Bull. Environ. Contam. Toxicol. (1996) 57:648-654

Bulletin of Environmental Contamination and Toxicology

Histopathological Changes Induced by Specific Pesticides on Some Tissues of the Fresh Water Snail, *Bellamya dissimilis* Müller

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Received: 18 November 1994/Accepted: 21 March 1996

Pathological and biochemical disturbances in aquatic organisms due to pesticide toxicity is well documented (Muley and Mane 1990). These disturbances can be structural and functional at the cellular and subcellular levels in organisms (Rodriguez et al, 1994). The action of the toxins on the liver and kidney might alter the enzyme activity (Dikshit et al. 1975). Histopathological changes were mostly confined to organs directly involved in their metabolism and detoxification (Rashatwar and Ilyas 1984).

The present study has been carried out to study the effect of the pesticides endosulfan, methylparathion, quinalphos and nuvan (DDVP) on the fresh water snail, Bellamya dissimilis Müller. This type of snail is consumed by the population in and around Kolleru lake, which is one of the largest natural freshwater lakes in India. It is also used as a duck bait.

MATERIALS AND METHODS

A total of 50 adult fresh water snails (B. dissimilis) Müller were collected from Kolleru lake and divided into five groups of 10 each. The first group consisted of control snails while the other four groups were exposed to 96-hr LC_{50} concentrations of different pesticides (Table 1). The 96-hr LC_{50} values for the four pesticides were determined by employing the unweighted regression method of probit-analysis (Roberts and Boyce 1972). The fiducial limits of the LC_{50} values were derived from the probit transformation at 95% confidence level (Snedcor & Cochran 1967). The digestive gland, mantle and foot of the control group and those of experimental groups that survived (50%) at the end of 96-hr exposure were removed. The tissues were fixed in alcoholic Bouin's fluid and processed (Weesner 1968). The sections (8 µm) were prepared from paraffin embedded tissues and stained with routine haemotoxylin and eosin preparations.

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Table 1. 96- hr LC_{50} concentrations of different pesticides

Group	Pesticides	Indian supplier	96-hr LC_{50} conc. g/l (10^{-3})
I	Control unexposed		
II	Endosulfan 35% EC 6,7,8,9,10 hexachloro, 1,5,5a,6,6,9,9a-hexahydro 6,9 methano-2,4,3-benzo(e)dioxothiepin-3 oxide	A.P. Agro Industries Develop Corp. Kurnool.	1.8 (1.65 to 2.11)
III	Metacid or Methyl-parathion 50% EC O,O,Dimethyl O-P nitrophenyl Phosphorothioate	Bayer India Ltd., Bombay.	4.7 (3.59 to 6.36)
IV	Quinalphos 25% EC Dimethyl O-quinoxalin 2yl phosphate	Premier Pesticides Pvt. Ltd. Cochin.	1.9 (1.52 to 2.38)
V	Nuvan 36 % EC 2-dichloroethenyl O-O-dimethyl Phosphoric acid ester	Hindustan Ciba Geigy Ltd. Bombay.	20.89 (19.96 to 23.43)

Numbers in parenthesis indicate 95% confidence limits.

RESULTS AND DISCUSSION

The histopathological studies have shown that the four pesticides have affected the digestive gland, mantle and foot of B. dissimilis Müller when compared with their respective controls (Figs. la, 2a and 2e). The lobules, interlobular connective tissue, muscle fibers surrounding the lobules were also affected but the degree of damage varied with different pesticides. The lumen of the digestive gland tubule was shrunken, hypertrophied with conspicuous vacuolations in endosulfan (Fig. lb) exposed snails. In methyl parathion (Fig. 1c) exposed snails, interlobular tissue was broken and large vacuoles appeared in the hepatic cells and in the connective tissues. Vacuoles increased in inter lobular connective tissue which lost its original shape and the secretory cells became irregular in quinalphos (Fig.1d) exposed snails. In nuvan exposed snails (Fig. le) damage to the digestive gland tubules was extensive resulting in deformity of the hepatic cells, or complete destruction of the tubules, hypertrophy of muscles and vacuolation of hepatic tissue. Hepatic necrosis was conspicuous.

