

# Accumulation of Chlorinated Hydrocarbon Residues in the Uropygial Gland of the Large White Turkey

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## Introduction

Poultry can be exposed to chemicals or biological products from a variety of sources such as medications, pesticides, equipment, or even building materials. Drug or chemical residues remaining in poultry at the time of slaughter can result in condemnation of the product and, if passed onto the consumer, will lower their confidence in the safety or wholesomeness of the poultry supply. A vigilant chemical residue prevention program is essential to fostering the prudent use of drugs and pesticides in animals that enter the human food supply. The implementation of Hazard Analysis and Critical Control Point (HACCP) systems is a significant step in this evolutionary process.

Preventing residue at all stages of animal production is a responsibility that must be shared by all segments of the industry. In the United States, the Food Safety and Inspection Service (FSIS) National Residue Program (NRP) provides a variety of sampling plans to verify and enforce that slaughter establishments are fulfilling their responsibilities under the Hazard Analysis and Critical Control Point (HACCP) regulation along with Food and Drug Administration (FDA) and Environmental Protection Agency (EPA) regulations that also prevent the occurrence of violated residues. The purpose of the NRP is to identify critical points in animal production for residue prevention and to educate producers to adopt controls, which ensure that marketed food animals do not contain illegal residues.

For example, in a voluntary residue-monitoring program for poultry, four to ten birds per flock are sacrificed 5-10 days prior to slaughter and samples of abdominal fat are submitted to a certified lab for analysis of chlorinated hydrocarbon compounds (CHCs). The types of CHCs typically screened during a typical analysis of poultry abdominal fat include: lindane, chlordane, dieldrin and aldrin, DDT and metabolites, endrin, heptachlor and epoxides, polybrominated biphenyl (PBB), methoxychlor, toxaphene, polychlorinated biphenyl (PCB), hexachlorobenzene (HCB), mirex, and chlorpyrifos.

Various names have been applied to the uropygial gland: examples are oil sac gland, preen gland, rump gland, and scientifically the *glans uropygii*. The uropygial gland is a bilobed organ embedded beneath the dorsal side of the base of the tail. Its sole function is to secrete fatty acid esters during the act of "preening" for maintenance of water repellent quality and structure of feathers. The structure and function of the uropygial gland has been reviewed (Lucas and Stettenheim, 1972).

There are few reports indicating that uropygial gland fluid (UGF) can be successfully collected from live birds (Larsson and Lindegren, 1987). The lipid composition of UGF may potentially be utilized to monitor lipophilic residues (i.e. chlorinated hydrocarbons) (Aparandi and Edwards, 1964; Tang and Hansen, 1976; Jacob, 1978). If a method were developed to monitor residues in the live bird by collection of UGF, then levels of residues may be determined using a more proficient sampling method without sacrificing the bird.

## Materials and Methods

### Collection of Uropygial Gland Fluid

Inadequate amounts of UGF were obtained when the fluid was expressed from the gland, and contamination was encountered with this method. Withdrawing fluid from the gland utilizing a 3 ml syringe fitted with a 3.5 cm x 18 gauge needle yields approximately 0.3

ml of clean UGF from a single turkey. Insertion of the needle below and to the outside of each lobe yields the best results and successful collection results in a slight pucker of the skin as the fluid is being withdrawn (Figure 1). The fluid should be expelled from the syringe immediately after collection, since UGF solidifies rapidly once removed from body temperature.

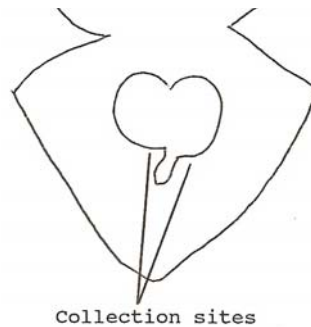


Figure 1. Collection sites for uropygial gland fluid in the Large White Turkey.

### Experiment 1

A total of 36 Large White male turkeys were fed a contaminated diet containing 115, 0.51, and 19 ppm chlordane, dieldrin, and DDT, respectively for a 7-d period from 12-13 wks of age. At the end of the feeding period (13 wks), and weekly until 18 wks of age, UGF was obtained from 6 birds. Birds were sacrificed and samples of abdominal (AF), breast (BF), and thigh fat (TF) were obtained. Individual samples from two birds were pooled for residue analysis.

### Experiment 2

Groups of six Large White male turkeys were fed the same contaminated diet used in Experiment 1 for a 1-week period beginning at 12, 13, 14, 15, 16, or 17 wks of age. At 18 wks of age, all 36 birds were sampled for UGF and then sacrificed to obtain AF, BF, and TF samples. Individual samples from two birds were pooled for residue analysis. In both experiments, samples of UGF and fat were analyzed according to AOAC methods (AOAC, 1984) as specified in the Chemistry Quality Assurance Handbook (USDA, 1982).

### Results and Discussion

The intent of both studies was to provide an oral intake level that resulted in fat residue levels at about the EPA established action levels of 0.3, 0.3, and 5.0 ppm for chlordane, dieldrin, and DDT, respectively. Results from both studies resulted in tissue levels well above the established action levels. Results from the analysis of AF, BF, and TF indicated no significant differences ( $P>0.05$ ) in the amount of residues (chlordane, dieldrin, or DDT and metabolites) found between tissue types. Therefore, representative samples could be obtained from any of these fat tissues (AF, BF, or TF) for residue analysis, if one chooses to sacrifice the animal. Due to the indifferences between tissue types, results from AF are presented.

In Experiment 1, the amount of residues found in UGF paralleled that amount in AF (Figure 2). Only at 13 weeks were residue levels significantly greater ( $P<0.05$ ) in AF as compared to UGF indicating that these residues may not be initially as rapidly assimilated into AF.

