Uptake, Metabolism and Excretion of DDT by the Fresh Water Snail, *Vivipara heliciformis*

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Among molluscs there are many reports on the accumulation of organochlorine insecticides in the terrestrial gastropods (THOMPSON, 1973), but very few in the aquatic snails (DINDAL, 1970). These animals are nontarget organisms for the above insecticides, however, the accumulation of DDT and other organochlorine insecticides in them becomes important as they are predated upon by various vertebrates The terrestrial snails accumulate DDT like earthworms but there is no data available on its excretion. Thus an investigation was undertaken with the common fresh water snail of Delhi viz, Vivipara heliciformis on the uptake, metabolism and excretion of DDT.

Materials and Methods

The snails for the present work were collected from a pond in Delhi University Campus and kept in an aquarium (60 x 30 x 30 cm) containing pond water and aquatic plants from the same pond . The snails were acclimatized to the laboratory conditions at least for one week.

A stock solution of DDT (1 mg/ml acetone) was prepared and this was mixed in pond water contained in aquaria so as to give DDT concentrations of 0.005, 0.01 and 0.05 ppm. The pH of the pond water was 7.0. For each concentration 40 snails were kept in an aquarium containing 30 litres of pond water. The water level in all the aquaria was maintained by adding appro - priate quantities of pond water regularly. Samples of water (100 ml) and snails (3 each) were removed for analysis initially after 24 hours and subsequently on alternate days for a period of 22 days. In case of the highest concentration (0.05 ppm) the samples were taken only for a period of 8 days. The remaining snails from this aquarium were transferred to another aquarium containing fresh pond water free of any added DDT in order to study their excretion. The samples of snails were removed after 24 hours and then on every third day for a period of 19 days. The DDT and its metabolites were extracted, processed and analysed as described earlier (YADAV et al., 1976).

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Results and Discussion

Uptake of DDT

The snails before the experiment were found to contain 0.178, 0.083 and 0.023 ppm p, p'-DDE, p, p'-DDT and p, p'-DDD respectively. The pond water also contained 0.024, 0.022 and 0.019 ppm DDE, DDT and DDD respectively.

The snails exposed to different concentrations of DDT accumulated the insecticide very rapidly (Fig. 1-3). In the lowest concentration i.e. 0.005 ppm the snails concentrated the DDT about 300 times in 24 hours whereas in 0.01 ppm it was about 325 times. However, in the highest concentration i.e. 0.05 ppm the initial accumulation was only about 76 times. The total DDT in the snails after 24 hours was 1.5, 3.25 and 3.78 ppm respectively in the three concentrations used. Terrestrial slugs have been reported to accumulate a maximum concentration of 70 ppm total DDT (STRINGER, 1966). In a terrestrial snail, Cepaea hortensis, DINDAL and WURZINGER (1971) reported very high levels of DDT after ingestion of lettuce treated with DDT unlike earlier studies in snails where the DDT residues were very low (GISH, 1970). In the present study the total DDT concentrations obtained were much lower than found in C. hortensis (DINDAL and WURZINGER, 1971). However, the concentration factor obtained in V. heliciformis was much higher than the ones reported in terrestrial slugs and snails (GISH, 1970).

There were two maxima of total DDT residue in all the three experiments (Figs. 1-3). DINDAL and WURZINGER (1971) also reported two such maxima in several tissues of a terrestrial snail. Similar two maxima trend has been reported in many aquatic organisms and this was explained to be due to an initial ingestion of DDT followed by a redistribution in the body (EBERHARDT et al., 1970).

The DDT concentration in the water in the three aquaria showed a rapid decline in the first 24 hours

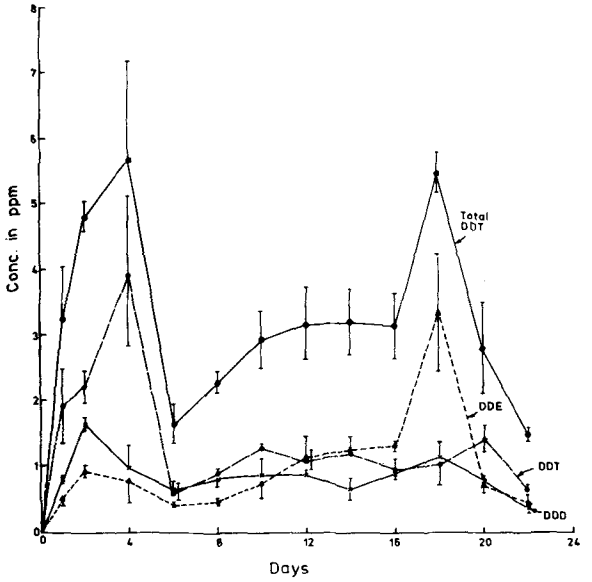

Fig. 1 DDT and its metabolites in snails exposed to 0.005 ppm DDT in water.

