

Toxic Impact of Nuvan (DDVP) on Tissues of Common Carp *Channa punctatus* (Bloch.)

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Abstract—Nuvan (DDVP) is a member of organophosphorus compounds. It is extremely toxic to insects and is widely used as insecticides. Nuvan has been taken for the acute toxicity to a fresh water fish *Channa punctatus* LC₅₀ value calculated for the acute toxicity, which were 0.024 ml/L. Histopathological study of kidney and liver after 24hr, 48hr, 72hr and 96hr exposure to acute toxicity of Nuvan. Treatment with nuvan resulted in hypertrophy of hepatic cells, necrosis and connective tissue damage in liver. Kidney showed shrinkage in glomerular network and desquamation of tubular cells. The aim of this study is to show the alteration in histopathological changes in liver and kidney and get the real picture of toxicological effect of organophosphate pesticide Nuvan, and correlated to know about the adverse consequence of environmental toxicant on human health. The study is very important from histopathological point of view.

Keywords—Nuvan, *Channa punctatus*, kidney, liver.

I. INTRODUCTION

The use of crop –protecting toxicants and pesticides now become a necessity of farmers in these days. When chemical, fertilizer and pesticide applied in the field its show lethal effect on survival, growth, metabolism and reproduction on non- targeted organisms. Pesticides applied directly to the soil are carried away by rains and floods as runoff to the water bodies and this alters the physico-chemical properties of water. Nuvan (DDVP) is a systemic organophosphate insecticide used widely for controlling insect pest of fruits, vegetables and crop plants. This is very toxic insecticide and has been classified as possible carcinogen by USEPA based on occurrences of tumors in mice and rated as moderately hazardous by W.H.O. The fish is a good indicator and highly sensitive in such ecosystem where the water gets contaminated to toxic chemicals. Specific lesions occurring in organs of fish exposed to toxic substances under laboratory conditions are helpful as biomarker of exposure.

As a result histopathological examination is increasingly being recognized as a valuable tool for assessing the impact of environmental pollutants on fishes (Tehet *et. al.*, 1997; Handyet *et. al.*, 2002). Sub-lethal concentrations are usually considered safe because they do not cause death. But, as the liver and kidney serves many vital functions and a major route of excretion of metabolites of xenobiotics, and receives the largest proportion of post branchial blood, and therefore, it is more likely to undergo histopathological alterations under pesticide stress (Ortiz *et al.*, 2003). The present work is an effort to assess the toxic impact of nuvan on the histology of kidney and liver tissues of common carp *Channa punctatus*.

II. MATERIALS AND METHODS

Living specimens of fresh water fish *Channa punctatus* were collected from the local fish market. The average length and weight of fish is 12-15 cm and 60-70 g respectively. They were kept in glass aquarium (75 x 37.5 x 37.5) capacity 25 liter, having non chlorinated tap water aquaria bath 1% KMnO₄ solution for disinfection. The fish were acclimatized for one week before examination. The water used for toxicity test contained 20-25 °C and 7.2 pH during acclimatize and they were feed readymade market fish food twice in a day. Feeding was stopped

24hr before starting the experiment. Dead fish (If any) was removed from aquaria as soon as possible to avoid water fouling and water was changed after 2 or 3 days. Organophosphate Pesticide, Nuvan (DDVP) from Syngenta India Ltd. was use for present study. Five aquaria were set up for each concentration and each aquarium contained six fish in 25 L dechlorinated water.

The data was analyzed statistically by log dose /probit regression line method (Finney,1971).The stock solution of nuvan was prepared in distilled water. The LC₅₀ of nuvan for 96h to *Channa punctatus* was calculated 0.024ml/L. One control group of healthy fish

was maintained simultaneously. Water quality monitoring was done prior to the experiment, during the experiment and after the experiment. Fish *Channa punctatus* were sacrificed at 24h, 48h, 72h and 96hr of exposure. Fish were first immobilized in ice and then dissected out carefully; Liver and kidney were removed and fixed in bouins fluid for 24 hr and then processed and embedded in paraffin for block preparation. The section were cut at 5 micron and stained in hematoxylin and eosin. Prepared slides were examined under light microscope and photographed for histopathological effects.

III. RESULTS

The microscopically histopathological observations in the liver of fish *Channa punctatus* after exposed to sub lethal concentration of nuvan, noticed several histological alterations in compared to the control (Fig.-1).