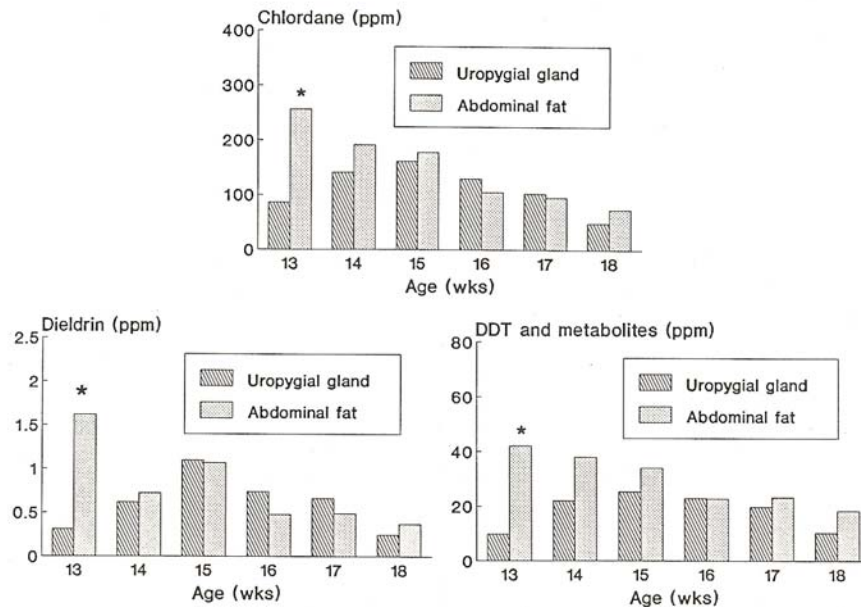


Figure 2. Amount of chlordane, dieldrin and DDT (including DDE and DDD) in uropygial gland fluid (UGF) and abdominal fat (AF) tissue of the Large White male turkey when fed these compounds from 12 to 13 weeks of age. Significant differences ( $P < 0.05$ ) between UGF and AF are indicated by asterisk.

In Experiment 2, the amount of chlordane, dieldrin, or DDT and metabolites in UGF paralleled the amount in AF in birds fed the contaminated diet from 13 to 14 weeks of age (Figure 3). However, beginning at 15 weeks of feeding, results indicate that the residues were not as rapidly assimilated into UGF as compared to AF by the time birds were sampled at 18 weeks of age. It also appears that DDT was more slowly accrued into UGF than either chlordane or dieldrin.

If residues are consumed at a young age, as in Experiment 1, accumulation of residues in UGF and AF are similar. When residues are consumed at an older age and particularly closer to market age as in Experiment 2, accumulation of residues in UGF is somewhat lower and delayed as compared to AF. Such results indicate that level of residues detected in UGF may be lower in comparison to AF depending on age, amount, and type of compound consumed.

Results from these and other experiments with broilers and turkeys (Blake, 2003) indicate that CHCs such as chlordane, dieldrin, and DDT are assimilated into UGF and it is possible to monitor these compounds in the live bird by collection and analysis of UGF. The measurement of CHC residues in UGF collected from the live bird is a viable alternative to sacrifice and collection of AF, but levels of CHCs in UGF may be somewhat lower in comparison to AF depending on age, amount, and type of compound consumed. The applicability of this method is not just restricted to broilers and turkeys, but may be useful to other species of poultry (ducks, geese) as well as wild avian species where valuable specimens can be monitored without sacrifice. Therefore, collection of UGF may be useful in determining the presence of CHCs for a wide spectrum of avian species in a simple and ethically attractive way.

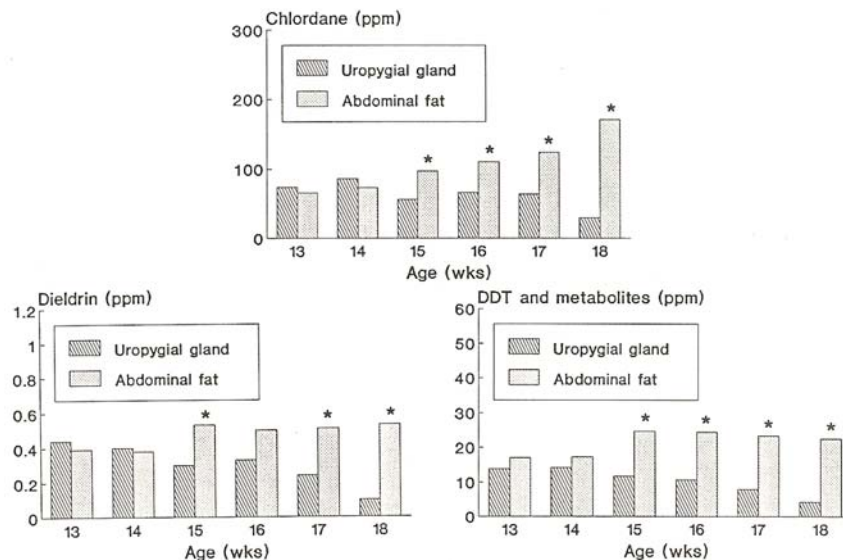


Figure 3. Amount of chlordane, dieldrin, and DDT (including DDD and DDE) in uropygial gland fluid (UGF) and abdominal fat (AF) of the Large White male turkey when fed these compounds at either 12, 13, 14, 15, 16, or 17 weeks of age and subsequently sampled at 18 weeks of age. Significant differences ( $P < 0.05$ ) between UGF and AF are indicated by asterisk.

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