

Metabolism of ^{14}C -DDT in *Pheretima posthuma* and Effect of Pretreatment with DDT, Lindane and Dieldrin

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Earthworms are known to accumulate DDT and its metabolites from the soil in varying degrees (YADAV et al., 1976 a). There have been very few reports regarding the metabolism of DDT in earthworms and even these are conflicting (EDWARDS and JEFFS, 1974; DAVIS, 1968, 1971 and STRINGER et al., 1970). In *P. posthuma* DDT and its metabolites have been found to be present with DDE being the major metabolite (YADAV et al., 1976 b). It was also observed that presence of lindane inhibits the uptake of DDT in the earthworms but the proportion of metabolites found was more. However, it is not clear if this increase in DDT metabolites is due to a selective pickup from the soil or an accelerated rate of metabolism. Therefore, a study was undertaken on the metabolism of ^{14}C -DDT and the effects of pretreatment with DDT, lindane or dieldrin on DDT metabolism in *P. posthuma*.

MATERIALS AND METHODS

Earthworms were collected from Delhi University Campus and acclimatized to the laboratory conditions for one week. Standard solutions, 1 mg/ml (w/v) of p, p'-DDT, lindane and dieldrin were prepared in acetone and mixed in soil with an atomizer to give a concentration of 1 ppm of the insecticide. Twenty healthy earthworms were transferred to the pots containing 5 kg each of the treated soil and left there for one week. At the end of the week the earthworms were taken out of the treated soil and injected intraprostomially with 0.1 μCi of C^{14} -DDT (Sp. activity 19.1 mCi/mM) and transferred to petri dishes lined with moist filter paper. At the same time untreated earthworms were also injected with ^{14}C -DDT as controls. Earthworms were kept in deep freeze at zero time, 12 hrs and 24 hrs after DDT injection. The samples were extracted and purified as described elsewhere (YADAV et al., 1976 a, b). The containers were rinsed with a total of 200 ml acetone for excretory products. Purified samples were applied on TLC plates coated with silica gel G along with the standards and the areas corresponding to DDT, DDD and DDE spots were scrapped and extracted with hexane into vials. The samples were evaporated to dryness, re-dissolved in 0.5 ml of cyclohexane and 12 ml of scintillation fluid consisting of

RESULTS AND DISCUSSION

When the earthworms were treated with ^{14}C -DDT only, it was found that 12 hours after treatment, DDT was metabolized to p, p'-DDE and p, p'-DDD, the proportions being 18.9 and 17.6% of the total (Table 1). This shows clearly that the earthworms, *P. posthuma* is able to metabolise DDT to DDE and DDD. The same metabolites have been detected earlier in earthworms (YADAV et al., 1976 b and STRINGER et al., 1970). After 24 hours, the same metabolites were present, but there was a slight decrease in the quantities of DDT and the metabolites (Table 1), perhaps due to excretion by the earthworms. In earthworms pretreated with DDT, the total percentage of metabolites was the same as in the previous case, except that DDE was the predominant metabolite. In 24 hours, DDE accounted for about 59% of the label, while DDT and DDD accounted for 25 and 16% respectively. The pretreatment of earthworms resulted in an accelerated metabolism of DDT compared with the controls. Pretreatment with lindane showed again the same metabolites i.e. DDE and DDD which accounted for 19 and 26% of the total 12 hours after treatment. Here also there was an acceleration in the rate of metabolism as found earlier by YADAV et al. (1976 b). An acceleration of lindane metabolism was observed in rats pretreated with DDT or lindane (CHADWICK and FREAL, 1972). At 24 hours after treatment, the total DDT content was reduced to about one sixth (Table 1), apparently because of rapid excretion. A different earthworm, *Lumbricus terrestris*, is known to excrete DDT and its metabolites very rapidly when they are kept in an insecticide free environment (EDWARDS and JEFFS, 1974). YADAV et al. (1976 b) had earlier reported that earthworms pick up less DDT from soil treated with DDT and lindane. This rapid excretion of DDT may be a reflection of the same trend (Table 2).

