HAEMATOLOGICAL ALTERATIONS INDUCED BY THE PERMETHRIN (A SYNTHETIC PYRETHROID) TECHNICAL GRADE AND 25% EC IN THE FRESHWATER FISH CTENOPHARYNGODON IDELLA (VALENCIENENSIS)

S. Satyanarayana*, G. Srinivasa Rao and N. Gopala Rao

Department of Zoology and Aquaculture, Acharya Nagarjuna University, Nagarjunanagar-522 510, A.P., India

DOI: http://dx.doi.org/10.24327/ijrsr.2020.1103.5171

ABSTRACT

Alterations in the blood parameters of the freshwater fish Ctenopharyngodon idella are studied in the laboratory after exposing the fish to both technical grade and 25% EC of permethrin, a synthetic pyrethroid for 10 days in 1/100 of LC50 values of 96 hours. The parameters studied are Erythrocytes (RBC), White Blood Cells (WBC), Haemoglobin (Hg), Haematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and also Mean Corpuscular Haemoglobin Concentrations (MCHC). Except White Blood Cells (WBC) all other parameters resulted or decrement for both technical grade and 25% EC of permethrin exposure in lethal and sub-lethal concentrations of the toxicants in the fish. The EC of commercial formulation had a significant impact on the blood parameters which will have impact on the physiology of the fish particularly of the metabolism and if it is impaired render the fish not to have a proper growth which is important for the cultivable species like the one studied in the present experimentation.

INTRODUCTION

The study of blood, Haematology can be used as indices of any toxic stress. When the medium of water by any means changed, the contamination that was resulted in that situation immediately will be perceived by the actively swimming poikilothermic fish. Any change in the blood constituents will reflect the functioning aspects of physiology of the organisms as the blood performs many functions.

This may be possible either in sublethal (chronic) concentrations also and any change in Erythrocytes (RBC), Leucocytes (WBC), Haemoglobin (Hb) Haematocrit (HCT) and based on calculated values of packed cell value (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) which do altered by subtle variations and can be considered as the bioindicators of the toxicant action of the pollutants.

Such studies when attempted according to Wells et al. (2005) can be used as criteria for establishing the permissible limits for any of the toxicant, which was also mentioned in a standard text book by Rand and Petrocelli (1985). An increase or decrease according to Ooset et al., (2003) and sanchoo et al. (2000) will be a potent indicator in aquatic eco-toxicology.

The present studied fish Ctenopharyngodon idella also cultivable along with Cyprinus carpio and other major carps. Hence, an attempt is made to study the impact of the blood constituents of the fish Ctenopharyngodon idella, by exposing them to technical grade as well as 25% EC.

The toxicity varies and is species specific and all are cultivable and army pollutant load which is dependent on concentration can be perceived by circulating fluid, the blood, in the venous (branchial) heart of having a single circulation will be having overall impact in the fish, particularly in the growth.

As per Giulio and Hinton (2008) fish serve as tool in the aquatic toxicology and Sahen et al., (2016) too opined the same that rapid changes in the blood characteristics will be an indicator of pollution. Aleosa and Ekwezor (2009), Lie et al., 2010, Jerkins et al. (2003), Suvetha et al., (2010), Khatum et...
al. (2014) too opined that the blood alterations serve as indices of toxic action.

Adhikari et al., (2004) opined it will be a pathological tool and Adedeji et al. (2000) emphasized the alterations of blood constituents study can be used for the monitoring pollution abatement.

MATERIALS AND METHODS

Collection and Maintenance of Test Organism

The freshwater fish Ctenopharyngodon idella with length 6-8 cm, weight 6.5-7.5 g, irrespective of their sex, have been chosen as the test organisms for present investigation. Healthy and active fish were obtained from Ratna Singh Hatcheries, Kuchipudi, Guntur (A.P), India. The fish were acclimatized to the laboratory conditions in large plastic water tanks for three weeks at a room temperature of 28 ± 1°C. Water was renewed every day with 12-12 h dark and light cycle. During the period of acclimatization, the fish were fed (ad libitum) with groundnut oil cake and rice bran. Feeding was stopped one day prior to the actual toxicity test. All the precautions laid by committee on toxicity tests to aquatic organisms (APHA, 1998, 2005 and 2012) were followed and such acclimatized fish only were used for experimentation. If mortality exceeded 5% in any batch of fish during acclimatization, the entire batch of that fish were discarded.