The mantle of the exposed snails showed disorganisation of the tissue especially in the lamellae. Interlamellar space was filled with hyperplastic epithelium and lamellar shape and structure were lost due to desquammation, and this was more conspicuous in methyl parathion (Fig.2c) and Quinalphos when compared with endosulfan exposure (Fig.2b). Cytoplasmic vacuolation and the nucleus were either karyorrhectic or pyknotic. Hemorrhage and infiltration were also observed. Hyperplasia was so

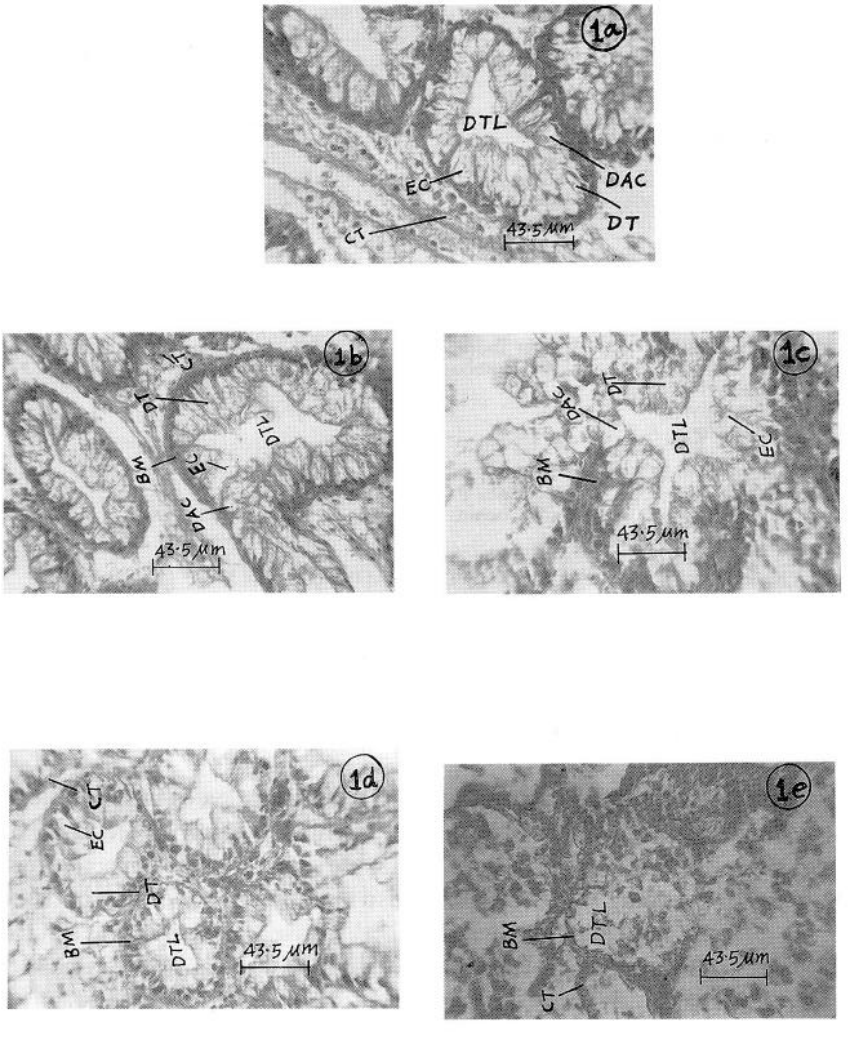

Figure 1. Transverse section of digestive gland (Figs 1a to le) of (a) control (unexposed) and after 96-hr exposure to 96-hr LC_{50} concentrations of (b) endosulfan, (c) methyl parathion, (d) quinalphos and (e) nuvan (X250)

DTL - Digestive Gland Lumen; DAC - Digestive Absorptive Cell; DT - Digestive Tubule; BM - Basement Membrane; CT - Connective Tissue; EC - Excretory cell.

acute in methyl parathion (Fig.2c) and nuvan (Fig.2d) exposed snails that the lamellae were transferred into globular or balloon-like structures.

The main targets of toxic action were epithelium, mucous glands and muscle fibers of the foot. The epidermis was broken and the mucocytes were concentrated. The central connective tissue and columnar muscle fibers were disrupted in endosulfan exposed snails (Fig.2f). In methyl parathion (Fig.2g) and quinalphos exposed snails, desquammation of the hyperplastic epithelium was noticed. The subepidermal cells were concentrated and muscular layers were damaged. Damage to the foot tissue in nuvan (Fig. 2h) exposed snails was extensive. In addition to the disruption of the muscle fibers, spaces and gaps appeared between fibers and the vesicular cells, and the mucous cells were concentrated and lost their shape.

