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Histopathological Study of Liver And Kidney of The Fish *Ctenopharyngodonidella* Exposed To The Deltamethrin 11% EC, A Synthetic Pyrethroid

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Abstract: *Histopathological study of the liver and kidney of the fish Ctenopharyngodonidellaexposed to Deltamethrin 11% EC for 10 days was studied (1/10th of 96 h LC_{50} value 0.0172). Due to toxic effect on the 96 h selected organs, alterations are observed as pathological biomarkers indicating the load of pollution of toxic stress. Degeneration of hepatocytes and hypatic cords are observed in the liver of toxicant exposed fish. Similarlyin the kidney severe necrosis,cloudly swelling of cytoplasm and a decrease in the epithelial cells of the distal convoluted tubules are also observed. Pathological lesions in liver and kidney culminates the impairment of physiological process of the fish.*

Keywords: *Ctenopharyngodonidella, Liver, Kidney, Deltamethrin 11% EC, Biomarker, Histopathological study.*

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I. Introduction

The significance of aquatic environment, the largest subdivision of the plannet earth has increased, due to conscious nourishment trends, biological values of aquatic products because of high protein qualities. Water, Water everywhere but is there any water that is not pure, may be impure in the scientific sense that is contaminated. How to detect the situation of that sort that is what in the science of Ecotoxicology which encompasses certain evidences as biomarkers, the biochemical, histopathological, genotoxic and molecular changes.

So contamination by pesticides is viewed as there are four different classes of compounds organochlorines, organophosphates, carbamatesand syntheticpyrethroids. Such compoundsas the xenobiotic and infact anthropogenic in an ambition to increase the produce either from agricultural or from aquacultural sources. Being present, in such situationsthediversity of organisms are harmed. In doing, research of diverse fauna especially the fish will play a role for determining the effect of chemical substance of pollutant, which is also diverse on aquatic ecosystems (FigenEsinKayhan*et al*., 2013).

One such study is histopathology, a pathological condition of different organs, which is made of tissues of course they are made of cells. Marie Francois Xavier Bichat a French anatomist and pathologist and is known as father of histology, a pathobiologist who invented the technique that deals with the study of any disease or abnormalities in the tissues. The pesticides cause certain such changes which as when studied in fishes, will be a tool that guide us byecotoxicologist to assess the defilement of aquatic environment (Yanchava*et al*., 2015; Reddy and Kusum, 2013).

Such histopathological studies are mentioned for pesticides in their review articles by Ullah and Jallil (2015); KaushikMondal*et al*., (2015); Shankarmurthy*et al*., (2013); Prusty*et al*., (2015); Ahrar Khan *et al*., 2014,Velisekand Stara (2014) and Velisek*et al*., (2006,2007& 2009) for synthetic pyrethroids to which the present study of the toxicant belongs.HasiburRehman*et al*.,(2014) andBhattarcharjee and Das, (2014) in their reviews on Deltamethrinof the present study toxicant in the above aspect made clear that the studies of fish, organ/tissues i.e., histopathology will be due to toxic action by the toxicant even the concentrations are in sublethal level that are present in waters, inhabited by them.

Velisek and Stara (2014) reported that deltamethrin did not cause histopathological changes in gills, skin, liver, spleen and kidney of rainbow trout and common carp in lethal concentrations. But Srivastava (1997), Cengiz (2006), Cengiz and Unlu (2002, 2003 & 2006) and Staien*et al*., (2007) reported changes in common carp, mosquito fish *Gambusiaaffinis* and Nile tilapia *Oreochromisniloticus* respectively. Sayed*et al*., (2007) too reported on *Carassiusauvatusgibelio*. But according to Yildrim*et al*., (2005) who also reported histopathological studies in nile tilapia (*Oreochromisniloticus* L.) fingerlings in gills, liver, brain and spleen. However, overall paucity of information on the present study of fish and asdifferent opinions are available on

Deltamethrinas mentioned in the above as well as in the review articles, the present study is undertaken to study the pathological lesions in the liver and kidney of the fish *Ctenopharyngodonidella*, the exotic carp commonly cultured along with other major carps (may be first time of the toxicant on the grass carp – *Ctenopharyngodonidella*).

II. Materials And Methods

Fresh water fish *Ctenopharyngodonidella* was acclimatized to laboratory conditions for 10 days. 50 Fish are exposed to 11% EC Deltamethrin for 10 days $1/10^{th}$ of the 96h LC_{50} 0.0172 continuous flow through system (CFTS) value and i.e.,for 10 days as per APHA guidelines (1998, 2005, 2012). The toxicant deltamethrin 11% EC is purchased locally, manufactured by GIDC, Industrial Estate Ltd., 629/630, Gujarat, marketed by Sikko Industries Ltd., Ahmedabad. At the end of the exposure, period of 10 days the fish are randomly selected for histopathological examinations and liver and kidney, tissuesare isolated and also from fish not exposed to the toxicant which serve as control.

