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Absorption and Elimination of Lindane by *Asellus aquaticus* (Crustacea, Isopoda)

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Lindane is the only organochlorine insecticide still in use in France. Several recent studies showed the widespread contamination of temperate freshwater ecosystems by this insecticide (Kveseth 1981; Ramade et al. 1984; Thome 1984; Winger et al. 1984). In order to improve the knowledge of the mechanism by which the contamination of aquatic toxicities occurs, we studied the toxicity and bioaccumulation of lindane by Asellus aquaticus (Crustacea, Isopoda), which is a key species in freshwater trophic webs as a major source of food for many fishes (Rask and Hüsivuori 1985).

In this paper are described our main experimental data obtained about the toxicity and bioaccumulation of this insecticide into A. aquaticus.

MATERIALS AND METHODS

Experimental animals were collected in a pond located in the vicinity of our laboratory. The following physico-chemical parameters have been measured with a Hach set: pH = 7.5; total hardness 102 mg/L measured as $CaCO_3$; nitrites = 0.14 mg/L; nitrates = 16 mg/L; NH_4^+ = 1.1; chloride = 30 mg/L as NaCl.

Organisms were acclimated to the laboratory water with temperature = 18 ± 1°C; pH = 7.1; total hardness = 160 mg/L as $CaCO_3$; nitrite = 0.12 mg/L; nitrate = 19 mg/L; NH_4^+ = 0.33 mg/L; chloride = 41 mg/L as NaCl, for 3 weeks before experiments. The test animals were not fed during our experiments.

Acute toxicity of lindane (Pepro, 99.9 %) was determined in static test using 10 A. aquaticus in 250 mL of water kept at 18 ± 1°C. The physico-chemical parameters of water were the same as for acclimation. The compound dissolved in acetone (0.5 % maximum) was added to the flasks. After 24 and 48 h the number of dead animals was recorded. The LC50 was determined using a computer program developed in our laboratory (Probit method).

During the bioaccumulation study two types of experimentation were

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performed. In the experiment n°1 an acetone solution of lindane was diluted in 250 mL of water at concentration of 1, 2, 4, 8 or 10 µg/L. Ten A.aquaticus were confined in each flask. After a 48 h exposure, the animals were sampled and analysed. In the experiment n°2, five groups of ten A.aquaticus were put in 250 mL of water at concentration of 2 µg/L. Ten A.aquaticus were sampled and analysed every day during 5 days. Every day water samples were analysed.

In order to investigate elimination of lindane from the organism, Asellus aquaticus were exposed to 2 µg/L of lindane for 5 days and transferred to lindane-free water. Ten Asellus were sampled 1, 2 or 3 days after transfer for determination of lindane concentration in their tissue. The water analyses were also performed.

The water sampled was extracted by n-hexane and analysed by gas chromatography. Biological samples were ground with anhydrous sodium sulfate and n-hexane. The extracts were cleaned-up by florisil chromatography. Two successive elutions were performed, the first one with 20 mL n-hexane and the second one with 50 mL of n-hexane: diethyl ether (100:5 (V/V)). The second eluate of florisil column was analysed by gas chromatography equipped with 63 Ni detector (chromatograph GIRDEL 3000). The 2.10 m x 2 nm glass column was packed with 3% ov 225 on 100/120 chromosorb W-HP (column GIRDEL). The injector, column and detector temperatures were 250, 220 and 280°C, respectively. The carrier gas was AR:CH4 (90:10) at 60 mL/min (Carboxyque française, HP quality).

RESULTS AND DISCUSSION

The 24 and 48 h LC50 values obtained are shown in Figure 1. These data were in accordance with Ulman's results (1972). A comparison of these LC50 with data reported in the literature (Sanders and Cope 1966) for other species or previously obtained in our laboratory (Bluzat and Seuge 1979) showed that A.aquaticus sensitivity is similar to that of Chaoborus (LC50 = 8 µg/L) but higher than Cloeon (LC50 = 90 µg/L) or Gammarus (LC50 = 30 µg/L) but much higher than Daphnia (LC50 = 460 µg/L).

Figure 2 depicts the bioaccumulation of lindane by A. aquaticus as a function of the water concentration during 48 h exposure. We can observe a good correlation between residue levels in organisms and water concentration. A bioconcentration factor (concentration in organism / concentration in water) of about 50 was reached in our experiments. A bioconcentration factor of the same level was observed by Streit (1979) in Glossiphonia complanata.

We found a rapid uptake from water and bioconcentration of lindane by A. aquaticus. A plateau was reached on the third day after the beginning of experiments (Fig.3A). Under similar conditions the guppy reached equilibrum in 4 days (Yamato et al. 1983).

