Available online at www.journalijmrr.com

INTERNATIONAL JOURNAL OF MODERN RESEARCH AND REVIEWS

Int. J. Modn. Res. Revs.

Volume 5, Issue 11, pp 1654-1657, November, 2017

ISSN: 2347-8314

ORIGINAL ARTICLE

HISTOPATHOLOGICAL EFFECT OF PESTICIDE QUINALPHOS TOXICITY ON GILL AND LIVER OF FRESH WATER FISH, *CATLA CATLA*

[*1]V.Rajesh, [1]J.Prakash Sahaya Leon, [2] M.Mariappan and [3]K. Balakrishnan

[*1]P.G and Research Department of Zoology, Government Arts College for Men, Krishnagiri.
[2]Department of Zoology, Government Arts College,Melur,Madurai.
[3]Department of Zoology,Govt, Arts College(Autonomous),Karur.

Article History: *Received 3rd November,2017, Accepted 29th November,2017, Published 30th November,2017*

ABSTRACT

The aquatic environment is continuously being contaminated with toxic chemicals from industrial, agricultural and domestic activities. Quinalphos is one of the most widely used organophosphate pesticides. Excessive application of pesticides from agricultural fields contaminate aquatic medium, resulting in serious damage to non-target species, including fish. The fish as a bioindicator of aquatic medium, it play an important role in the monitoring of water pollution. Histopathology is an important tool for evaluating the action of any toxicant at tissue level. The aim of the present study is to assess the histological changes in gill and liver of the fresh water fish *Catla catla* exposed to sublethal concentrations of Quinalphos 1/10th of the 96 hour LC50 values for the period of 21 days. The fish exposed to quinalphos showed a excessive secretion of mucous in the intercellular spaces, fusion of secondary gill lamellae, reduction in length, swelling of epithelial cells of secondary lamellae, swelling of primary lamellae, damaged RBC cells, cytoplasmic vacuolization and necrosis were some of the observable changes in gill and rupture of hepatocytes and their nuclei, necrosis, space formation and vacuolization of the liver, enlargement of hepatocytes, aggregation of nucleus and displacement of nuclei, hypertrophy in liver. The objective of the present work was to observe the effect of quinalphos on histological alteration in gill and liver of freshwater fish, *Catla catla.*

Keywords: Histopathology, *Catla catla*, Quinalphos, Gill, Liver

1.INTRODUCTION

The aquatic environment has always been subjected to different types of pollutants. The problems of environmental pollution and its harmful effect on fish is receiving focus during the last few decades. Industrial discharges containing toxic and hazardous substances, including pesticides contribute more effect to aquatic environment. The pollution of freshwater ecosystem by chemical pesticides has become one of the most critical environmental problems (Northoff and William, 2004). Aquatic ecosystems that run through agricultural or industrial areas have highly contaminated by the hazardous chemicals. Among the pesticides, organophosphorus pesticides are the most commonly used pesticides in the world owing to their high insecticidal Property (Singh *et al.,* 2010). Quinalphos is an organophosphate extensively used in agriculture for pest eradication. The major use of quinalphos in farming is to protect corn, cotton and fruit trees against insects. Quinalphos is a hard insecticide with more hazardous effect. The presence of pesticides in fresh water is one of the major causes of declining fish production in the natural habitats. Fishes have been the most popular test organisms because they are presumed to be the best understood organisms in the aquatic environment (Palanikumar et al., 2012). Histopathology is an important tool for evaluating the action of any toxicant at tissue level (Sprague,1973). The monitorization of histological changes on gill and liver of fish is a highly sensitive and accurate way to assess the effects of pesticides in the experimental studies. The present investigation was to assess the histopathological changes in gill and liver of *Catla catla* exposed to different sublethal concentrations of quinalphos.