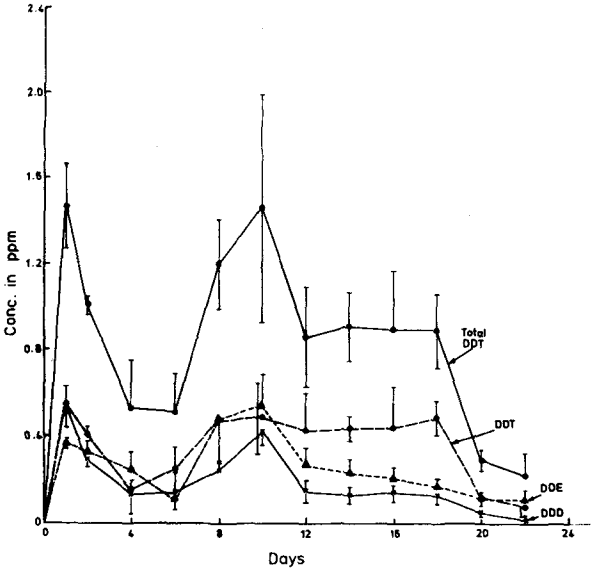

Fig. 2 DDT and its metabolites in snails exposed to 0.01 ppm DDT in water.

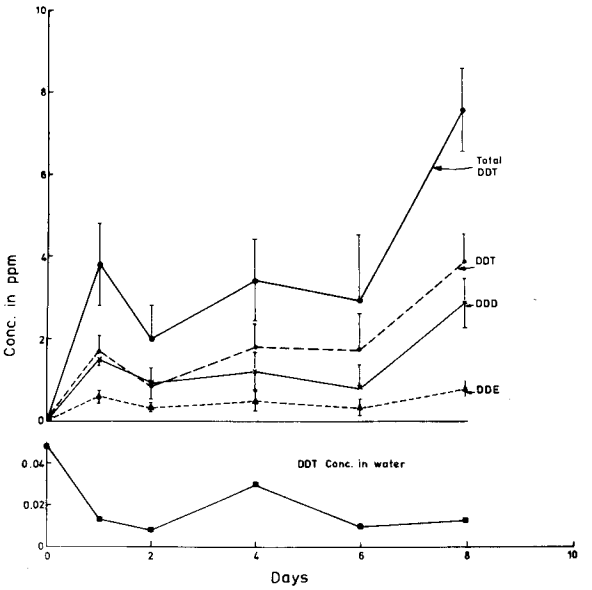

Fig. 3 DDT and its metabolites in snails(above) and water (below) exposed to 0.05 ppm DDT in water.

(Fig. 3 to 5). This was obviously due to the rapid pick up of DDT by the snails.

Metabolism of DDT

DDD and DDE were the only two metabolites detected in the snails. In the lowest concentration i.e 0.005 ppm, the snails contained slightlyhigher levels of DDE compared to DDD. In the higher concentrations i.e. 0.01 and 0.05 ppm the DDD was the major metabolite(Fig. 1 to 3). In terrestrial slugs and snails also, the same two metabolites were detected with DDD being the predominant one (DINDAL and WURZINGER, 1971 ; THOMPSON, 1973).

Significant amounts of DDT metabolites, DDD and DDE , appeared in the aquaria water from 14 days after the begining of the experiment in case of 0.005 and 0.01 ppm concentrations (Figs. 4 and 5). In both the cases initially there was more of DDE but DDD concentrations became more in about 8 days.

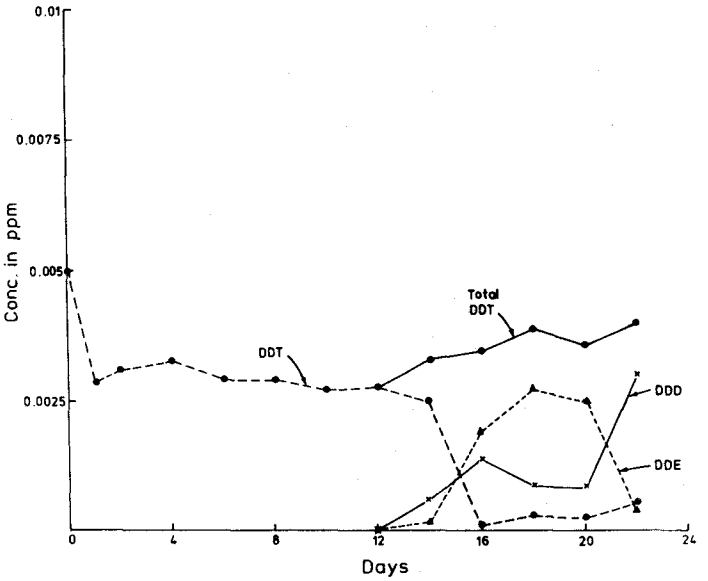

Fig. 4 DDT and its metabolites in water which contained snails and 0.005 ppm DDT initially.

