CASE REPORT

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Detection of Organophosphate Poisoning in a Putrefying Body by Analyzing Arthropod Larvae

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ABSTRACT: Deaths as a result of organophosphate poisoning are usually detected by analysis of body fluids and tissues for the presence of the toxic agent. These procedures present particular difficulties when performed on remains in an advanced stage of decomposition. Malathion poisoning was suspected in a case in which the remains were in an advanced stage of decomposition and the presence of malathion was confirmed by analyses of gastric content and body fat. Two species of fly larvae, *Chrysomya megacephala* (Fabricius) and *Chrysomya rufifacies* (Macquart), were present on the remains. A sample of these larvae was analyzed for malathion content. A total of 574 μg of malathion was detected in 0.26 g of pooled larvae, or a level corresponding to 2050 μg/g of larvae. Presence of organophosphates in arthropod larvae has not been documented previously and the analysis of larvae from decomposing remains may prove a useful technique for detection of these toxicants in decomposing remains.

KEYWORDS: pathology and biology, poisons, larvae, decomposition

Accounts of detection of drugs and other toxicants in decomposing tissues by analyses of Diptera larvae have previously been presented by Beyer et al. [*1*] and Goff et al. [*2*]. This report documents an instance in which an organophosphate, malathion, was detected in larval calliphorid Diptera feeding on decomposing remains.

Case Report

The remains were those of a 58-year-old male with a history of previous attempts at suicide, having shot himself in the head during 1985. The remains were in an advanced state of decomposition and located in a crawl space under the decedent's mother's house. Beside the remains was an 8-oz (237-mL) bottle of Malathion 50, with about 6 oz (177 mL) missing. Tissue samples taken from the remains during autopsy were submitted to the Chemical Tox-

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icology Institute, Foster City, California, for analyses. Malathion was determined by gas chromatography with nitrogen-phosphorus detection following solvent extraction [*3*]. Malathion was detected in fat (17 mg/kg) and gastric contents (presence only noted). Malathion or other drugs were not detected in the blood, urine, or fluid from the chest cavity.

During autopsy procedures, numerous Diptera larvae were observed on the remains on the upper extremities, torso, and head. Large numbers were observed in the eyes, mouth, and armpits. Representative samples of these larvae were taken and preserved in ethanol for use in estimation of postmortem interval. The larvae represented two species of Diptera in the family Calliphoridae, both of which had been commonly associated with decomposing remains on the island of Oahu in the Hawaiian Islands [*4-6*]. *Chrysomya megacephala* (Fabricius) was represented by third instar larvae and *Chrysomya rufifacies* (Macquart) was represented by both second and third instar larvae. This combination of species and developmental stages indicates a minimum postmortem interval of five days under normal conditions in the Hawaiian Islands. Presence of these larvae feeding on decomposing tissues in the mouth, where there would be close contact with the insecticide, was a matter of some curiosity and representative third instar larvae of both species were submitted for analysis. This analysis, performed by gas chromatography using HP 5840A and Bendix 2500 in the Department of Agricultural Biochemistry, University of Hawaii at Manoa, of the pooled larvae showed 574 μg of malathion in 0.28 g of larvae or 2050 μg/g.

Discussion

This represents the first instance of detection of an organophosphate compound in larvae feeding on decomposing tissues containing the toxicant. This procedure of analysis of larvae may prove useful in detection of organophosphate poisoning in decomposing remains, although further research is indicated. There are several aspects of this case that present interesting associated problems. While the level of malathion present in the larvae is substantially higher than the established LD_{50} for adults of either *Chrysomya* species, data are lacking on the effect of this substance on the larvae of either species. This is, in fact, a characteristic of LD_{50} data for many insecticides; adult data are readily available but larval toxicity data are lacking. What data are available for larvae are generally based on topical applications of the insecticides and no consideration is given to possible ingestion of the toxin by the larvae. For example, Inoue [*7*], in work on *Boettcherisca peregrina* (Robineau-Desvoidy), considered only topical applications of malathion to larvae and concluded that lethal effects of this insecticide did not occur at practical application concentrations. The effects of organophosphate compounds on larvae of Diptera appears to be a significant area for future research, given the easy access by the general public to these compounds.

Another problem presented by this case lies in the postmortem interval estimate based on the rate of larval development. In this case, the decedent was last seen on 7 January and the remains discovered on 15 January, giving an elapsed time of eight days. The estimate was based on only two species of Calliphoridae. The stages of development present (third instar *C. megacephala* and second and third instar *C. rufifacies*) indicated a minimum postmortem interval of five days. Compared with results of decomposition studies conducted in similar areas on the island of Oahu [*5,6*], this was an unusually small number of species. Characteristic of this period are other Diptera species in the family Muscidae, including *Musca Domestica* (Linnaeus) and *Fannia pusio* (Wiedemann). Along with these taxa, species of families Milichiidae and Sarcophagidae are also generally present.

During the fourth and fifth days of the decomposition process in Hawaii, adult Dermestidae begin to frequent the remains and normally were recovered. All of these taxa were absent from the remains in this case. The same situation exists for the time period indicated by the last known sighting of the decedent, eight days before recovery of the remains. In addition to the taxa mentioned above, there are families of Coleoptera, notably the Histeridae and

Staphylinidae, which are generally present on the remains. Presence of the malathion on the remains could serve to retard the invasion of the remains by the various arthropod taxa, thus shortening the estimated postmortem interval, based on arthropod taxa and developmental stages observed on the remains. Another factor to be considered is the possible effect of ingested malathion on the rate of development of the larvae. Goff et al. [*2*] and Nuorteva and Nuorteva [*8*] have demonstrated that the presence of drugs and toxins in tissues may alter the rate of development of arthropod larvae feeding on them. No data are presently available on sublethal effects of malathion on the larvae of the two *Chrysomya* species involved in the present case.

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