Corresponding author:V.Rajesh,** P.G and Research Department of Zoology, Government Arts College for Men, Krishnagiri.*

2.MATERIAL AND METHOD

The fish *Catla catla* having mean weight of 170-180 gm and length of 25 – 26 cm were collected from KRP Dam located at Krishnagiri, Tamilnadu, India and acclimatized in to laboratory conditions. They were given the treatment of 0.1% KMNO4 solution and then kept in cement tank for acclimatization for a period of two weeks. They were fed on oil cake and rice bran daily in calculated ratio. The quinalphos was used as a experimental in this study for the experiment and stock solutions were prepared. Quinalphos LC_{50} was found out for 96h (5.50 mg/L) and $1/10^{th}$ of the LC_{50} value 0.55 mg/L was taken as sublethal concentrations for this study. Twenty fish were selected and divided into 2 groups of 10 each. The first group was maintained in free from quinalphos and served as the control (Group-I). The other group (Group-II) was exposed to $1/10^{th}$ of sub lethal concentration of quinalphos (0.55 mg/l) in 10 litre capacity aquaria for 21 days respectively. At the end of each exposure period, the fish were sacrificed and the required tissues were collected for histological studies. To examine the extent of cellular changes by quinalphos in the gill and liver of the control and treated tissues were fixed in Bouin's fluid. After 24 hr, the standard histological technique was followed by the method of Gurr (1959). The photographs were taken with computer aided microscope.

PHYSICOCHEMICAL PROPERTIES OF QUINALPHOS

Chemical structure : $C_{12}H_{15}N_2O_3PS$

IUPACname *O,O*-Diethyl *O*-2-quinoxalinyl phosphorothioate
Molar mass : 298.30 $g \cdot mol^{-1}$
Appearance : Reddish-brown liquid
Appearance : Liquid
Color : Light yellow
Odor : A characteristic odor
Density : 1.235g/ cm3

Melting point : 31 °C (88 °F; 304 K)
Solubility in water : 17.8 mg/L at 22 °C

3.RESULTS

GILL HISTOLOGY AND GILL HISTOPATHOLOGY

The control gills of *Catla catla* comprised of laterally compressed primary gill lamellae arranged alternately on either side of the inter branchial septum. Each primary filament bore a row of secondary gill lamellae on both sides perpendicular to its long axis. Primary gill lamellae comprised of a central core of cartilaginous rod, lining epithelial cells and blood vessels whereas secondary lamellae consisted of a layer of flattened epithelial cells attached to the basement membrane, contractile pillar cell system and blood spaces(Fig.1).

The fish, *Catla catla* exposed to (1/10) sublethal concentrations of quinalphos for 21 days showed marked histopathological changes in their gill. Excessive secretion of mucous in the intercellular spaces, fusion of secondary gill lamellae, reduction in length, swelling of epithelial cells of secondary lamellae, swelling of primary lamellae, damaged RBC cells, cytoplasmic vacuolization and necrosis, hypertrophy were some of the observable changes.(Fig.2)

Fig. 1 HISTOLOGY OF GILL TISSUE IN CONTROL FISH

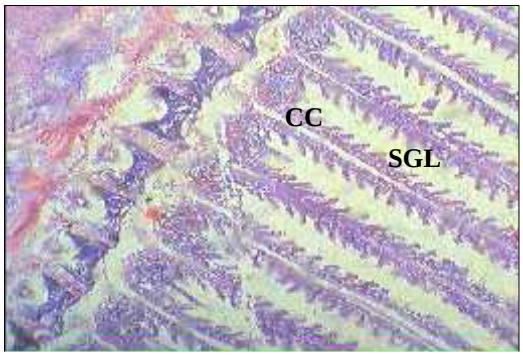

Fig.1 – Gill section taken from control fish showing normal histoarchitectural pattern (Xca 200)
CC– Centralcore SGL– Secondary gill lamellae

Fig. 2 HISTOPATHOLOGY OF GILL TISSUE IN TREATED FISH

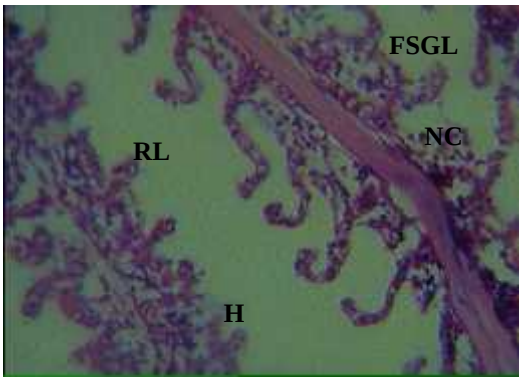

Fig.2 Gill section taken from high(1/10) sublethal concentration of quinalphos treated fish for the period of 21 days (XCa 200)

