DDT Residues Associated with Cestodes from Mallard and Lesser Scaup Ducks

by DANIEL L. DINDAL and PAUL C. STROMBERG
Department of Forest Zoology, State University College of Forestry, Syracuse, New York

Objectives

While studying the experimental accumulation and excretion of Cl^{36} DDT in the tissues of wild waterfowl, tapeworm specimens (Cyclophyllidea: Hymenolepididae) were collected and analyzed for DDT residues. Therefore, the purpose of this investigation was to determine if DDT residues were associated with the tapeworms found in ducks having known pesticide residue levels.

Methods

In 1964 radioactively ring-labeled chlorine-36 DDT was applied at the rate of 0.2 lb/A to a 4-acre marsh near Lake Erie, Port Clinton, Ohio. During the following 2-year period wild mallard and lesser scaup ducks were exposed, collected, and their tissues analyzed for pesticide residues.

After various periods of exposure, ducks were captured and frozen immediately in the field. Therefore the cestodes were not fixed properly and identification beyond the fmaily level was impossible. Specimens remained frozen until thawed during dissection in the laboratory. At that time, the intestines were evacuated and tapeworm masses from 16 ducks were separated from intestinal contents, washed and radioassayed. Tapeworm masses from 8 non-exposed ducks also were assayed for background radiation. A one-tailed t distribution was used to determine the 99% confidence level for maximum background calculations.

Ring-labeled Cl^{36} DDT was analyzed by liquid scintillation spectrometry (LSS) permitting the identification of the total DDT residues present in tissues which originated from our application. Tapeworm specimens were solubilized with hydroxide of hyamine 10-X in a glass scintillation vial for radioassay. Each sample was counted for 100 minutes in a Packard Tri-Carb Scintillation Spectrometer Model 3003. The scintillation solution as recommended by Hayes (1963) consisted of 2,5 diphenyloxazole (PPO) and 1,4 bis-2(4-methyl-5 phenyl-oxazole)benzine (Dimethyl POPOP) in spectrograde toluene.

Since tapeworm masses weighed about 100 mg each, only radioassay by LSS was carried out routinely. Insufficient material was available to also analyze each tapeworm mass by gas-liquid

Bulletin of Environmental Contamination & Toxicology,
Vol. 5, No. 1, 1970. published by Springer-Verlag New York, Inc.

chromatography (GLC). With these limited cestode masses, only 1 sample was analyzed with GLC. However, all duck tissues were being tested concurrently and positive verification of LSS by GLC and thin layer chromatography (TLC) provided valid evidence (Dindal and Peterle (1)) and therefore acceptance of LSS results from all tapeworm samples.

Sample extraction and clean-up for GLC followed methods described by Faubert Maunder et al. (2). Hexane extracts were analyzed in a Barber Colman Gas Chromatograph Series 5000 equipped with a 6-foot glass column. Column packing consisted of a support of Anakrom-ABS (60/80 mesh) with a liquid phase of 1.5% (by wt.) SE52. Operational temperatures were: flash heater (injector) 230 C, column 215 C, and detector 225 C. DDT metabolites were further verified by TLC.

Results

Radiotagged DDT residues were found associated with 11 of the 16 tapeworm samples analyzed by LSS (Table 1). The single qualitative evaluation by GLC showed the presence of DDE associated with tapeworms. Some DDT residue was found in 10 or 12 tapeworm masses obtained from lesser scaup. Only 1 tapeworm sample from mallards contained detectable concentrations; however the mallards sampled were very low. In addition, Table I presents the DDT residue concentrations in contents of the intestinal tracts from which cestodes were collected. This, therefore, represents the residue concentrations within the immediate environment of the tapeworm.

Discussion

We have no data to show if tapeworm cuticle or parenchyma is the specific site of DDT residue accumulation. The lipophilic nature of DDT has been well documented, and since Von Brand (3) states that the most important storage organ of lipids in tapeworms is the parenthyma, this tissue appears the most probable site of DDT concentration. In summarizing lipid content of cestodes, Von Brand lists 9.5-34.6% lipid (dry tissue wt) in Hymenolepsis diminuta, with phospholipid comprising 26% and saturated and unsaturated fatty acids at 69% total lipids. Also, an increasing gradient of lipid content in Hymenolepsis diminuta occurs along the strobila with immature proglottids (Von Brand (3)).

The above summary suggests several possible interrelationships. The presence of tapeworms may provide a site of pesticide accumulation which could reduce that absorbed by the duck, or provide a site for absorption of residues reintroduced into the intestinal lumen via the bile of the host. Also, pesticide excretion could be facilitated as gravid proglottids with high lipid content are sloughed off and expelled with the feces of the duck.

Table I

Total DDT residues associated with tapeworms (Hymenolepididae) and intestinal contents from wild ducks exposed to 0.2 lb/A Cl^{36} DDT for 15 to 45 days.

	Means ± S.E. (ppm DDT residues)	
Species	Tapeworms	Intestinal contents
MALLARD n = 4	0.40 ± 0.40	1.56 ± 0.91
LESSER SCAUP n = 12	0.93 ± 0.15	1.34 ± 0.63
COMBINED: MALLARDS AND LESSER SCAUP n = 16	0.80 ± 0.3	1.40 ± 0.51

Literature Cited

1. DINDAL, D.L. and PETERLE, T.J. Bull. Environm. Contam. and Toxicol. 3, 37 (1968).

2. deFAUBERT MAUNDER, M.J., EGAN, H., GODLY, E.W., HAMMOND, E.W., ROBUM, J. and THOMSON, J. The Analyst 89, 168 (1964).

3. VON BRAND, T. Biochemistry of Parasites, p 206 (1966), Academic Press, New York.