When we transferred the animals to lindane-free water, we observed a rapid elimination of this insecticide. For example, 24 h after transfert, 40 % of the initially bioconcentrated insecticide was

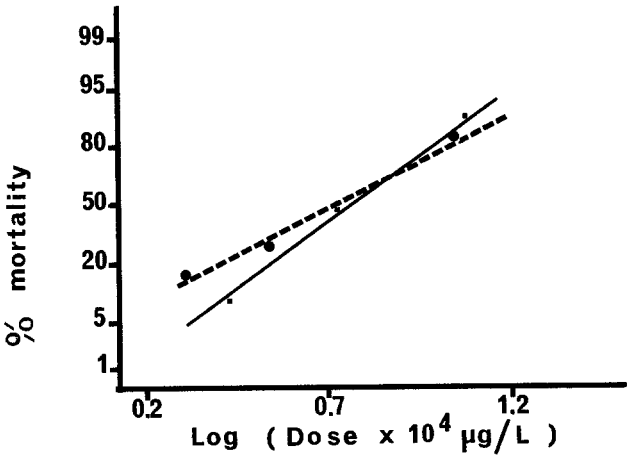

Figure 1. Mortality induced in the Asellus aquaticus population after exposure to different lindane concentrations in water (——— 24 h, ---- 48 h).

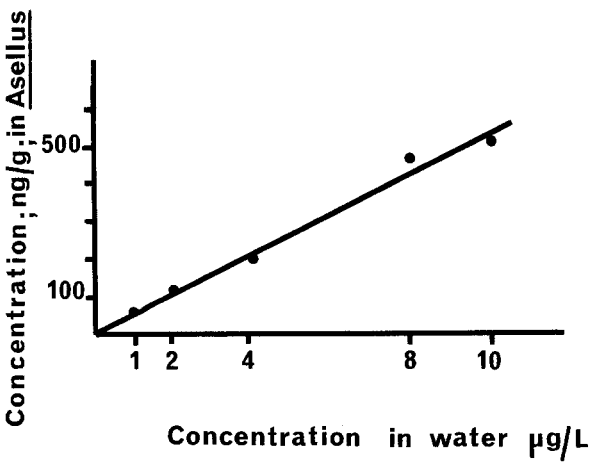

Figure 2. Bioaccumulation of lindane by Asellus aquaticus as a function of concentration in water.

eliminated by the organisms. A similar elimination was observed for Daphnia with chlordane, another organochlorine insecticide (Moore et al. 1977).

The lindane concentration measured in water is shown in Figure 3B. During the first five days a decrease of the lindane concentration in water can be observed. This decrease is correlated with the increase of insecticide concentration in Asellus. Other experiments carried out in our laboratory showed that the lindane concentration

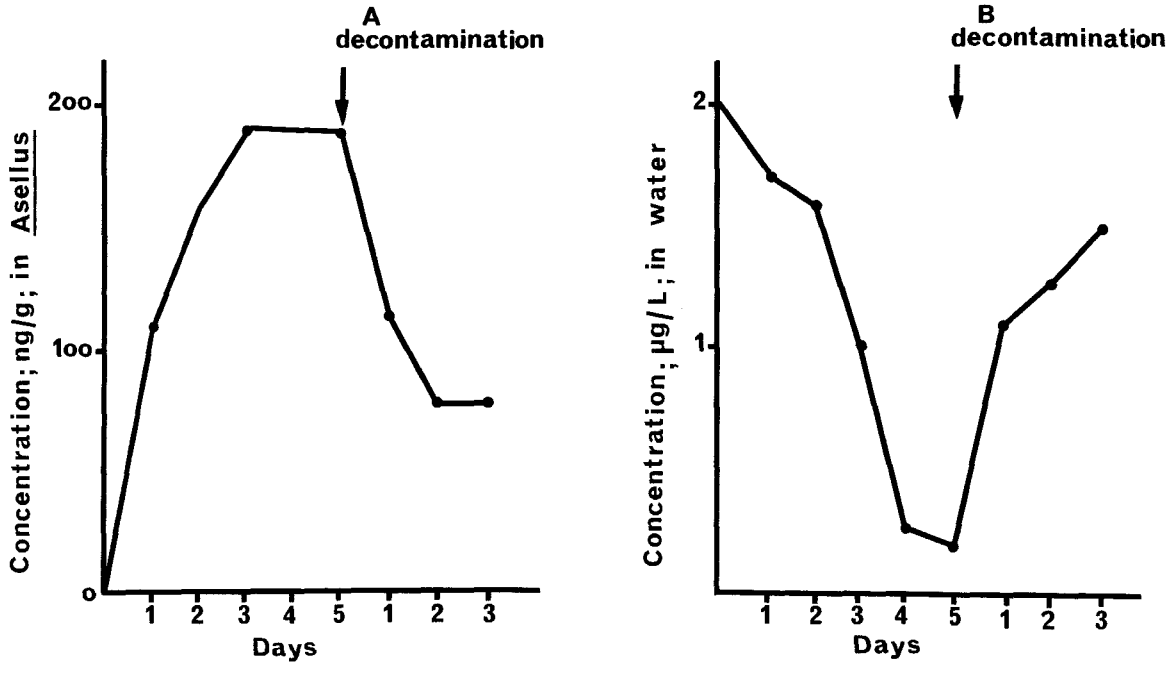

Figure 3. Bioaccumulation and elimination of lindane by Asellus aquaticus as a function of time (A: concentration in Asellus aquaticus , B: concentration in water)

in water was unchanged after 5 days in absence of Asellus. Conversely, when the animals were transferred to insecticide-free water, we observed an increase of the residue level in water. This research demonstrates the direct influence of insecticide absorbtion by Asellus on the depletion of pesticide from water.

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