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Bioconcentration of Endosulfan and Monocrotophos by *Labeo rohita* and *Channa punctata*

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Circulation of pesticides in a water body leads to accumulation in silt, zooplankton, algae and aquatic plants and fish. Upon uptake by the organisms, pesticides rapidly spread in them becoming selectively accumulated in different organs of the body. Many pesticides that enter the organisms undergo chemical transformation to form metabolites. The ability to biotransform pesticides by fish have been reported by studies of Baker *et al.*, (1963), Creanen *et al.*, (1965), Ludke *et al.*, (1972) who have established the fact that fishes possess mixed function oxygenase systems. Many laboratory studies have been carried out by researchers like Shannon (1977), Muir & Grift (1981), Maslanka *et al.*, (1991), Schlenk *et al.*, (1992), Barron *et al.*, (1993), Tsuda *et al.*, (1994), Galassi *et al.*, (1994), Sancho *et al.*, (1998). Bioconcentration of hazardous substances causes serious ecological problems when the degree of partitioning of a substance or its transformation products results in translocation to, and storage in, critical tissues of the organism.

Laboratory studies to assess the potential hazard of endosulfan (an organochloride) and monocrotophos (an organophosphate) for their persistence, accumulation and transformation in the fish *Labeo rohita* and *Channa punctata* have been carried out.

MATERIALS AND METHODS

Juveniles of *L. rohita* annd *C. punctata* obtained from local fish seed farms were acclimatised to laboratory conditions for a period of one week. Fishes weighing 6-7 g and measuring 7-8 cm were used for the study. The Organisation for Economic Cooperation and Development (OECD, 1981) guidelines have been followed for the bioconcentration studies. Concentrations of 0.1414 µg/l and 0.2274 mg/l for levels of endosulfan and monocrotophos were chosen as test concentrations. Ten juveniles of each group of fish were placed in test chambers (80 l capacity) and experiments in duplicate were carried out for a period of one month. At the end of the experimental period, whole body analysis for residues and metabolites of both the pesticides were determined for *L. rohita* and *C. punctata*.

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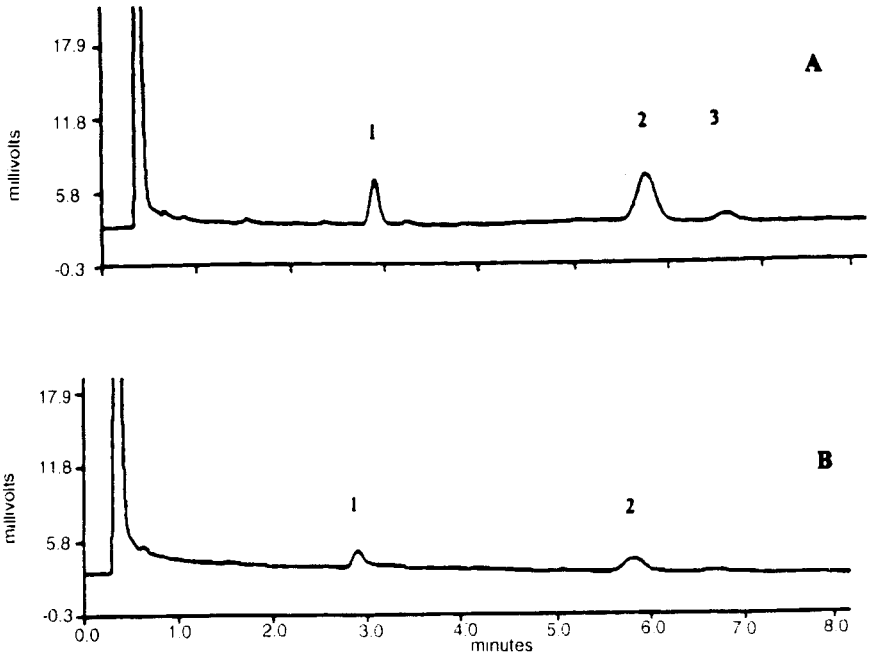
For each sample 50 g was placed in a 500 ml stoppered conical flask to which 125 ml of acetonitrile and 30 ml of petroleum ether were added and shaken on a mechanical shaker for 2 hrs. The contents were filtered and the filtrate was partitioned in 2×125 ml petroleum ether. Prior to clean-up the volume of petroleum ether was reduced to 25 ml on a rotatory evaporator. A Florisil column topped with 10 g of sodium sulphate was used for clean-up and eluted with eluting mixtures of 6% and 15% diethyl ether in 50 ml petroleum ether for endosulfan and monocrotophos respectively. The eluants were evaporated to dryness on a rotatory evaporator. The residue was dissolved in 5ml iso-octane and analysis was carried out with Perkin Elmer Gas Chromatograph with Dual EC (ColumnH-608[30m×0.53mm×1.0µm]; Injector-250 °C; Detector-270 °C; Carrier gas - N_2 - 15 ml/min; for endosulfan: Column Temp.- 150 °C/2 min/6 min $^{-1}$/270 °C/3 min; for monocrotophos: Column Temp. 120 °C) . One blank run using distilled water and one recovery run by spiking standards to distilled water were performed. A 99% pure secondary standards of endosulfan and monocrotophos were used for calibration