Physiological saline solutions 0.85% sodium chloride (NaCl) was used to rinse and clean. They were fixed in aqueous Bouins solution for 48 hr processed through graded series of employing alcohols, cleared xylene and embedded in paraffin wax. Sections of 6 μm thickness were cut stained with Ehlrichhematoxylin/Eosin dissolved in 70% alcohol and mounted on Canada balsam(Humason,1972). Sections were observed and photographed with the help of Intel Pentium Q x 3 Computer attached microscope, under 400x lens (made in China).

III. Observations And Discussion

General Histology of Liver (Plate 1FIG:A)

The surface of the liver is covered with serous membrane and some connective tissue which extends inwards into hepatic cords with hepatic cells and lattice fibers and sinusoids. Hepatic cells are round or polygonal containing clear spherical cells modified cuboid cells rested on cosumnarcally highly secretory on basement membrane. It is the highest secretory gland. Bile carrilculi are centrally located in each hepatic cord and generally obscure. Fairly large quantities of lipid glycogen granules (glycolipids) are located in each cord. The hepatic cell cytoplasm have fairly large quantities in the cytoplasm of the fish liver.

Secretion and storage of bile, rich in vitamin A and K which play an important role in protein and carbohydrate metabolisms and its detoxification, among it the benzopyrin (Lagler, 1962).

Pathology of Liver (Plate 1FIG:B)

Degeneration and necrosis are prominent. The degeneration of hepatocytes at the polygonal epithelium, atrophy which is prominent, cytoplasm is with vacuoles supposed to have exocytosis, ruptured blood vessels and disposition of hepatic cords. Liver in an organ of portal circulation and any foreign molecule, the antigen can damage the epithelial linning. The toxicity induced the membrane of the largest gland of the body and it detoxification role is very prominent. Due to damage of these metabolism and immunity is effected (Prosser, 1950).

General Histology of Fish Kidney (Plate IIFIG:A)

Teleostean kidney consists of head and body. Head is the anterior portionof the kidney and consists of lymphoid tissue. Body kidney is composed of many nephrons and interstitial lymphoid tissue. The interstitial tissue is the majorhematopoitic tissue in the body. Each nephron consists of two parts, theglomerules and the urinary tubule. The glomerules capsule consists of an innerand outer layer of single flattened epithelia. Renal tubules consist of single layerof epithelial cells. Mesangium fills the space between the loops of glomerularcapillaries.

Renal tubules are thin and short in the neck segment. The proximalconvoluted segment is divided into two parts i.e., segment I and segment II. Therenal tubules are composed of cuboidal epithelial cells with densely arrangedmicrovilli in the tubular lumen. In segment II, renal tubules are composed ofcuboidal epithelial cells. Cilia and microvilli are found in the tubular lumen. In thedistal convoluted segment, epithelial cells have no microvilli.The cells of thissegment are stained with eosin more faintly than those of proximal convolutedsegment (Fig. A). Thus, it is easy to distinguish between proximal and distalconvoluted segments under light microscopy

Pathology of Kidney tissue under observation (Plate 2 FIG:B)

Highly degenerative changes were observed in haemopoitictissue whichincludesevere necrosis, cloudy swelling cytoplasm. The epithelial cells of the distalconvoluted tubule decreased in size. The interstitial renal tissue was lessaffected. Renal interstitial tissue showed formation of vacuoles and cellularcontours were not clearly distinguished (Plate 2B).

The waste products collected from the body are eliminated through kidney.The non-detoxified pesticide molecules must be eliminated through the kidney onlyofthe fish and hence, it is susceptible to different chemical substances compoundswhen exposed to sublethal doses of the toxicant.