FSGL–Fusion of secondary gill lamellae;
RL– Reduction in length; H – Hypertrophy;NC – Necrosis

LIVER HISTOLOGY AND LIVER HISTOPATHOLOGY

The liver of control fish, *Catla catla* comprised of a continuous mass of hepatocytes arranged in irregular cords. The hepatic cells were large, polygonal in shape with the nucleus almost centrally placed. Blood sinusoids were also seen among the hepatocytes (Fig.3).

The structural organization of the liver appeared disturbed when fish were exposed to (1/10) sublethal concentration of quinalphos for the period of 21 days. Rupture of hepatocytes and their nuclei, necrosis, space formation and vacuolization of the liver, enlargement of hepatocytes, aggregation of nucleus and displacement of nuclei, hypertrophy were some of the observable changes. (Fig.4).

Fig.3 HISTOLOGY OF LIVER TISSUE IN CONTROL FISH

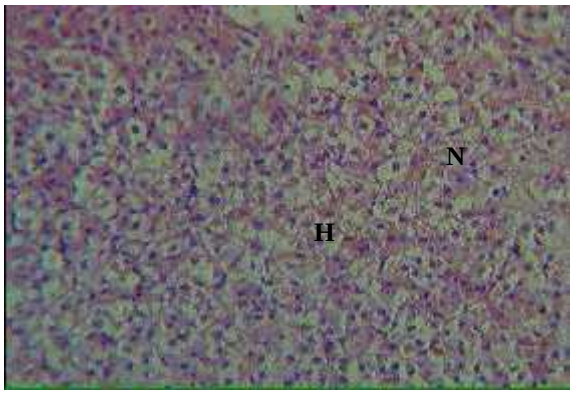

Fig.3– Liver section taken from control fish showing normal histoarchitectural pattern (Xca 200)
H– Hepatocytes; N– Nucleus

Fig.4 HISTOPATHOLOGY OF LIVER TISSUE IN TREATED FISH

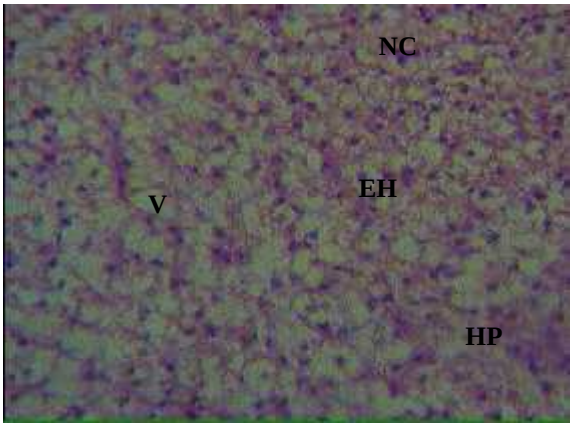

Fig.4– Liver section taken from high (1/10) sublethal concentration of quinalphos treated fish for the period of 21 days (XCa 200)
V-Vacuolization; NC- Necrosis; EH-Enlarged Hepatocytes; HP-Hepatocytes