The present study has shown several degeneration changes in the histological structure of the digestive gland, mantle, and foot of B. dissimilis exposed to 96-hr LC_{50} concentrations of the four pesticides. Mane et al. (1979) have noted similar changes while investigating the histopathological changes in the hepatopancreas of the bivalve, Indonaia cauruleus exposed to DDT, malathion, endrin and thiometon.

There seems to be scanty information on the histopathological effects of pesticides on the foot of molluscs. Swelling of epithelium, reduction in the number and size of mucous glands in parenchyma and disruption of muscle fibers are noted in B. dissimilis.

Pesticides in general induce histopathological changes in the tissues of fish. However, in other short term studies no marked histological changes were observed in the tissues of experimental animals (rabbits and rats) but only increased or decreased weight was reported (Gupta and Gupta 1977; Wayman et al. 1978).

Of the three other parameters (toxicological, metabolic and biochemical) studied, it was clear that endosulfan was more toxic to B. dissimilis than the three other pesticides mentioned (Padmaja et al. 1988, Padmaja and Rao 1991; Padmaja and Rao 1994). In the present study it was interesting to note that histopathological changes induced by nuvan were more intense when compared to endosulfan. Indeed, while finding the effect of endosulfan on Labeo rohita, it was observed that the death of the fish exposed to acute doses is the result of direct toxic action of the pesticide rather than due to destruction of cells and interference with cellular metabolism (Rao et al, 1980). Cellular destruction may perhaps accelerate death by way of affecting the biochemical pathways and energy reserves (Padmaja and Rao 1994).

Most of the pesticides, particularly the organochlorines have been reported to be hazardous to non-target species (Matthiessen et al. 1982). It is interesting to note that in the present study, the organophosphorous pesticide, such as nuvan was more toxic than organochlorine, endosulfan, when various parameters were considered