PLATE 1

Fig. A

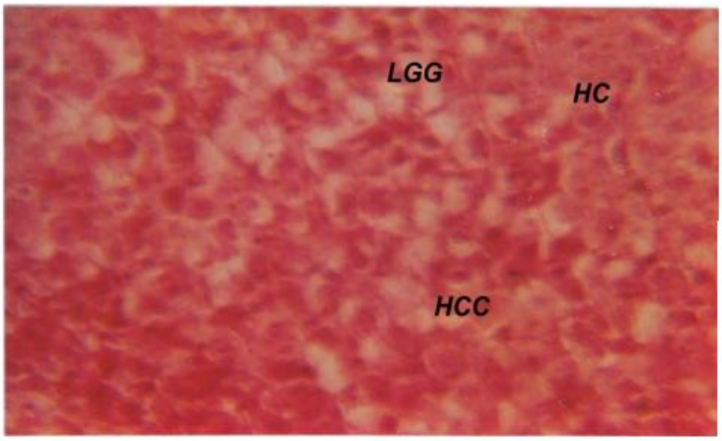

Fig. B

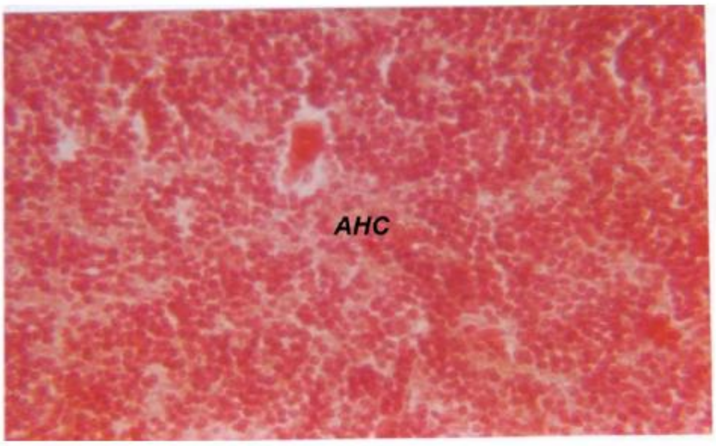

Plate 1: Fig. A. Normal Structure of Liver in CtenopharyngodonidellaHaematoxylin/ Eosin Stain (HE), x400 HC: Hepatic Cells; HCC: Hepatic Cells Cords; LGG: Lipid andGlycogen Granules.

Fig. B. Liver of Ctenopharyngodonidella exposed for 10 days to sublethalconcentration of Deltamethrin 11% EC Haematoxylin/Eosin Stain (HE), x400
AHC: Atrophy in Hepatic Cells.

PLATE 2
Fig. A

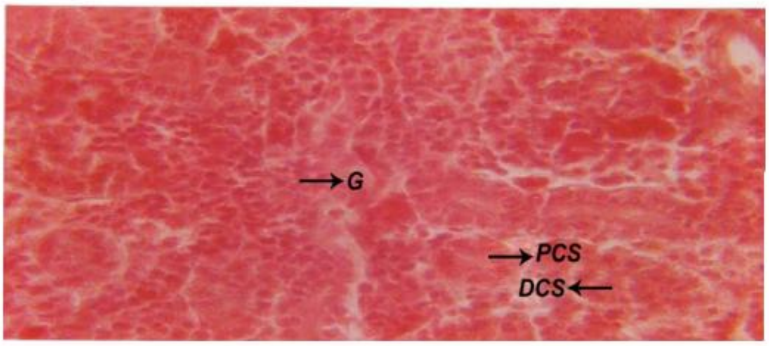

Fig. B

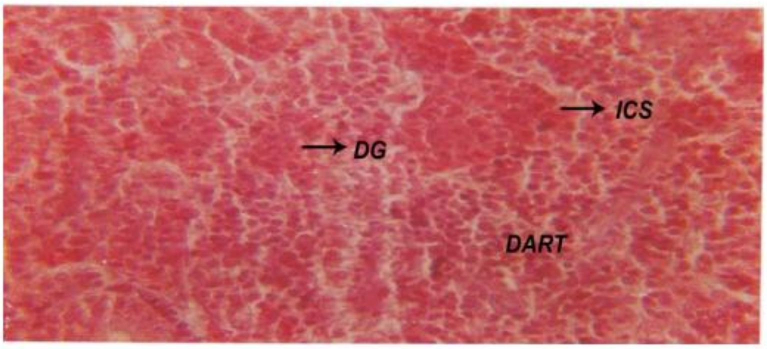

Fig. A. Normal Kidney Structure in CtenopharyngodonidellaHaematoxylin/Eosin Stain (HE);x400
PCS: Proximal Convoluted Segment; DCS: Distal Convoluted Segment; G: Glomerulus.

Fig. B. Kidney of Ctenopharyngodonidella exposed for 10 days to sublethalconcentration of Deltamethrin 11% EC Haematoxylin/Eosin Stain (HE), x400 DART: Degeneration and Atrophyin Renal Tubules; DG: Degeneration in Glomerulus; ICS: Intercellular Spaces formation giving mesh like appearance.

Suvetha*et al*., (2015) reported on the intoxication of deltamethrin in an Indian major carp *Labeorohita*due tohormonal and enzymatic homeostatic responses. They reported significant alterations in the enzymes of both liver and kidney of the fish. These biochemical changes will be due to the tissue damages of the respective organs of the fish, one is metabolically active whereas the other one is for excretion.

Cengiz (2006) reported kidney histopathology in the freshwater fish *Cyprinuscarpio* after acute exposure to deltamethrin. The study revealed appearance of lesions in the kidney tissues of the fish and is characterized by degeneration of the epithelial cells of renal tubule, pyconotic nuclei in the hematopoietic tissue dialation of glomerular capallaries and degeneration of glomerulus, intracytoplasmic vacuoles in the epithelial cells of renal tubule with hypertrophied cells and narrowing of the tubular lumen. The freshwater fish needs to maintain osmoregulation and will be definitely a problem if kidney is effected as in the reported fish and also in the present studied fish.