4.DISCUSSION

HISTOLOGICAL STUDY

GILL

Histopathological studies are commonly used to evaluate the toxic effects of pollutants and provide a useful means to evaluate water quality (Murty, 1986). In fish the gill is the most important organ for respiration and osmoregulation and it is the first organ to which, pollutant comes into contact. Hence, it is more vulnerable to damage than any other tissue (Vijayalakshmi and Tilak, 1996). In the present investigation, fish *Catla catla* when exposed to sublethal concentrations of quinalphos for 21 days showed marked histopathological changes in the gills such as excessive secretion of mucous in the intercellular spaces, fusion of secondary gill lamellae, reduction in length, swelling of epithelial cells of secondary lamellae, swelling of primary lamellae, damaged RBC cells, hypertrophy, curling of secondary gill lamellae, rupturing of secondary gill lamellae, cytoplasmic vacuolization and necrosis. Similar histopathological changes have been observed in lead exposed estuarine mullet, *Liza parsia* (Pandey et al., 1997) and in DDT exposed estuarine mullet, *Liza parsia* (Pandey et al., 1993). Gill showed necrosis, degeneration of secondary lamellae due to odema, shortening of secondary lamella. Cell proliferation with thickening of gill filament epithelium may lead to the lamellar fusion (Pane et al .,2004). Hypertrophy, hyperplasia, fusion of adjacent lamella of the gill were noticed, when fish exposed to LAS for chronic test (Fernandes et al., 2003). Rejeki et al., (2008) have observed hyperplasia, lamellar fusion, curling and bulging of tips of primary gill lamellae, when the fish *Cyprinus carpio* was exposed to sublethal concentration of endosulfan. Riji John, (2007) have observed hyperplasia, lamellar fusion, curling and bulging of tips of primary gill lamellae, exudation of erythrocytes, when the fish *Cyprinus carpio* was exposed to sublethal concentration of endosulfan. Pane et al .,(2004) says that the lifting of lamellar epithelium is due to other histological change observed, probably induced by the incidence of severe edema. Cell proliferation with thickening of gill filament epithelium may lead to the lamellar fusion(Figueiredo-Fernandes *et al.,* 2007). In the present investigation the histopathological changes in gill were evident from the sublethal concentrations of quinalphos exposed to *Catla catla*.

LIVER

Liver is the most important centre for metabolising and also for detoxification. The liver has high concentration of xenobiotic metabolizing enzymes, some of which activate the toxicants to induce lesions locally (Lu, 1985). Tissue histology is considered as an indicator of exposure to pollutants and represents a useful tool to assess the degree of pollution, particularly for sublethal and chronic effects(Cengiz *et al.*,2003). In the present investigation, rupture of hepatocytes and their nuclei, enlargement of hepatocytes, necrosis, space formation, hyperplasia and vacuolization of the tissue, aggregation of nucleus and space formation were the important histopathological abnormalities observed in the liver of *Catla catla* exposed to sublethal concentrations of quinalphos for the periods of 21 days. Tilak et al.,(2005) recorded pyknotic nucleus, protein precipitation, pancreatic acini appeared with the loss normal structure and necrosis of the hepatic and pancreatic tissue in freshwater fish treated with chlorpyrifos. Changes in the liver were time and concentration dependent. Histological changes in the liver could be attributed to the fact that, the liver is the major site of detoxification (Nagai et al.,2002) , it is expected that the toxicant insecticide would reach there in abundance for detoxification and disposal (Mushigeri ,2005). Focal necrosis were also observed in the liver of the fishes *Heteropneustes fossilis* and *Brachy danio* were exposed to organophosphate insecticide malathion (Rodrigues et al.,1998). Degenerative changes in the liver of *Catla catla* demonstrated the liver to be the organ affected most severely in response to quinalphos intoxification.

5.ACKNOWLEDGEMENT

The authors wish to thank the authorities of Government Arts College for Men, Krishnagiri for providing the facilities to carry out the work.

6.REFERENCES

Bhatnagar, M. C. and Bana, A.K. 1990. Pesticides induced histophysiological alterations in liver of Channa gachua.

Abst. Proceed. XI Ann. Sess. Acad. Environ. Bio. Aurangabad. 77. Biochem Physiol 99:148–156.

Casida, J.E., 1964. Esterase inhibitors as pesticides. Sci. N. Y. 146, 1011.catfish, Heteropneustes fossilis. J. Nat. Conserv.3: 121-125.

E.I.Cengiz and E. ¨Unl¨u, 2003."Histopathology of gills in mosquito fish, Gambusia affinis after long-term exposure to sub-lethal concentrations of malathion," Journal of Environmental Science and Health. Part B Pesticides, Food Contaminants ,and Agricultural Wastes, vol.38, no.5, pp.581–589.