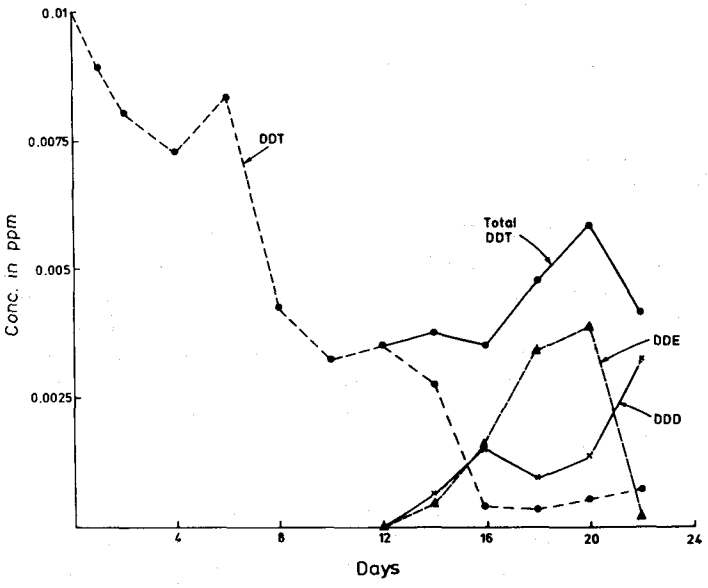

Fig. 5 DDT and its metabolites in water which contained snails and 0.01 ppm DDT initially.

At the highest concentration used i. e. 0. 05 ppm , no metabolites could be detected in water till the duration of the experiment (8 days).

Excretion of DDT

When the snails exposed to 0. 05 ppm DDT for 8 days, were transferred to an aquarium containing fresh pond water, the DDT and its metabolites were excreted very rapidly in the first 24 hours (Fig . 6) .

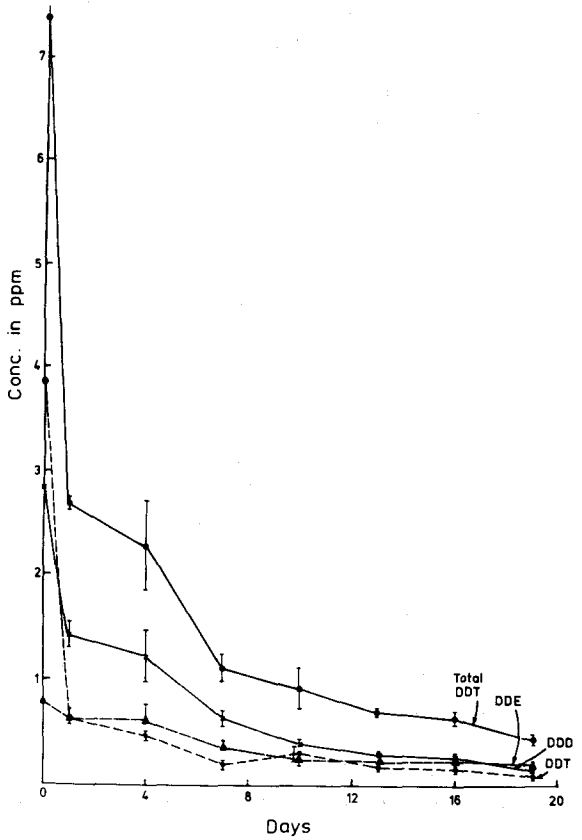

Fig. 6 DDT and its metabolites in snails transferred to water containg no added DDT after an initial 8 days exposure to 0. 05 ppm DDT .

About 75% of the total DDT in the snails was excreted within 24 hours and in 9 days the concentration in the snails was about 6% only. The rate of excretion of DDE was slow compared to DDT and DDD. In C. hortensis large quantities of DDT was excreted rapidly from 24 hours onwards through the faecal matter (DINDAL and WURZINGER, 1971).

The distribution pattern of DDT and its metabolites obtained in our experiments may not be entirely due to metabolism. It is possible that the metabolites may be reabsorbed from the water as snails are known to reingest their faeces, thus recycling the materials again (DINDAL and WURZINGER, 1971). It is evident from the present data that DDT and its metabolites can be easily eliminated from aquatic snails if the environment is freed of these pesticides.

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