The water that was used for experimentation is similar to the one used for toxicity determination and the physical and chemical characteristics are:

- Turbidity-8 silica units; Electrical conductivity at 28°C-816 Micro ohms/cm, pH at 28°C-8.1, Alkalinity: Phenolphthalein-Nil, Alkalinity: Methyl orange-472, Total Hardness (as CaCO₃)-232; Carbonate Hardness (as CaCO₃)-232, Non-Carbonoate Hardness (as CaCO₃)-232; Non-Carbonoate Hardness (as CaCO₃)-Nil, Calcium Hardness (as CaCO₃)-52; Magnesium Hardness-40; Nitrite Nitrogen (as N)-Nil; Sulphate (as SO₄²⁻)-Trace; Chloride (as CI)-40; Fluoride (as F⁻)-1.8; Iron (as Fe)-Nil; Dissolved Oxygen- 8-10 ppm; Temperature-28±2°C.

The permethrin technical grade is supplied by Sudharshan Chemical Industries Limited, Global Head office 162, Wellesley Road, Pune 411 001, India (Production Roha 46 MID Estate Dhatav, Roha district Raigad 402 116 India and MID Estate Dhatav, Roha district Raigad 402 116 India). The fish were acclimatized to laboratory conditions in large plastic water tanks for three weeks at a room temperature of 28 ± 1°C.

The permethrin technical grade is supplied by Sudharshan Chemical Industries Limited, Global Head office 162, Wellesley Road, Pune 411 001, India (Production Roha 46 MID Estate Dhatav, Roha district Raigad 402 116 India and MID Estate Dhatav, Roha district Raigad 402 116 India) and the laboratory conditions in large plastic water tanks for three weeks at a room temperature of 28 ± 1°C.

Sampling of Blood

Fish were euthanized by an overdose of MS-222 and then weighed and measured. Blood was sampled by caudal severance from the disease free test fish during the early hours of the day and stabilized with 50 IU sodium heparin (anticoagulant)/ml blood.

Hematological Examination

The haematological variables analyzed were red blood cells count (RBC), haemoglobin (Hb), white blood cells count (WBC), haematocrit (Ht), mean corpuscular volume (MCV) mean corpuscular haemoglobin (MCH) and also its concentration as mean corpuscular concentration (MCHC).

The RBC was determined by with an Nenbauer Crystalline Country Chouscher as described by Sheperclaus, (1979). The white blood cells count was determined by the method described by Donald and Bonfords (1963). The Haemoglobin was estimated by cyanomethanoglobin method as described by Blaxhall and Daisley (1973). The mean corpuscular volume (MCV) was calculated by the following formula and expressed as sembliter.

\[
MCV = \text{Haemocrit} \% \times 10 / \text{RBC count}.
\]

The mean corpuscular Haemoglobin (MCH) was calculated by the following formula and expressed in pictogram (Pg)

\[
\text{MCH} = \text{Haemoglobin} (8/dL) \times 10 / \text{RBC count}.
\]

RESULTS AND DISCUSSION

The results of the haematological parameters are found to be time dependent. The summary of the results after exposing the fish Ctenopharyngodon idella to lethal (96 h) concentration of Permethrin is appreciable. The blood parameters estimated are presented graphically as Figure 1 & 2 for technical grade Permethrin and 25% EC in lethal concentrations and sub-lethals as Figure 3. Percent changes of haematological alterations in Ctenopharyngodon idella on exposure to both sublethal and lethal concentrations of Permethrin in Technical Grade as well as 25% EC is also graphically represented as Figure 3. Except in WBC all other parameters decreased both in lethal and sub lethal concentrations of technical grade as well as 25% EC. The impact of commercial formulation in the alteration of parameters is significant and increase in WBC also.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>TG</th>
<th>TG</th>
<th>25% EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC (10⁶/mm³)</td>
<td>100</td>
<td>96</td>
<td>92</td>
<td>87</td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>9.5</td>
<td>8.5</td>
<td>8.0</td>
<td>7.5</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>54</td>
<td>50</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>MCH (Pg)</td>
<td>37747</td>
<td>37000</td>
<td>35000</td>
<td>33000</td>
</tr>
</tbody>
</table>