Fernandes M. N. and A. F, Mazon. 2003. Environmental pollution and fish gill morphology. In: Val, A. L. and B. G. Kapoor (Eds.). Fish adaptations. Enfield, Science Publishers., 203-231. [10].

Figueiredo-Fernandes A., J. V Ferreira-Cardoso., Garcia-Santos., S M Monteiro, J Carrola., P Matos and A Fontaínhas-Fernandes. 2007..Histopathological changes in liver and gill epithelium of Nile tilapia, Oreochromis niloticus exposed to water borne copper. Pesq.Vet. Bras.,27(3), 103-109. [9].

Gurr, E., 1959. Methods for analytical histology and histochemistry, Leonard Hill (Books) Ltd., London.

Lu, F.C., 1985. Basic toxicology-Fundamentals, target organs and risk assessment. Hemispher Publishing Corporation, Washington.

Murty, A.S., 1986. Toxicity of pesticides to fish, vol. II. Boca Raton, FL: CRC Press. Nation JL, A new method using hexamethyldisilazane for preparation of soft insect tissues for scanning electron microscopy. Stain Technol., 58: 347-351

Mushigeri SB, David M.2005. Fenvalerate induced changes in the Ach and associated AChE activity in different tissues of fish Cirrhinus mrigala (Hamilton) under lethal and sub-lethal exposure period. Environmental Toxicology and Pharmacology 20:65-72.

Nagai T, Yukimoto T, Suzuki N. 2002.Glutathione peroxidase from the liver of Japanese sea bass Laeolabrax japonicus. Z Naturforscher 57C:172-176.

Northoff, E. and William, M. (2004). Farm workers need to be better protected against pesticides; FAO, UNEP call for stronger safety measures. Press release SAG/296. FAO-UNEP.

Palanikumar, L., A.K. Kumaraguru, C.M. Ramakritinan and M. Anand, 2012. Biochemical response of anthracene and benzo[a]pyrene in milkfish Chanoschanos. Ecotoxicol. Environ. Safety, 75: 187-197.

Pandey, A.K., K.C. George and M. Peer Mohamed, 1997. Histopathological alterations in the gill and kidney of an estuarine mullet, Liza parsia (HamiltonBuchanan), caused by sublethal exposure to lead (Pb). Ind. J. Fish., 44: 171-180.

Pandey, A.K., M. Peer Mohamed, K.C. George and Shyamlal, 1993. Histopathological changes in gill, kidney and liver of an estuarine mullet, Liza parsia, induced by sublethal exposure to DDT. J. Indian Fish. Assoc., 23: 55-63

Pane E.F., A Haque. and C.M Wood. 2004. Mechanistic analysis of acute, Niinduced respiratory toxicity in the rainbow trout, Oncorhynchus mykiss: an exclusively branchial phenomenon. Aquatic Toxicology, 69, 11-24. [8].

Riji John, K. and Jayabalan., N.2007. Sublethal effects of endosulfan on the histology and protein pattern of Cyprinus carpio gill. J. Applied Ichthyology. 9: 49-56. [13].

Rodrigues E, Fanta E. 1998.Liver histopathology of the fish Brachydanio rerio Hamilton-Buchanan after acute exposure to sub-lethal levels of organophosphate dimetoato 500. Rev Bras Zool 1998; 15(2):441-450.

Singh RN, Pandey PK, Singh NN, Dass VK. 2010. Acute toxicity and behavioral responses of common carp Cyprinus carprio (linn.) to an organophosphate (dimethoate). World J Zool 5: 183–188.

Sprague J.B., 1973.The ABC's of pollutant bioassay using fish. In biological methods for the assessment of water quality, *Am. Soc. Test. Mater. Tech. Publ.*, 528, 6-36.

Tilak K, Rao K, Veeraiah K. 2005.Effects of Chlorpyrifos on histopathology of the fish Catla catla. J Ecotoxicol Environ Monit 15 (2):127-140.

Vijayalakshmi, S. and K.S. Tilak, 1996. Effect of pesticides on the gill morphology of Labeo rohita. J. Ecotoxicol. Environ. Monit., 6: 59-64.

*****