After 24hr of nuvan toxicity in *Channa punctatus* were predominantly shown in the hepatocytes were radially from central vein at place. There were increases sinusoidal spaces also cirrhosis, mild necrosis and fat accumulation. Some of the hepatocytes are accumulate cytoplasmic granules and shrinkage leading to damage of the cytoplasmic material in the liver cells (Fig.-2). After 48hr exposure of nuvan toxicity, liver shown pathogenesis with many lesion. Most important histopathological changes were the necrosis and inflammation in the sinusoidal tissue. The hepatocytes were ischemic condition i.e. the lack of blood in the tissues (Fig.-3). While after 72hr exposure toxicity showed remarkable changes i.e. cloudy swelling and extension of sinusoids, fibrosis and cirrhosis in hepatic lobules and nuclear necrosis. The hepatocytes show hepatic vacuolization (fig.-4). The most remarkable changes in the liver were observed after 96hr of nuvan toxicity. The architecture hepatocytes loss of polygonal shape of hepatocytes, degeneration, focal necrosis and loss of cell boundaries of giant cell were also develop (Fig.-5).

The histopathological observations have been observed in the kidney after 24hr of nuvan toxicity shows cloudy swellings on renal tubules, several variations in size and cellularity in glomeruli to normal. The tubules were showing focal necrosis at various places (Fig.7). After 48 hr several hyper cellular glomeruli were seen with much vascular degeneration of the tubular cells and displacement of nucleus in renal cells. The renal tubules were shown mild necrosis of interstitial haematopoetic tissue and hyperchromatic nuclei and widening of the renal tubular lumen (Fig. 8). While after 21 days of nuvan toxicity

kidney shows pathogenesis with many lesions. Several hypertrophy in glomeruli and loss of haemopoietic tissue and lack of blood supply in tissue and nephrosis (Fig.9). An interesting and remarkable changes in kidney after 28 days compare to control, shows chronic inflammation of interstitial tissue, internal hemorrhage. The scattered area of fibrinoid necrosis as well as ischemic brinkling of glomeruli were observed (Fig.10).

IV. DISCUSSION

Similar findings have been supported by Mathur (1962, 1965, and 1976) in *Ophiocephalus punctatus*, *Barbus stigma*, *Trichogaster fasciatus* and *Heteropneustes fossilis* due to DDT, dieldrin and lindane toxicity. Konar (1970), Chakraborty, Amminikutty and Rege (1977), Anees (1978), Dubale and Shah (1979) and Awasthi (1984) reported hypertrophy of hepatic cells, loss of characteristic polygonal shape of liver cells, degeneration, shrinkage, rupture swelling necrosis margination of cells vacuolation, centralobular, perilobular hypertrophy, loss of cell boundaries resulting in to binuclear hepatocytes. Formation of gaint cells, splitting of the tissue, disintegration of hepatic cords, neoplasia and atrophy due to various pesticides exposure in fresh water fishes. Shastry and Sharma (1979) observed hypertrophy of hepatic cells and liver corrdisary, vocuolatuion of cytoplasm and necrosis, rupture of hepatic cells membrane and necrotic centro lobular area in fresh water fish *Channa punctatus* due to a sub lethal concentration of aldrin. Mandal and Kulshrestha (1980), Qureshiet al. (1983), Kulshrestha and Jauhar (1984), Bhatnagaret. al. (1987) and Ramalingam (1988) reported cytoplasmic degeneration of nuclei in liver tissues and vacuolation in hepatic cells and ruptured of blood vessels due to organophosphate pesticides in fresh water fishes. Desai et al. (1984) have been reported necrosis and vacuolization of hepatocytes and fat degeneraton from the tissues due to the organophosphate monocrotophas toxicity exposure in the liver of *Tilapia mossambica*. Mathur (1965) observed the vacuolation and necrosis in the liver of *Ophiocephalus punctatus* due to pesticidal toxicity. Elezabyet al. (2001) studied hemorrhage, necrosis and lipidosis in the liver *Oreochromis niloticus* and *Clarias gariepinus* due to malathion and organophosphorus insecticide (Hostathion) toxicity. Similar histopathological changes were reported in the fresh water fish *Anabas testudines* exposed to paper mill effluents (Nanda and Panigrahi, 2004). King (1962) observed several histopathological changes in liver of