Figure 1 Haematological alterations in Ctenopharyngodon idella on exposure to lethal concentrations of Permethrin in Technical grade (TG) and 25% EC
S. Satyanarayana, G. Srinivasa Rao and N. Gopala Rao, Haematological Alterations Induced by the Permethrin (A Synthetic Pyrethroid) Technical Grade and 25% Ec in the Freshwater fish Ctenopharyngodon idella (Valenciennesi)

Figure 2 Haematological alterations in Ctenopharyngodon idella on exposure to sub-lethal concentrations of Permethrin in Technical grade (TG) and 25% EC

Figure 3 Percentage changes of Haematological alterations in the fish Ctenopharyngodon idella exposed to both lethal and sublethal concentrations of technical grade (TG) and 25% EC

Much of the work, that was reported earlier is not a comparative study of both technical grade and commercial formulation as in the presents study and are not in the procedure of standard methods of choosing the 1/10$^{th}$ of 96h LC$_{50}$ values as recommended by APHA (1998, 2005 and 2012).

Gopala Rao et al. (2017) reported the haematological changes in the fish, *Cyprinus carpio* exposed to a synthetic pyrethroid, permethrin which belongs to the type I of the synthetic pyrethroids. The study concluded as in the present one, alterations in the blood and the percent changes were varied as in this study. The RBC, WBC, Hb, PCV, MCHC decreased and MCV increased. But the formulation exposure behaved different while inducing the changes.

Srinivasa Rao et al. (2018) reported the changes in the blood of the same fish of the present study after exposure to deltamethrin a synthetic pyrethroid of type II. RBC, HB and Ht values are decreased whereas WBC increased in sublethal concentrations and also the formulations, showed more percentage of alterations. The ingredients that are mixed must be viewed seriously what finally what they opined in their report is in the agreement of the present study result.

Saha and Singh (2013) while using cypermethrin as a toxicant and the fish *Cyprinus carpio* is exposed and reported that RBC and Hb values decreased and WBC increased. But the present study had more percent change in commercial formulation where in the cypermethrin belongs to type II synthetic pyrethroid. The report does not pertain to the commercial formulation. The changes in the blood parameters in the present study area compensatory response that reduces the oxygen carrying capacity to maintain gas transfers. The diffusion phenomenon is inhibited as due to damage of the gill lamellae as well as enzyme enhydrase action (Jee et al., 2005) and that can be attributed as in the present study.

The review articles by Prusty et al., (2015) and Hasibur Rahman (2014) for synthetic pyrethroid mentioned some earlier works and even in such reports of the present study results are reiterated.

Sana Ullah and Zerriezhara (2015) and Murty et al. (2013) for different pesticides in their respective reviews also reiterated the changes are possible due to toxic stress of the toxicants as pollutants where the effect will be more in commercial formulations.

Jaya Prakash and Shuttu (2013) reported that in the fish exposed to deltamethrin for 45 days there was a significant decrease in haemoglobin content, total erythrocyte count, PCV, MCV and MCHC on the other hand, a significant increase in total leucocyte content and MCH which in majority coincides the present work even though the toxicants belong to two different groups of synthetic pyrethroid, i.e., type I and II.

In the present investigation the total WBC exhibited significant decrease in lethal concentration and an increase when the fish exposed to sublethal concentration of permethrin which is considered as an adaptive mechanism.

