciences*, 1(4): 359-363.

[65] Sudha, S. 2012. Comparative hematological studies of *Clarius batrachus* in Bisalpur reservoir and Pushkar Lake. *J. Fundamental Appl. Life Sci*. 2(2): 230-233.

[66] Summarwar, S and Verma, S. 2012. Study of selected haematological indices of freshwater fish from Bisalpur reservoir. *Int. J. Fundament. Appl. Lif. Sci.* 2: 51-54.

[67] Suvetha, L, Ramesh, M. and Saravanan, M. 2010. Influence of cypermethrin toxicity on ionic regulation and gill Na+/K+-ATPase activity of a freshwater teleost fish *Cyprinus carpio. Environ. Toxicol. pharmacol*., 29: 44-49.

[68] Tavares-Dias, M., Martins, M. L. and Kronka, S. N. 1999. Evaluation of the haematological parameters in *Piaractus mesopotamicus* Holmberg, 1887 (Osteichthyes: Characidae) with *Argulus sp*. (Crustacea: Branchiura) infestation and treatment with organophosphate. *Rev. Brasil. Biol.*, 16:553-555.

[69] Tilak, K.S., Rao, D.M.R., Devi, A.P and Murty, A.S.1980. Toxicity of carbaryl and naphthol to the fresh water fish *Labeo rohita.Ind.J.Exp.Biol*.,18(1):75-76

[70] Tilak, K.S., Veeraiah, K. and Ramanakumari, G.V. 2001. Toxicity and effect of Chloropyriphos to the freshwater fish *Labeo rohita* (Hamilton). *Neurol Research*., 20: 438–445.

[71] Vani, T., Saharan, N., Mukherjee, S.C., Ranjan, R., Kumar R. and Brahmchari R.K. 2011. Deltamethrin induced alterations of hematological and biochemical parameters in fingerlings of *Catla catla* (Ham.) and their amelioration by dietary supplement of vitamin C. *Pestic. Biochem. Physiol*., 101: 16–20.

[72] Wood, C.M., Pessy, S.F., Wright, P.A., Bergman, H.L. and Randall, D.J. 1989. Ammonia and urea dynamics in the lake Magadi tilapia a teleost fish adapted to an extremely alkaline environment. *Respire Physiol* .,77:1 -20.

[73] Yang, J.L. and Chen, H.C.2003.Serum metabolic enzyme activities and hepatocyte ultrastructure of common carp after gallium exposure. *Zool. Stud.* 42: 455-461.

[74] Yonar, M.E., Mise Yonar, S., Ural M.S., Silici, S. and Dusukcan, M. 2012. Protective role of propolis in Chlorpyrifos-induced changes in the haematological parameters and the oxidative/antioxidative status of *Cyprinus carpio*. *Food Chem. Toxicol*., 50: 2703–2708.

[75] Zhiteneva, L., Poltavceva, T.G. and Rudnickaja, O.A. 1989. Atlas of normal and pathological cells in the blood of fish. *Rostov-on-Don*. pp. 112.

AUTHORS

First Author – AMPILI, M., M.Phil, Ph.D., N.S.S. Hindu College, Changanacherry, ampilirajeev@gmail.com
Phone No.9447337266

Table I: Haematological parameters of *Oreochromis mossambicus* exposed to sub- lethal concentration (10ppm) of fame (Mean ± Standard Error)

Haematological parameters / Duration of exposure	RBC (X 10^6/mm^3)	WBC (cells/mm^3)	Hb (g %)	PCV (%)
CONTROL	5.47 ± 0.082	7950 ± 46.78	9.12 ± 0.143	41.40±0.425
24 HOURS	5.09 ± 0.021	8950 ± 20.00	8.44 ± 0.372	39.40±0.201
1 WEEK	4.72 ± 0.020	10100 ±2 6.07	7.84 ± 0.312	35.00±0.282
2 WEEKS	4.05 ± 0.208	11320 ± 30.06	6.96 ± 0.057	31.00±0.282
3 WEEKS	3.93 ± 0.022	11970 ± 17.57	6.40 ± 0.282	28.60±0.203
4 WEEKS	3.21 ± 0.024	13350 ± 59.66	4.94 ± 0.051	22.40±0.483
't' value	3.88, $p<0.01$	4.12, $p<0.01$	3.61, $p<0.01$	3.29, $p<0.01$

Table II: Haematological indices of *Oreochromis mossambicus* exposed to sub-lethal concentration (10ppm) of fame (Mean ± Standard Error)

Haematological indices / Duration of exposure	MCV fL	MCH pg	MCHC g/dL
CONTROL	75.68±0.881	16.67±0.193	22.08±0.235
24 HOURS	77.37±0.625	16.58±0.023	21.44±0.198
1 WEEK	74.86±0.397	16.61±0.020	22.43±0.154
2 WEEKS	76.52±0.959	17.18±0.021	22.50±0.284
3 WEEKS	72.70±0.446	16.28±0.017	22.41±0.257
4 WEEKS	69.63±0.280	15.38±0.085	23.00±0.583
't' value	0.56, p<0.10	3.86, p<0.01	0.425, p<0.10

Table III: Enzyme Profile of control and fish *Oreochromis mossambicus* exposed to 10ppm of pesticide for 4 weeks

	CONTROL		FISH EXPOSED TO PESTICIDE (10ppm) FOR 4 WEEKS	
	SGPT (U/L)	SGOT(U/L)	SGPT (U/L)	SGOT(U/L)
Mean	58.4 ±1.00	70.8±0.51	116.4±1.90	149.4±0.85
't' value	-	-	17.55, p<0.01	31.57, p<0.01