guppies and brown trout after DDT exposure. Jordnoska and Kostoski (2005) reported several histopathological changes due to pesticides toxicity in fresh water fish *Barbus meridionalis peteniyi* (Heckal). These findings similar to Mathur (1962), Konar (1970), Shastry and Sharma (1979), Mandal and Kulshrestha (1980), Kulshrestha *et al.* (1984), Radhiah *et al.* (1986), Saxena (1988) and Bhatnagar *et al.* (1989) have been reported the rupture and flattening of the cells of renal epithelium, displacement of nuclei in renal cells, widening of the renal tubule lumen, shrinkage of glomerulus, haemorrhage of blood vessels and clumping of erythrocytes and carbaryl pesticides in fresh water fishes. Dubale and Shah (1981) and Dhanapakiam and Premletha (1994) reported the consequent necrosis of cell and vacuole formation in *Cyprinus carpio* due to malathion and sevin vacuolation, necrosis, loss of nuclei, ruptured glomeruli, cellular debris and accumulation of dark granules in fresh water fish *Channa punctatus* due to phenyl mercuric acetate (PMA) toxicity. Annes (1976) and Pandey (1996) have observed rupture and flattening of renal epithelium cells, displacement of nuclei in renal cells, widening of the renal tubular lumen, eosinophilic casts in the tubular lumina, rupture of renal peritonyum, shrinkage of glomerulus, haemorrhage of blood vessels, necrosis of interstitial haematopoietic tissue and hyperchromatic nuclei in the fresh water fish due to pesticide toxicity. Das and Mukherjee, (2000) reported dilation of renal tubules and necrotic changes characterized by karyorrhexis and karyolysis in *Labeo rohita* exposed to hexachlorocyclohexane. Tilak *et al.* (2001) noticed severe necrosis, cloudy swelling in the renal tubules, cellular hypertrophy, granular cytoplasm and vacuolization in kidney tissues of *Ctenopharyngodon idella* after exposure to fenvalerate. Degeneration in the epithelial cells of renal tubules, pycnotic nuclei in the hematopoietic tissue, dilation of glomerular capillaries, degeneration of glomerulus, intra cytoplasmic vacuoles in the epithelial cells with tubular lumen were observed in the kidney tissues of fish exposed to diltamethrin (Cengiz, 2006). Valmurugan *et al.* (2007) reported pycnotic nuclei in tubular epithelium, hypertrophied epithelial cells of renal tubules, contraction of glomerulus and expansion of space inside the Bowman's capsule in the kidney of *Cirrhinus mrigala* exposed to monocrotophos.

REFERENCES

- [1] A.K. Pandey, K.C. George and M. Peer Mohamed (1996). Histopathological alterations induced in the liver of an estuarine mullet, *Liza parsia* by mercuric chloride and DDT. *Indian J. Fish.* 43(3), 277-284.
- [2] Anees, M. A. 1978: Haematological abnormalities in a freshwater teleost, *Channa punctatus* (Bloch) exposed to sub lethal and chronic levels of three organophosphorus insecticides. *Int. J. Ecol. Environ. Sci.* 4, 53-60.
- [3] Awasthi M. (1984). Biochemical changes in the liver and kidney of cat fish, *Heteropneustes fossilis* exposed to dimethate. *Comp. Physiol. Ecol.* 7, 111-114.
- [4] Bhatnagar M.C., A.K. Bana and R.C. Dalela (1987): Histopathological alterations in liver of *Channa gachua* exposed to endosulfan. *Environment and pesticide Toxicity*, 205-209.
- [5] Bhatnagar, M.G., A.K. Bana and R.C. Dalela (1989): Histological damage of kidney in *Channa gachua* exposed to acute and sub acute levels of endosulfan. *Environmental Risk Assessment*, 145-150.
- [6] Cengiz, E.I., (2006): Gill and kidney histopathology in the freshwater fish *Cyprinus carpio* after acute exposure to diltamethrin. *Environ. Toxicol. Phar.* 22, 246-253.
- [7] Chakrabarti, P; D.K. Datta, and G.M. Sinha, (1986): Effect of lead toxicity on the alimentary tract, pancreas liver and kidney of a fresh water teleost, *Mystus vittatus* (Bloch). *Proceedings of 2nd National Conventino of Young Scientists.* Meerut University; P. 220-229 (Ed. K.C. Pandey).
- [8] Das B. K. and Mukherjee S.C., 2000. A histopathological study of carp (*Labeo rohita*) exposed to hexachlorocyclohexane. *Vet. Archiv.* 70(4), 169-180.
- [9] Desai A.K., Joshi U.M., Ambadka P.M., (1984). Histological observations on the liver of *Tilapia mossambica* after exposure to monocrotophos, an organophosphorus insecticide. *Toxicol. Lett.* 21, 325-331.
- [10] Dhanapakiam, P. and J. Premletha (1994): Histopathological changes in the kidney of *Cyprinus carpio* exposed to malathion and sevin. *J. Environ. Biol.* 15(X), P. 283 - 287.
- [11] Doubal M.S. and Awasthi M. (1984): Biochemical changes in the liver and kidney of a cat fish