Such opinions with results were explained for *Catla catla* (Vani et al., 2012). *Labeo rohita* (Adhikari et al., 2004), *Channa orientalis* (Sinde et al., 2014), *Cyprinus carpio* (Masud and Singh, 2013), *Clarias gariepinus* (Akinrotimi et al., 2012). Increase in total leucocyte count has been suggested to be due to lymphopoiesis and/or enhanced release of lymphocyte from lymphomeloid tissue. The lysis of the tissue resulted an increase of them according to Das and Mukherjee, (2003). Added to this, according to Gabbaianelli et al., (2002), pyrethroids are more hydropholic than other class of chemical and action will be more on biological membranes.

The results of the present study, the type of the pesticide and fish being different the methodology of experimentation is different. The report opined that anaemic condition was due to erythropoietic, haemosynthetic and osmoragulatory dysfunction or might be due to destruction of the haemotopoietic organs. The same might be the reason even in the present study, which can be considered as validation of the result.

Das and Mukherji (2003) reported the toxicity of Cypermethrin in *Labeo rohita* fingerlings, biochemical enzymatic and haematological consequences. Sublethal exposure studies for up to 45 days at 1/10$^{th}$ and 1/50$^{th}$ of 96h LC$_{50}$ value. Blood glucose level and total leucocytes were elevated compared with controls at either concentration from 15 day to 45 day. Haemoglobin percentage and total
erythrocytes decreased in both sublethal concentrations. Even the alterations are imperative, the toxicant is representative of class II synthetic Pyrethroid, the alterations can be viewed as trends with the Permethrin the class I pesticide and duration of exposure is different in the present work.

The reduction in RBC, Hb and Hct in test fish in the present study can be interpreted as a compensatory response that reduce the oxygen carrying capacity to maintain gas transfers and indicates a change in the water blood barrier for as exchange in the gill lamellae (Jee et al., 2005). The results of the present study indicate that the toxicant causes haematological changes that can interfere in oxygen uptake which may jeopardize the animal’s overall health.

Packed cell volume or Haematocrit values showed declining trend at both lethal and sublethal concentration of Permethrin in the exposed fish. This may be due to impaired oxygen supply to various tissues, resulting in slow metabolic rate and low energy production.

In the present study, the levels of MCV, MCH and MCHC values have reduced at lethal and sublethal concentrations of Permethrin. Increased WBC may be caused due to endosmosis which leads to the passage of solvent from less concentrated solution to more concentrated one. This results in haemodilution, further increasing the value as suggested by Anandakumar (1994). As MCH and MCHC are derived from Hb and RBC, any sort of alteration in the levels of Hb and RBC would result in the alteration of MCH and MCHC. Parma et al. (2007) and Atamanalp et al. (2002), Velisek et al. (2006) for other toxicants reported elevated levels for different toxicants.

Kannan et al. (2014) as already mentioned investigated the effects of Cypermethrin (10% EC) in the concentration of 0.0006 ml/ l on Catla catla for 24 hours and reported significant (P<0.01) increase in the number of erythrocytes, segmented neutrophils granulocytes and a significant (p<0.01) decrease in mean erythrocyte volume, mean erythrocyte haemoglobin and lymphocyte count. Khatun et al. (2014) studied the effect of Cypermethrin on haematology of Labeo rohita exposed to two concentrations of Cypermethrin (0.15 and 0.30µL/L) for 96 h. The blood parameters viz., total WBC and RBC count, Hb, PCV, MCV, MCH and MCHC values were analyzed. A decreased in WBC and RBC count, Hb and PCV values were found both concentration of Cypermethrin exposure (P<0.05). MCV value was decreased in low concentration and increased in high concentration whereas MCH and MCHC values were increased in low concentration and decreased in high concentration of Cypermethrin exposure as compared.

