The Scientific Temper
VOL-IX, NO.1&2; JANUARY-JULY, 2018
ISSN 0976 8653, E ISSN 2231 6396
UGC SR NO 2535; JR NO. 47226
e-mail:letmepublish@rediffmail.com
Web: www.scientifictemper.com

PESTICIDE TOXICITY AND BIOCHEMICAL CHANGES IN FRESHWATER FISHES

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ABSTRACT

The modern organic pesticides have increased in agriculture to enhance crops yield with low labour and effort. These chemicals affect almost each system of environment especially aquatic ecosystems. These residues enter in non-targeted animals via food chain threatening the ecological balance and biodiversity of the nature. Fishes serve as important bio-indicators for aquatic contamination to access the changes caused by human activities effectively and reliable monitoring bio-system to recognize and predict hazardous effects of pollutants. Therefore, the protection of aquatic ecosystem and water quality will be possible only with the judicious and rationalized applications of pesticides.

Key words: Pesticide toxicity, biochemical, fishes.

INTRODUCTION

The pesticides are very extensively used in agriculture and quite in generalization due to their ability to control weeds, pests including insects, plant diseases, aquatic weeds and aquatic snails (Naeem *et al*, 2010). The major pesticides that are usually being applied in fields are organophosphate, carbamates, organochlorine, pyrethroids, trizole, and necotenoides (Srivastava and Singh, 2014). Pesticides has credited with economic potential to enhance production of food and fibers and ameliorated in vector-borne diseases, the long-term use has caused effects on human health and the environment including aquatic ecosystem that evolved new branch of aquatic toxicology (Akhtar *et al*, 2009).

Pesticides have been found to be highly toxic not only for fish but also to the other organisms

which constitute the food chain. Agricultural run-off near water bodies is the major cause of deposition of pesticides in aquatic ecosystem. Bioaccumulations of these pesticides threat the long-term survival of fishes by disrupting the ecological relationships between organisms and loss of biodiversity (Abedi *et al*, 2013). Long-term exposure of pesticides induces physiological disturbance, behavioural changes, histopathological damages, haematological alterations, biochemical changes, immune-suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer (Pandey *et al*, 2014 and Mishra *et al*, 2008).

Fishes serve as important bio-indicators for aquatic contamination. Recent studies indicated that fishes are quickly becoming scarce owing the increasing use of chemical pesticides in fields. Since fishes are important sources of proteins and lipids, health of fishes is very important for human beings. The potential toxic hazards resulting from exposure to different levels of chemical pesticides have been discussed in this communication which may useful in environmental risk assessment of freshwater and marine organisms.

PESTICIDES IN INDIA

India is now the second largest manufacturer of pesticides in Asia after China and ranks twelfth worldwide (Mathur, 1999). The primary benefits of the pesticides being the direct gains from their use (Mathur, 1999). In year 2000, the pesticides demand from agriculture sector was reached up to 97,000 tons, out of these, 60 technical grade pesticides are manufactured indigenously and 500 units are making pesticide formulations (Singh, 2002).

There are 234 pesticides registered in India, out of these, 4 are WHO Class I(a) pesticides, 15 are WHO Class I(b) pesticides and 76 are WHO Class II pesticides together constituting 40% of the registered pesticides in India. In terms of consumption too, the greatest volumes consumed are of these poisons.

BIOCHEMICAL CHANGES

Ammonia is toxic for an organism even in trace amount, while excretory material in the fish body. There ammonia produces during metabolism through deamination process of several amino acids like as histidine, serine, asparagine and glutamine. These chemicals and pesticides have disturbed the balance between production and excretion of ammonia. This resulted in most cases significantly increase of ammonia levels in the blood and consequently in an ammonia autointoxication (Svobodová *et al*, 1986).

Blood is the indicator of pathological changes induced by the pollutants in fishes. The fish blood shows remarkable pathological changes. Hematological parameters are important for toxicological research and as indicators of environmental stress and disease in fish (Kumar *et al*, 2004) during any environmental toxicity in surrounding water. Das and Mukherjee (2003) reported that total leucocytes were elevated from day 15 to day 45 under cypermethrin exposure. They also found that haemoglobin percentage and total erythrocytes decreased in fish blood by the cypermethrin exposures.

Pesticide pollutions resulted in RBC reduction (Johal and Grewal, 2004; Gautam and Kumar, 2008). The haematopoietic system of fish is also located in intercellular cell spaces of kidney as also existed in mammals. Therefore, the reduction in haematological parameters may be due to malfunctioning of haematopoietic system which leads the morphological alteration in renal interstitium (Dutta *et al*, 1992).

The blood cell indices like mean corpuscular volume (MCV) mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) and total leukocytes differential seem to be changed that are more sensitive and can cause reversible changes in the homeostatic system of fish (Kumar *et al*, 2004). Fluctuations in these indices correspond with values of RBC count, haemoglobin concentration and packed cell volume (Kumar *et al*, 2004). Different blood parameters are often subject to change depending upon stress condition and various other environmental factors.

Shrivastava and Sriwastva (1980)

observed cellular and nuclear hypertrophy, change in shape, agglutination and bursting of erythrocytes in *Cirihinus mrigala* fingerlings treated with urea. Similar findings in fish treated with pesticides and chemicals have been reported (Joshi and Deep, 2002). The reason may be release of immature cells from haemopoietic tissue into the blood as well as disruption of iron metabolism that lead to a defective haemoglobin synthesis (Tavares *et al*, 1999).

Increases in WBC count establish leucocytosis which is considered to be of an adaptive value for the tissue under chemical stress. Presence of foreign substances or under pathological conditions leucocytosis in fish may be the consequence of direct stimulation of immunological defense (Marti *et al*, 1996). The increase in WBC count can be correlated with an increase in antibody production which helps in survival and recovery of the fish exposed to lindane and malathion (Joshi and Deep, 2002). Various pesticides showed lethal effect on haematology such as changes in WBCs and RBCs, haemoglobin contents and packed cell volume of different freshwater fish species.

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