RESULTS AND DISCUSSION

The results of qualitative and quantitative determinations of endosulfan and monocrotophos residues in fish *L. rohita* and *C. punctata* are shown in chromatograms as Figs. 1 & 2 respectively. The bioaccumulation and bioconcentration factors are presented in Table 1. From the Chromatograms for endosulfan (Fig.1) it is observed that endosulfan isomers as endosulfan A & B are persistently occurring in both the fish, and from Table 1 it is evident that bioconcentration of endosulfan B is greater compared to endosulfan A, whereas endosulfan sulfate is found as a metabolite in *L. rohita* only. From the Chromatograms for monocrotophos (Fig. 2.) it is evident that monocrotophos is found in the form of o-des methyl monocrotophos, hydroxy methyl monocrotophos (Vettorazzi, 1976) which are metabolites and monocrotophos as such in both groups of fish.

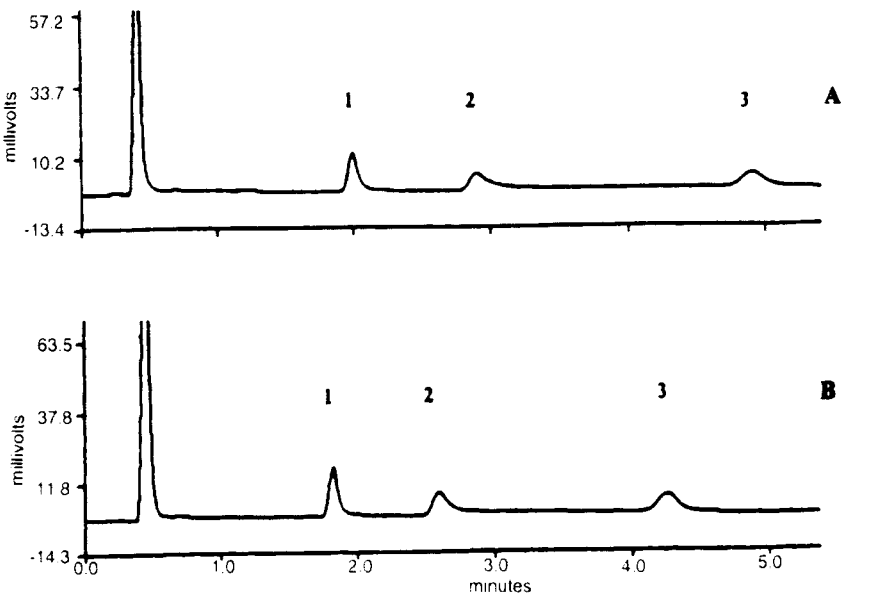
The results reveal that the isomers of endosulfan persisted in the fish, since technical endosulfan is a mixture of two stereo isomers of endosulfan 'A' and endosulfan 'B' (Lindquist & Dahm, 1957). It is also reported that endosulfan is poorly metabolised and is mostly converted to endosulfan sulfate (Rao *et al.*, 1982) and is as toxic as the technical material.

Bioconcentration factors give us an idea of the relative uptake of the substance from its medium by the organisms. From the results of the bioconcentration factors, it is evident that the accumulation of endosulfan is more in *L. rohita* and accumulation of monocrotophos is more in *C. punctata* which explains the reason for variation in the acute toxicity (96 hr LC 50) of endosulfan and monocrotophos to *L rohita* and *C. punctata* (Rao, Ramaneswari, 2000).



1.endosulfan-A 2.endosulfan-B 3.endosulfan sulfate

Fig 1.Chromatograms showing endosulfan and its metabolites in A)*Labeo rohita* B)*Channa punctata*



1. o-desmethyl monocrotophos 2.hydroxymethyl monocrotophos 3.monocrotophos

Fig 2.Chromatograms showing monocrotophos and its metabolites in A)*Labeo rohita* B)*Channa punctata*

Table 1. Bioconcentration and bioconcentration factors of endosulfan, monocrotophos and their metabolites in *Labeo rohita* and *Channa punctata*

	Bioconcentration		Bioconcentration factors	
	Labeo Rohita	*Channa punctata*	*Labeo Rohita*	*Channa Punctata*
Endosulfan-A	5.2±2.3	1.8±0.82	37.5	13.2
Endosulfan-B	7.7±3.4	11.8±5.3	55.4	13.4
Endosulfan sulfate	0.54±0.2	-	-	-
o – desmethyl monocrotophos	0.54±0.2	0.98±0.43	-	-
hydroxy methyl monocrotophos	0.59±0.2	1.18±0.52	-	-
monocrotophos	0.38±0.2	0.51±0.22	1.68	1.33

All values in µg/g

Uptake and bioconcentration of endosulfan is greater than that of monocrotophos. This finding is in agreement with Statham *et al.* (1976) who reported that uptake organochloride pesticides by fish is rapid and their elimination is slow. Further Lockhart *et al.*, (1973), Gray & Knowles (1980) have reported that organophosphate and carbamate compounds, due to their relatively higher water solubility, in general are taken up to a lesser extent than organochlorines and are eliminated faster.

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