Akinrotimi et al. (2012) as already mentioned that juveniles of Clarias gariepinus exposed to 0.05, 0.10, 0.20, and 0.25 ppm Cypermethrin solution for 10 days showed a significant (P<0.05) reduction, which is concentration dependent in the values of PCV, RBC, Hb, Hct, Lymphocytes, Eosinophils, Monocytes Thrombocytes, MCHC, MCH, and MCV while the values of WBC, Neutrophils and ESR increased significantly (P<0.05). These alterations were more pronounced at 0.25 ppm. Chandra Lekha and Dutta (2012) observed haematological changes in Heteropneustes fossilis viz., total erythrocyte count (TEC) and haemoglobin content (Hb). Fish subjected to 0.1 µg/L (1/6th of 96 hour LC50) of Cypermethrin 10% EC for 24, 48, 72 and 96h showed significant decrease (P<0.05) in total erythrocyte count (TEC) and haemoglobin content (Hb). The most common blood parameters monitored include total erythrocyte count, total leucocyte count and haemoglobin and haematocrit content, which were found to decrease on Cypermethrin exposure in the Indian Major carps Labeo rohita and Catla catla (Vani et al., 2012).

Yasser (2012) observed haematological and micronuclei alterations in C. carpio exposed to Cypermethrin. Fish showed a significant decrease (P<0.05) in erythrocytes count (EC), haemoglobin content (Hb), haematocrit count as well as mean corpuscular haemoglobin concentration (MCHC) and a significant increase (P<0.05) values of total leucocytes (TLC) and blood indices mean corpuscular volume (MCV) compared to control group with respect to the increase in exposure in both sublethal concentrations. There was no significant difference in value of mean cellular haemoglobin (MCH) in the experimental fish compared with control.

Dobsikova et al., 2006 reported that in Cyprinus carpio exposed to Alirimthin 10 EM in the concentration of 29.1 µg/L corresponding to 29.1 µg/L of Cypermethrin for 96 h showed a significant (P<0.01) increase in the number of erythrocytes, segmented neutrophilic granulocytes, developmental forms of myeloid sequence and Eosinophil and a significant (P<0.01) decrease in mean erythrocyte volume, mean erythrocyte haemoglobin and lymphocyte count. Velisk et al., (2006) found that the acute exposure to Cypermethrin resulted in a significant decrease in count of developmental forms of myeloid sequences and the segmented neutrophilic granulocytes.

By taking into all the above reports, the present studied tissue gills of the fish also showed alterations due to toxic action of the toxicant, cypermethrin, the type I synthetic pyrethroid. Such changes and also interfering the oxygen diffusion resulting the respiratory effect in consumption of oxygen which is impaired. Thus the fish gill, is an important organ for the nektonic organism is damaged histopathologically even in sub lethal concentrations exposure. Due to toxic stress and action the tissue damage impairs the respiratory actively rendering it not to survive. The sublethals are really lethal, and ingredients have to be considered seriously.

According to Ahrar Khan et al., (2012) report on the study of haematobiochemical changes induced by pyrethroid insecticide and also compared the toxicity and of Cypermethrin and Deltamethrin. Total erythrocyte count, Haemoglobin, Haematocrit and Leucocytes at 2 ppm concentration being low along with MCV, MCH and MCHC and similar result for Deltamethrin at 1.61 µg/L exposure both of them belong to Type II type synthetic pyrethroids, with cyano group but Deltamethrinis more toxic to fish than Cypermethrin. Leucocytosis has been resulted for Cypermethrin exposure but for deltamethrin, it was leucopenia. But the present study of Clampharyngodon idella, RBC values decreased more so in 11% EC whereas WBC values are increased more so in 11% EC, whereas WBC values are increased more so in 11% EC. Consequently MCH increased whereas Hb, PCV, MCHC, decreased and such measurement of the toxicity effect in haematological
alterations serve as indices of toxicity. They opined that haematological and biochemical disturbances result ultimately the damage to the tissues of the excretory organ kidney and liver also. That is why they recommended doses and also cautions related to other insecticides for this group of insecticides as well, along with other groups. The present studied fish toxicant is type I. The same mechanism of operation exists.

Velisek et al. (2011) reported that the effects of pyrethroids and triazine pesticides on the fish physiology and mentioned about blood changes. The present study revealed that Deltamethrin exposure to the fish, common carp resulted significantly lower values of RBC, HB and PCV, whereas in the rainbow trout significantly higher values of erythrocyte count, haemoglobin content and haematocrit than the control group. The results drastically are different in the two fish with the same toxicant. But with the common carp resulted the same as in the present study which is in agreement.