As observed in the case of pretreatment with DDT and lindane, ^{14}C -DDT was metabolized faster when the earthworms were pretreated with dieldrin. At 12 hours after treatment the percentage of DDT, DDE and DDD

TABLE 1

Per cent DDT and its metabolites recovered in *Pheretima posthuma* 12 to 24 hours after an intraprostomial injection of 0.1 μ Ci ^{14}C -DDT per earthworm pretreated with DDT, lindane or dieldrin

		DDT	DDE	DDD
Control	12 hr.	36.5 (63.5)*	10.8 (18.9)	10.1 (17.6)
	24 hr.	33.2 (65.1)	10.1 (19.7)	7.7 (15.1)
Pretreatment with DDT	12 hr.	43.6 (68.5)	11.7 (18.3)	8.4 (13.2)
	24 hr.	13.4 (24.9)	31.5 (58.6)	8.8 (16.4)
Pretreatment with Lindane	12 hr.	42.2 (55.2)	14.5 (18.9)	19.7 (25.8)
	24 hr.	6.0 (44.1)	2.9 (21.4)	4.7 (34.6)
Pretreatment with Dieldrin	12 hr.	26.5 (43.9)	24.2 (39.9)	9.7 (16.1)
	24 hr.	25.9 (57.2)	8.4 (18.6)	11.0 (24.2)

* per cent of total ^{14}C -DDT recovered.

TABLE 2

Per cent DDT and its metabolites excreted by *Pheretima posthuma* in 12 to 24 hours after an intraprostomial injection of 0.1 μ Ci 14 C-DDT per earthworm pretreated with DDT, lindane or dieldrin

		DDT	DDE	DDD
Pretreatment with DDT	12 hr.	19.1 (80.4)*	2.1 (8.8)	2.6 (10.8)
	24 hr.	20.9 (79.3)	2.6 (9.9)	2.8 (10.7)
Pretreatment with Lindane	12 hr.	6.3 (79.6)	0.5 (6.4)	1.1 (14.0)
	24 hr.	17.1 (79.7)	1.2 (5.6)	3.2 (14.7)
Pretreatment with Dieldrin	12 hr.	17.0 (78.3)	2.6 (11.5)	2.3 (10.2)
	24 hr.	18.1 (73.0)	3.6 (14.6)	3.1 (12.4)

* per cent of total 14 C-DDT recovered.

was 44, 40 and 16 % respectively, while 24 hours later, it was 57, 19 and 24. Thus it is seen that pretreatment with DDT, lindane and dieldrin accelerates the DDT metabolism.

Table 2 presents the data on the excretion of 14 C-DDT by the earthworms. It is seen that measurable quantities of DDT as well as its metabolites are excreted by the earthworms in 12 hours after treatment. The DDT is the major component of the excreta constituting 73 to 80 % of the total followed by DDE and DDD. With an increase in time to 24 hours, the quantity excreted also increased. EDWARDS and JEFFS (1974) have reported that earthworms (*L. terrestris*) containing DDT and DDE when kept in clean soil, excreted DDT within three weeks but DDE was much more persistent. A fresh water snail,

Vivapara heliciformis was shown to excrete DDT and its metabolites very rapidly when the snails were transferred to clean water (YADAV et al., 1976 a)

REFERENCES

- CHADWICK, R.W. and J.J. FREAL : *Fd. Cosmet. Toxicol.* 10, 789 (1972).
- DAVIS, B.N.K. : *Ann. Appl. Biol.* 61, 29 (1968).
- DAVIS, B.N.K. : *Soil Biol. Biochem.* 3, 221 (1971).
- EDWARDS, C.A. and K.A. JEFFS : *Nature (London)* 47, 157 (1974)
- STRINGER, A., C.H. LYONS and J.A. PICKARD : *Rept. Agr. Hort. Res. Stn. Univ. Bristol*, 1969, p. 98 (1970).
- YADAV, D.V., H.C. AGARWAL and M.K.K. PILLAI : (1976 a unpublished data).
- YADAV, D.V., M.K.K. PILLAI and H.C. AGARWAL : *Bull. Environ. Contam. Toxicol.* 16, 541 (1976 b) .