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Short Communication

Toxicity of certain pesticides to some freshwater fishes

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Abstract

Static bioassay to study the toxicity of BHC, DDT, Dieldrin and Aldrin to freshwater fishes, *Heteropneustes fossilis, Cyprinus carpio* and *Channa punctatus* was carried out under laboratory conditions. The 24-, 48- and 96-h LC_{50} values with confidence intervals, slope function values and correlation coefficient were calculated. The 96-h LC_{50} of BHC, DDT, Dieldrin and Aldrin were 4.00, 0 0076, 0.008 and 0.150 mg l^{-1} for *H. fossilis*, 2.2, 0.0024, 0.0097 and 0.0185 mg l^{-1} for *C. carpio* and 4.6, 0.049, 0.018 and 0.024 mg l^{-1} for *C. punctatus*, respectively. BHC was found to be the least and DDT the most toxic of the pesticides tested.

Key words: Toxicity, pesticides, freshwater fishes.

1. Introduction

Discharge of a variety of wastes, both domestic and industrial, spoils water quality. Pesticides used extensively in agriculture, forestry, public health and animal husbandry find their way into the aquatic systems through surface runoff from land and pose a constant threat to the non-target organisms such as fishes, prawns, crabs, etc., and alter their habitat (Barret and Drannel[1]), growth and nutritional value (Johnson and Davenport[2]), behaviour pattern (Arunachalam *et al*[3]), cellular morphology (Mukhopadhyay *et al*[4]) and physiology (Natarajan[5]). The present investigation reports the comparative toxicity of certain pesticides to some freshwater fishes collected from Etawah district in Uttar Pradesh.

2. Materials and methods

The test fishes, *H. fossilis, C. carpio* and *C. punctatus* were obtained from local fishermen of Etawah District. The size of the test fishes selected for the study was about 12±2cm (total length). They were dipped in 0.1% potassium permanganate solution for dermal disinfection (if any) and were acclimated in aquaria for 10 days before transferring to the experimental aquaria. During the period of acclimation, the fishes were fed daily with fish food and were also provided with trash fish flesh. Commercial BHC, DDT, Dieldrin and Aldrin obtained from local suppliers were

used to evaluate the toxicity. The purity of these pesticides was determined by employing GLC and electron capture detector. The media were prapared using the required quantity of insecticides and tap water. Physico-chemical characteristics of the media water were analysed following standard methods (APHA *et al*[6]) and were as follows: temperature 28±1°C; pH 7.4–8.4; dissolved oxygen 5.8–7.4 mg l^{-1}; total alkalinity 140.0–170.0 mg l^{-1} and total hardness 120.0–160.0 mg l^{-1}.

Static bioassay studies were carried out in glass aquaria holding 12 fish in 10 l of water of the desired concentration of each pesticide. The medium was renewed once every 24 h. The height of the water column maintained in the glass aquaria was about 10 inches from the base. The number of dead fishes was recorded at 24, 48 and 96 h. In all, three replicates were used and LC_{50} values were calculated according to Sitchfield and Wilcoxon[7].

3. Results and discussion

During toxicity tests, fishes exhibited varying responses. For instance, with BHC, which was found to be the least toxic, the fishes tended to be lethargic. In the case of DDT and Dieldrin, they appeared to be quite agitated and made active and brisk movements. Nunogawa *et al*[8] have indicated BHC to be the least and DDT and Dieldrin to be the most toxic. Normally the fishes visit the water surface within a period of 10 minutes. Gills of all the three fishes were severely affected and the exposure to pesticide induced quicker opercular movements. The two air-breathing fishes, *H. fossilis* and *C. punctatus* visited the surface more frequently. In *C. carpio*, as the period of exposure went on increasing, the nervous coordination appeared to indicate an acute stress and consequently the surfacing frequency was also reduced. They showed arching of the body which is quite obvious in the case of *H. fossilis* and *C. carpio* than in *C. punctatus*. Loss of balance was observed in all the cases initially but a few fishes recovered for a shortwhile and started swimming normally. Thereafter, the fishes settled at the bottom appearing completely exhausted. From the LC_{50} values given in Table I, it can be seen that Aldrin is more toxic to *C. carpio* than *H. fossilis* and *C. punctatus* with regard to 24- and 48-h exposure. But 96-h exposure of *H. fossilis* showed more sensitivity to Aldrin followed by *C. carpio* and *C. punctatus*. The toxicity increased with contact time in each case. *H. fossilis* was found to be the most resistant to the pesticides, *C. carpio* the most sensitive and *C. punctatus* in between.

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Table I

LC_{50} (95% confidence limit), slope function, toxicity and correlation coefficient values of (a) *H. fossilis*, (b) *C. carpio*, and (c) *C. punctatus* exposed to pesticides

Time (h)	*95% Confidence limit*			*Slope function*			*LC_{50} (mg/l)*			*Correlation coefficient(r)*		
	a	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*
						BHC						
24	9 24–9 96	2 45–3 19	7 32–9 184	1 125	1.605	1.494	9.60	2.80	8 2	0 9469	0 9182	0 6467
48	6.03–6.46	2.32–2.91	5.89–6 94	1 15	1.45	1.30	6 25	2 60	6 4	0.9141	0 9516	0 9227
96	3.72–4.3	1 98–2 44	3.83–5.52	1 20	1 43	1 742	4 00	2.2	4.6	0 9338	0 9824	0 9873
						DDT						
24	0 0184–0 028	0.0187–0 033	0.071–0 089	2 13	2 28	1 46	0.023	0 025	0 080	0.9591	0 9439	0 9024
48	0 0122–0 0175	0.0062–0 0078	0.064–0.080	1 71	1 373	1 131	0 014	0 007	0 072	0.8252	0 9972	0 7967
96	0.0064–0.0089	0 0019–0.0030	0 042–0.057	1 594	2 043	1 71	0 0076	0 0024	0 049	0.9372	0.9430	0 9358
						Dieldrin						
24	0.038–0.053	0 0146–0.0175	0 043–0.046	1.053	1 20	1 10	0.045	0 0165	0 045	0 9765	0 9863	0.7260
48	0.016–0 024	0.0138–0.0150	0.0279–0 034	1.65	1.186	1.36	0.020	0.0145	0 031	0 9024	0 9600	0.9458
96	0.0061–0 0104	0 0085–0.0110	0 016–0 019	2 08	1.414	1 30	0.008	0 0097	0 018	0 8290	0.8662	0.8155
						Aldrin						
24	0.036–0 0511	0.0244–0 027	0.069–0.096	1 819	1.215	1 702	0 043	0 026	0.082	0.9267	0 7690	0 8326
48	0.0198–0.029	0.018–0.022	0.034–0 069	1.660	1.339	2 69	0 024	0 020	0 049	0 7783	0 8972	0.9723
96	0.0120–0.0186	0.0173–0.0197	0.02–0 030	1.53	1.211	2 53	0 150	0.0185	0 024	0 9325	0 9025	0.9512

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