Abstract. A ciliate protozoan, Tetrahymena pyriformis was exposed to three insecticides, dieldrin, dimethoate, and permethrin for 12 hr to study the uptake and bioconcentration potential. Ciliates concentrated 922, 3547, and 1056 μg g⁻¹ dry wt. over an initial concentration of 1 μg mL⁻¹ of dieldrin, dimethoate, and permethrin, respectively. The highest bioconcentration factor for three insecticides was 2095, 3547, and 1110, respectively. It is suggested that if levels in the environment reach 1 μg mL⁻¹ the chief effects would be reduction of cell population, and accumulation of the toxicants by ciliates. Accumulation of insecticides by ciliates would permit the toxicants to enter aquatic food chains. Thus the compounds could exert toxic effects at higher trophic levels.

1. Introduction

Very few results have been published on the uptake and bioconcentration of insecticides in protozoa (Gregory et al., 1969; Lal, 1984); despite the fact that protozoans occupy an important trophic level where accumulation and/or bioconcentration are potential problems (Cooley et al., 1972). Tetrahymena, a representative microfauna of aquatic ecosystem, plays an important role in the turnover of organic detritus. It is one of the most extensively studied eukaryote and a vast literature is available on virtually every aspect of its biology (Elliott, 1973). In the laboratory, it can be cultured axenically both easily and economically and therefore forms a suitable experimental tool. In this study an attempt is made to determine the uptake and bioconcentration potential of this ciliate towards three insecticides, each representative of three major classes, organochlorine (dieldrin), organophosphate (dimethoate) and a pyrethroid (permethrin). This is for the first time that uptake and bioconcentration of a pyrethroid insecticide in a ciliate protozoan is reported.

* Author for all correspondence.
2. Materials and Methods

2.1. CHEMICALS

All the three insecticides were a gift by Dr Robert E. Thompson, NSI, US Environmental Protection Agency, Triangle Research Park, U.S.A. Stock solutions of these insecticides were prepared in analytical grade acetone. The purity of each insecticide was more than 97%.

2.2. ORGANISM AND CULTURES

Stock cultures of *Tetrahymena pyriformis* (Syngen-I) was obtained from Dr J. G. Jones, Department of biochemistry, University of Hull, U.K. Subsequently the ciliates were maintained axenically in sterilized medium consisting of 1% proteose peptone (Difco) supplemented with 0.5% NaCl and 0.3% yeast extract (Difco). The pH of the medium was 7.0. Accumulation studies were carried out with culture grown in 15 mL centrifuge tubes containing 2 mL medium. Cultures were incubated for 72 hr in the dark in 27 ± 1 °C. Three mL of autoclaved medium were transferred to log phase cultures of *Tetrahymena* and treated simultaneously with appropriate amounts of each insecticide to give a final concentration of 0.1, 0.5, and 1 μg mL⁻¹ for dieldrin and permethrin and 1, 5, and 10 μg mL⁻¹ for dimethoate.

2.3. EXPERIMENTAL

*Tetrahymena* cultures were regularly sampled at an interval of 2 hr till 12 hr. At each sampling time *Tetrahymena* was inactivated by chilling and then centrifuged at 5000 rpm for 10 min. The supernatant was decanted and the pellet was washed thrice with distilled water. Cells were extracted for insecticides with 2 mL acetone. The acetone extract was completely evaporated and the residue was dissolved in hexane before analysis by gas liquid chromatography. Since the uptake was expressed in terms of dry weight, the washed pellet was transferred to boat shaped aluminium cups, dried at 80 °C for 12 hr and weighed. The quantitative and qualitative analysis of dieldrin and permethrin was performed with electron capture detector (Packard-438 GLC). The detector, injector and column temperatures were 250, 220, and 200 °C, respectively. Nitrogen at a flow rate of 40 mL min⁻¹ was used as the carrier gas. Dimethoate was analyzed with flame photometer detector (FPD) and the instrument was operated at temperatures 220, 220, and 200 °C for detector, injector, and column, respectively. The flow rate of carrier gas (N₂) was 15 mL min⁻¹ and for external gases (H₂ and air) it was 145 and 105 mL min⁻¹, respectively.

The bioconcentration factor was calculated as follows:

\[ \text{Bioconcentration factor} = \frac{\text{Insecticide concentration (μg g⁻¹ dry wt.) in the organism}}{\text{Initial insecticide concentration in the medium (μg mL⁻¹)}} \]