- Heteropneustes fossilis* exposed to diethoate. *Comp. Physiol. Ecol*, 7, 111-114.
- [12] Dubale, M.S. and P. Shah (1981): Histopathology of the kidney of the fish *Channa punctuatus* exposed to cadmium. *J. Ani. Morphol. Physiol*, 28(1-2), P. 166-171.
- [13] Elezaby M., El-serafy S. Heckmann R., Sharf-Edden K and Seddek M., (2001): Effect of some toxicants on fresh water fish *Oreochromis niloticus* .J. Egypt Gen.Soc.Zool, 36,407-344.
- [14] Handy R.D., Runnalls T. and Russell P.M.(2002).Histopathologic biomarkers in three spined sticklebacks, *Gasterosteus aculeatus* from several rivers in southern England that meet the fresh water fishes directive. *Ecotoxicology*, 11, 467-479.
- [15] Jordanoska and Goce Kostosk (2005): Histopathological analysis of liver in fish *Barbus meridionalis petenyl* (HECKEL) in reservoir trebenista. *nat. croat*, 2, 147-153.
- [16] King F. (1962).Some effects of DDT on blue gill *Lepomis microchirus*- *Trans. Am. Fish. Soc*, 92, 372-378.
- [17] Koelle, G.B. &A.Gilman.1949.Anticholinesterase, *Jour. Pharmacol. Exp. T her*, 95,166-216.
- [18] Konar, S.K. (1970) Nicotine as a fish poison, *sci.andculti*, 35:340-341.
- [19] Kulshrestha, S.K. and L. Jaguar (1984): Effects of sub lethal doses of thioden and sevin on the liver of *C. punctatus*. *Proc. Sem. Eff. Pest. Aq. Fan*, 71-78.
- [20] Kulshrestha, S.K., R.S. Shrivastava and N. Arora (1984): Toxicity of two pesticides to the kidney of *Channa striatus*. *Proc. Sem. Eff. Pest. Aq. Fau*, 63-70.
- [21] Mandal, P.K. and A.K. Kushrestha. (1980): Histopathological changes induced by the sub-lethal sumithion in *Clarias batrachus*. *Ind. J. Exp. Biol*, 18, 547-552.
- [22] Mathur, D.S. (1967): Histopathological changes in liver of fishes resulting from exposure to dieldrin and lindane. In animal plant and microbial toxin. Plenum publishing corporation,N.Y.
- [23] Mathur,D.S.(1965): Histopathological changes in liver of certain fishes induced by dieldrin.Sc. and cult, 31.
- [24] Nanda, P. and S. Panigrahi (2004): Histopathological abnormalities in the fish climbing perch *Anabas testudineus* due to paper mill effluent. *Environ. Ecol*, 22, 24-25.
- [25] Qrtiz J.B., De Canales M.L.G. and Sarasquete C.(2003): Histopathological changes induced by Indane (gamma-HCH)in various organs of fishes. *Sci Mar.*, 67(1), 53-61.
- [26] Qureshi, N.A., Q.J. Shammi and R. Sharma.(1983): Histopathology of Malathion on liver of a cat fish *Clarias batrachus*. *Ind. J. Zool*, 11, 67-70.
- [27] Radhiah, V., G. Moses, G.R. Kumari. And K.J. Rao(1986): Effects of heptachlor on hydration levels and histosomatic indices in kidney of fish *Tilapia mossambica*. *Environment & Ecology*, 4, 274-276
- [28] Sastry, K.V. and S.K. Sharma (1979): Toxic effect of endrin on liver and kidney of a teleost fish. *Proc. Symp. Environ. Biol. Held at muzaffanagar(India)*, 337-342
- [29] Saxena. M. (1988): Toxic effects of Sub lethal doses of rogor on the kidney of *Channa striatus*. *Proc. Nat. Symp. Past*, 129-131.
- [30] Teh S.J., Adams S.M. and Hilton D.E., (1997): Histopathologic biomarkers in feral freshwater fish populations exposed to different types of contaminant stress. *Aquat.Toxicol*, 51-70.
- [31] Tilak K.S., Veeraiah K and Yacobu K., (2001): Studies on histopathologicalchanges in the gill, liver and kidney of *Ctenopharyngodon idella*(Valenciennes)Exposed to technical fenvalerate and EC20%.*Polln.Res*, 20:387-393.
- [32] Velmurugan B., Selvanayagam M., Cengiz E.I. and Unlu E., (2007). The effects of monocrotophos to different tissues of freshwater fish *Cirrhinus mrigala*. *Bull.Environ.Contam. Toxicol*, 78:450-454.