According to Alka Mishra (2017) who reported the toxic impact of pesticides on the morphological characteristics of blood cells of the fish Channa punctatus after the exposure to trichlorofan - an organophosphate and he opined that expansion of membrane increases of the area/volume proportion and could allow swelling of the blood cell thus reaching the largest volume before any lyses. The swelling of RBC increase the activity of MCV and is generally considered as stress factor.

Neelima et al., (2015) similar to the present study result reported on haematological alteration in Cyprinus carpio and considered as a biomarker of toxicity due to cypermethrin toxic stress wherein RBC count, Hb content and PCV showed decrement at both lethal and sublethal concentrations. WBC and MCHC values increased at sublethal and decreased at lethal concentrations. The study concluded that elevated values of MCV at both lethal and sublethal. The stress factor and the presence of the toxicant in the ecosystem by any means of transportation may cause a lot of disturbances resulting not to have a status of healthy nature and sustenance is in jeopardy.

Mohan et al., (2014) reported haematological alterations of pyrethroid cypermethrin 10% EC, exposure to the fish Catla catla resulted RBC, MCV, MCHC being decreased whereas haematocrit, WBC, MCH values increased. Deltamethrin, Cypermethrin and Fenvalerate all the three belong to the synthetic pyrethroid of group II with cyano group. The present study of permethrin differs in MCH with the report.

Julia Jasmin et al., (2018) reported haematological changes induced by Thiamethoxam a synthetic pyrethroid to the Labeo rohita. When exposed to 0.002 and 0.004 ml/L of the toxicant, RBC and WBC decreased significantly in the fish exposed to 0.002 ml/L whereas decreased slightly in the fish exposed to 0.004 ml/L.

In the fish exposed to lower concentration Hb a minute decrease. When compared to higher concentration which significantly increased. The values of PCV, MCH and MCRC significantly increased in both the concentrations but MCV value showed significant decrease in both the concentrations. Stress is the factor, where the pesticide had a negative impact on Hb level, wherein it is destroyed or decrease in the rate of its synthesis. The MCV, MCH and MCHC values are completely dependent upon the RBC count.

Nuri Cakmak and Girgin (2003) reported cypermethrin induced in the fish Rainbow trout (Oncorhynchus mykiss: Wabamum) as haematocrit, haemoglobin leucocyte RBC, MCHC decreased with increasing concentration but MCV value increased and MCH values are not affected. This is another contradicting result of the present study.

Patole et al., (2016) reported effect of fenvalerate another synthetic pyrethroid, in the fish Channa marulius exposed to 0% of LC50 value at sublethal concentration (0.086 ppm). TEC, Hb percentage, PCV and MCHC counts significantly decreased whereas TLC, MCV and MCH increased slightly. The Fenvalerate and Deltamethrin both of them belong to type II synthetic pyrethroid and the study had similar results of the present study.

Sheik Jamal (2006) reported haemotological changes induced by the pyrethroid insecticide fenvalerate in catfish Clarias gariepinus exposed to 1/10 of LC50 value at fenvalerate for one, 5 and 10 days. The toxicant induced a significant decrease in the haemoglobin due to haemolysis content haematocrit and erythrocytes. The leukocytes count was increased and the results are in agreement of the present study of the fish Cyprinus carpio but both the toxicants belong to the different class.

Tayfun (2016) reported the effect of deltamethrin on some haematological parameters of brown trout (Salmo trutta fario), after exposure for four days, in two different concentrations of Deltamethrin i.e. 0.91 µg/L and 188 µg/L and the results are that the WBC, Hb, PCV, MCV, MCHC decreased however RBC cells increased. The results are quite contradicting of the present study, Deltamethrin is more toxic than permethrin.