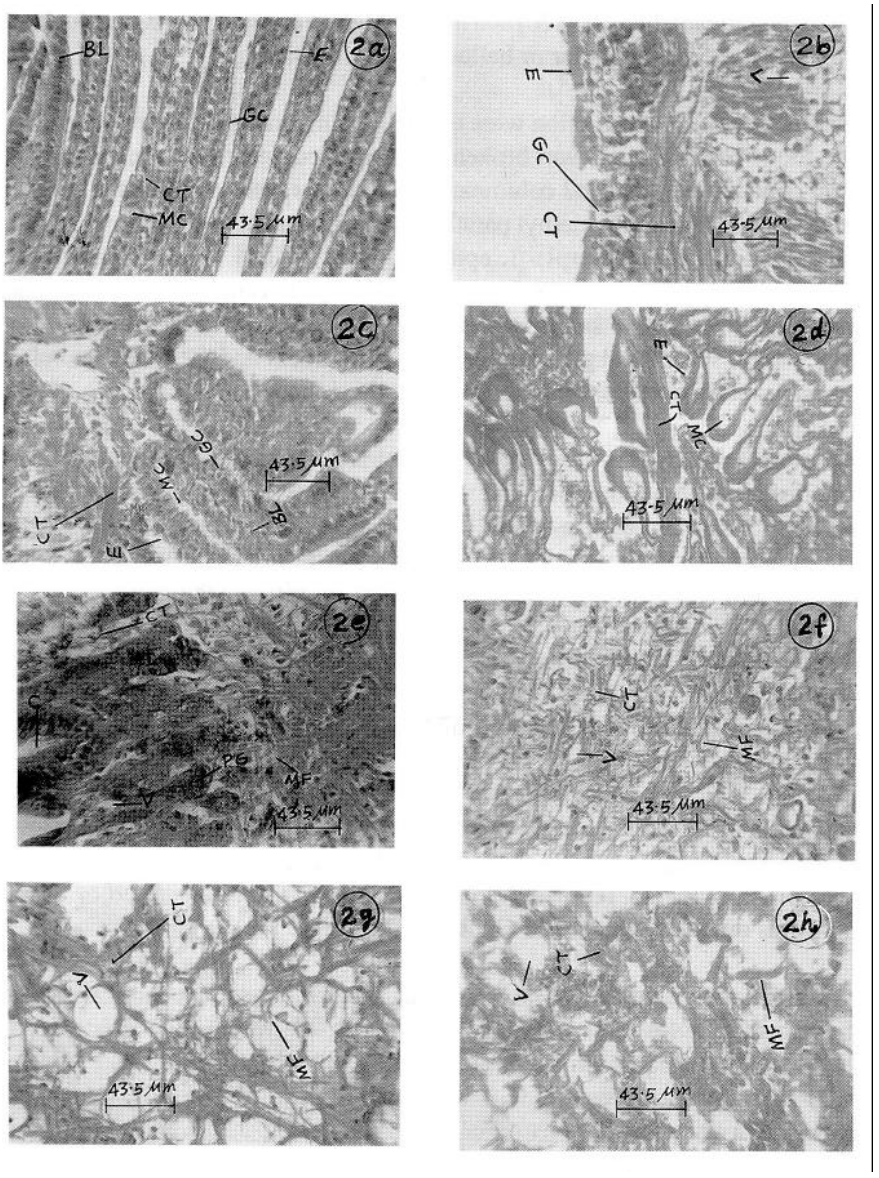

Figure 2. Transverse sections of mantle (Figs 2a to 2d) and foot (Figs 2e to 2h) of (a and e) control (unexposed) and after 96-hr exposure to 96-hr LC_{50} concentrations of (b and f) endosulfan, (c and g) methyl parathion, (d and h) nuvan (X250)

E - Epidermis; GC - Gland Cell; CT - Connective Tissue;
MC - Mucocyte; BL - Blood Lacuna; MP - Muscle Fibers;
V - Vacuole.

together. Hence,it is essential to study the toxicological effects, changes in metabolism and biochemical constituents before arriving at a definite conclusion in the toxicity of the compound.

Acknowledgments. The financial support given by the Council of Scientific and Industrial Research, New Delhi, India was gratefully acknowledged.

REFERENCES

Dikshit TSS, Behari JR, Datta FK, Mathur AK (1975) Effect of diazinon in male rats. Histopathological and biochemical studies. Environ Physiol Biochem 5:293-299

Gupta PK, Gupta RC (1977) Effect of endosulfan pretreatment on organ weights on pentoparpital hypnosis in rats. Toxicol 7:283-288

Mane UH, Kachore MS, Pawar SS (1979) Effect of pesticides and narcotants on bivalve mollusc. Proc 6th Europe Malac Congr Malacologia 18:347-360

Mathiessen P, Fox PJ, Douthwaite RJ, Wood BA (1982) Accumulation of endosulfan residues in fish and their predators after aerial spraying for the control of Tsetse fly in Botswana. Pestic Sci 13:39-48

Muley DV, Mane UH (1990) Histopathological changes in body parts of the freshwater gastropod, Vivinarus bengalensis Lam. due to pesticides J Environ Biol 11:413-425

Padmaja K, Nagalakshmi P, Rao MB (1988) A comparative evaluation of the toxicity of metacid (methyl parathion), quinalphos and nuvan (DDVP) to the fresh water snail Bellamya dissimilis Müller. Indian JComp Anim Physiol 6:34-38

Padmaja K, Rao MB (199 1) The effect of metacid and endosulfan on the respiration of thefreshwater snail Bellamya dissimilis Müller. Indian J Comp Anim Physiol 9: 108-111

Padmaja RJ, Rao MB (1994) Effect of an organochlorine and three organophosphate pesticides on glucose, glycogen, lipid and protein contents in tissues of the fresh water snail Bellamya dissimilis Müller. Bull Environ Contam Toxicol 53: 142-148

Rao DMR, Devi AP, Murty AS (1980) Relative toxicity of endosulfan, its isomers and formulated products to the fresh water fish Labeo rohita. J Toxicol Environ Hlth 6:825-834

Rashatwar SS, Ilyas IC (1984) Effect of phosphomidon in a fresh water teleost fish -Nemachelius denisonii Day - Histopathological and biochemical studies. J Environ Biol 5:1-8

Roberts M, Boyce CBL (1972) Principles of bioassay. In Methods in Microbiology (Ed.J.R.Narris and D.W.Ribbons). Academic Press London 7A: 153-190

Rodriguez EM, Schuldt M Romano L (1994) Chronic histopathological effects of parathion and 2,4-D on female gonads of Chasmagnathus gravulata (Decapoda, Brachyura) Fd Chem Toxic 32:811-818
Snedcor GW, Cochran G (1967) Statistical methods. The IOWA State University Press Ames IOWA USA 593 pp
Wayman DH, Kurt H, Thomas MC (1978) Fate of endosulfan in rats and toxicological considerations of apolar metabolites. Pestic Biochem Physiol 3:251
Weesner FM (1968) General Zoological Microtechniques The Williams and Wilkin Company Baltimore. 228 pp