Velisek*et al*., (2007) reported the effects of deltamethrin on rainbow trout *Onchorynchusmykiss*. Being strongly toxic to fish the fish showed alterations both biochemically and haematologically due to pathological conditions of the damage of the largest gland of the body and alsoammonotelic excretory organ.

Yeldrim*et al.,*(2005) reported on histopathological effects of deltamethrin on tissues (gills, liver, brain, spleen, kidney, muscle and skin of nile tilapia (*Oreochromisniloticus* L.,) fingerlings.Hydrophobic degenerations in liver were reported. The fish not only have alterations but also exhibited certain behavioural changes too due to severity of the organs damage.

Cengiz and Unlu (2006) reported the sublethal effects of commercial deltamethrin on the structure of the gill, liver and gut tissues of mosquito fish, *Gambusiaaffinis*: The significant pathological alterations reported in liver reported are, hypertrophy of hepatocytes, significant increase of Kupffer cells circulatory disturbances focal necrosis fatty degeneration, nuclear pycnosis and narrowing of sinusoids. Some of these change are also observed in the present study of the fish.

Dobsikova*et al*., (2006) reported histopathological parameters of common carp *Cyprinuscarpio* after exposure to Cypermethrin the other one of type II synthetic pyrethroid. The study revealed vacuolization of pancreas particularly the exocrine cells. The importance of the pancreas associatedwithliverwhich play a significant role in digestion.

Velumurugan (2009 & 2007a) reported histopathological changes in the liver of the fresh water fish *Cirrhinusmrigala* exposed to Dichlorovos an organophosphate. Hepatic lesions in the liver tissues of fishes exposed to dichlorvos were characterized by cloudy swelling hepatocytes congestion vacuolar degeneration karyolysiskaryotaxisdialation of sinusoids and nuclear hypertrophy.

Velisek*et al*., (2009) reported the histopathological effects of bifenthrin, a synthetic pyrethroid in the rainbow trout (*Ochorhynchusmykiss*). Degeneration of liver hepatocytes were reported as a histological biomarker.

Velumurugan (2007b) reported the effects of fenvalerate which is also type II synthetic pyrethroid on different tissues of fresh water fish *Cirrhinusmrigala*. The study on liver and kidney of the fish showed significant changes such as necrosis of tubular epithelium pycnotic nuclei in the hematopoietic tissue hypertrophied epithelial cells of renal tubules, narrowing o the tubular lumen expansion of space inside the Bowmans capsule and contractions of the glomerulus were observed in the kidney tissues of the fish.Hepatic lesions in the liver of the fish exposed to the toxicant which were characterized by congestion and cloudy swelling of hepatocytes and focal necrosis.

Velisek*et al*., (2006) reported the effects of Cypermethrin on rainbow trout (*Oncornchusmykiss*). Being highly toxic to fish, the liver showed severe pathological condition resulting significant changes in the enzymes of the respective organs.

Neelima*et al*., (2015) reported histopathological alterations in the gill, liver and kidney of *Cyprinuscarpio* exposed to cypermethrin (25% EC). Hepatocytes damage and glomerulus damage respectively in liver and kidney are reported.

Hasan*et al*., (2014) reported histomorphometric profile of grass carp *Ctenopharyngodonidella* during acute Endosulfan toxicity. The study reported degenerative changes including vacuolization pyknosis etc.

Andem*et al*., (2017) reported histopathological changes of synthetic pyrethroid pesticide cypermethrin exposed to African clariid mud catfish (*Clariasgariepinus*) fingerlings. The term hyperplastic hepatocytes and necrosis is reported.

Mohammed *et al*., (2016) too reported the subchronic toxicity of Deltamethrin and tetramethrin in the nile tilapia fish. The report mentioned about the necrosis of spleen.

Thus not only synthetic pyrethroids any pesticides preclude damage of the important organs and using histopathology of fish as a protocol serve as a biomarker in the assessment of aquatic pollution.The liver is known for the metabolic process such as glycogenesis, glyconeogenesis and glycolysis.If they are impaired the growth the fish especially in aquaculture the venture is at loss.Similarly the kidney, the primary organ of excretionammonotelic in nature is disturbedif the organ is pathologically damaged.

IV. Conclusion

The xenobiotic compounds effect the fish organs like liver and kidney and the susceptibility of the fish in the context of environmental monitoring and the biomarker approach. Metabolically active organs the liver and kidney when damaged the very survival of the fish, the non-target organisms is questionable. Due emphasis must be on sublethal concentrations and formulations have to be viewed seriously.

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