David et al., (2015) reported effect of Deltamethrin on Haematological indices of Indian major carp Cirrhinus mrigala (Hamilton). The fish are exposed to both lethal and sublethal Deltamethrin of 8 mg/L and 0.8 mg/L respectively, for 1, 2, 3 and 4 days and 1st, 5th, 10th and 15th day respectively. The results that are reported are RBC, Hb and haematocrit values decreased, whereas WBC, MCV and MCH were increased MCHC remain unchanged. The results are in agreement of the present study except MCV and MCHC. The increase of MCV and MCH values after exposure to deltamethrin indicates that a reduced RBC count which may be due to destruction of erythrocytes or then decreased synthesis (Erythrosis and Erythropenia).

Venkataramudu et al., (2009) as already mentioned reported haematological studies in freshwater fish Channa punctatus during sublethal toxicity of Deltamethrin in relation to sex. They studied only the two parameters RBC and WBC in both males and females of carnivorous fish Channa punctatus (Bloch) exposing the fish to sublethal concentration for periods of 24 h, 7 day, 15 day, 20 day and 30 day. A decreasing trend in RBC except in 24 h period and increasing trend of WBC in all the exposure periods in both sexes was revealed in their study. The fish reacted quickly to the stress conditions tried to eliminate the pesticide which can be correlated a detoxification process. They opined the presence...
of pesticide that might have induced hypoxia which in turn had influenced in the rate of the haemopoietic tissue. They referred Rodriguez et al., 2005 in their discussion that the decline in RBC count obviously is due to the entry of the toxicant into the body of the fish and in turn entitled erythropoiesis. They also opined the increase in WBC may be attributed as a work of defensive mechanism against the pesticide that has entered and as a homeostatic mechanism of such a change was resulted to increase the WBC. The report is also in the agreement of the present study of the fish, wherein a decrease and increasing trend of RBC and WBC count respectively, which ultimately have profound bearing on Hb, Ht, MCV, MCH and MCHC values.

The haematological parameters of the fish altered due to exposure to different types of toxicant synthetic pyrethroids. Type I Permethrin Type II Cypermethrin, Deltamethrin and Fenvalerate wherein the stress after swap resulted in the blood of the fish certain parameters even in low concentration termed as sublethal. Such sublethal toxicants slowly is alienation of the time factor to succumb instead of not being in lethal concentration. The ambient waters defilement definitely pose a threat, as a result the blood changes which serve as a biomarker as opined by Kaviraj and Gupta (2014) proved to be true. They mentioned higher erythrocyte count haemoglobin, haematocrit, MCV, MHC and MCHC fail to harmonize that resulted a disturbance of the equilibrium in homeostasis a failure ultimately reflected on haemostasis rendering to be unsuitable to lead a normal mode of life. Really, one can view that sublethal is really lethal wherein later there is a happy death but in former it is slow suffocative death. Different results are in different fish by different chemicals and hence better to study all the important ones.

The present study suggested that the perturbations in blood indices attributed to a defense reaction against toxicity of Permethrin through the stimulation of erythropoiesis or may be due to the disturbances that occurred in both metabolic and haemopoietic activities of fish exposed to below safe concentrations. The toxicant caused haematological disturbance which could lead to impairment of the fish ability to combat diseases, reduce its chances for survival and potential for growth and reproduction. Thus Permethrin in the aquatic medium is a major factor responsible for drastic change in the fish blood. However, it would be more rational to mention that alternations in haematological parameters in pesticide exposed fish will provide important information on the general health being of the fish. Thus fish blood following exposure to pesticides is the best suitable biomarker in the field of aquatic toxicology.

**CONCLUSION**

The poikilothermic blood of the fish is altered due to pesticide toxic stress. The RBC of the blood is important to carry oxygen to the venous heart and in turn the increase of WBC is a good sign of the fish, an immunological response. But both erythrocytopenia and leucocytosis are dangerous reflecting changes in other blood parameters. The alterations of the blood parameters, in sublethal concentration is dangerous too apart from lethal.

The commercial formulation had more significant changes hence in the environmental policy and planning the formulations have to be viewed seriously and sublethals are really lethals.

**References**


How to cite this article:

******