Explanation of figure: - Kidney photo figure (1-5)



Fig.1:Kidney(Control)

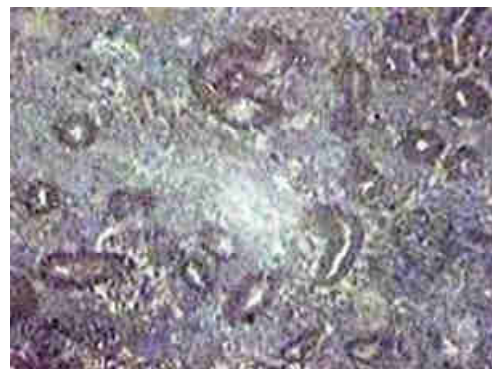


Fig.2: Kidney(24hour)

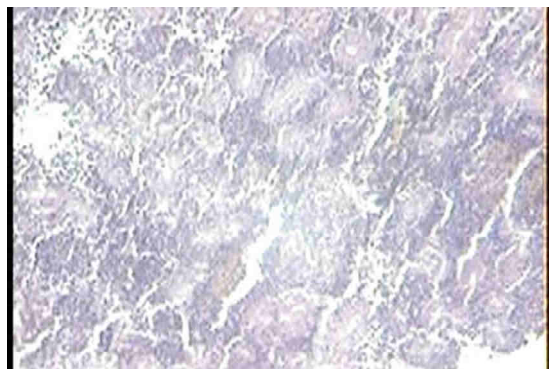


Fig.3:Kidney(48hour)

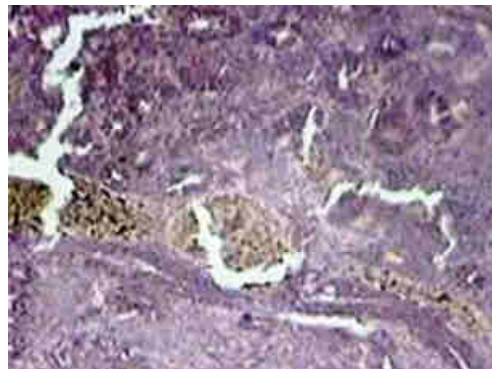


Fig.4 :Kidney(72hour)

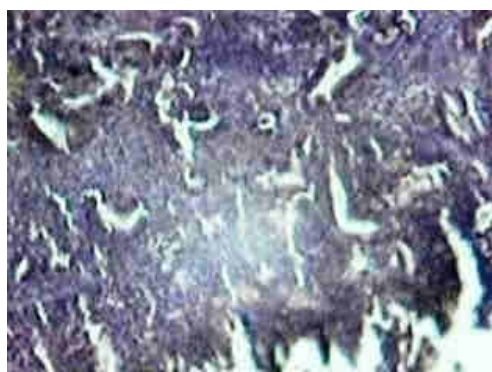


Fig.5: Kidney(96hour)

Explanation of figure: - Liver photo figure (6-10)



Fig.6:Liver(Control)



Fig.7: Liver(24 hour)



Fig.8 :Liver(48 hour)



Fig.9: Liver(72 hour)

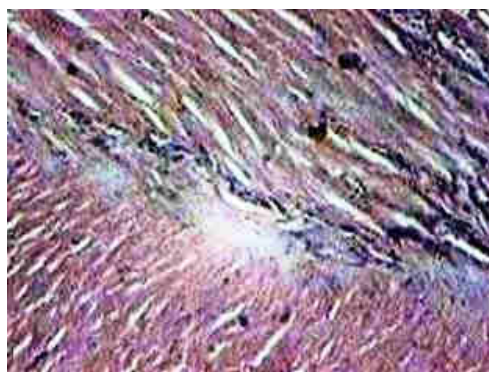


Fig.10: Liver(96 hour)