Bull. Environm. Contam. Toxicol. 27, 869–871 (1981)

Accumulation of Fenvalerate Insecticide In Lamb Tissues

Patricia C. Wszolek[1], Douglas E. Hogue[2], and Donald J. Lisk[1]

[1]*Toxic Chemicals Laboratory and* [2]*Department of Animal Science, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14853*

Fenvalerate is an effective, broad-spectrum pyrethroid insecticide with low mammalian toxicity and good stability in the field. WSZOLEK et al. (1980, 1981) showed that fenvalerate was excreted in the milk and feces, but not in the urine, of dairy cows fed fenvalerate. Only about 25% of the dose could be accounted for in the excreta studied, and rumen fluid did not appear to degrade fenvalerate readily in vitro (WSZOLEK et al. 1981). We fed fenvalerate-fortified grain to lambs and studied excised tissues for residues of the insecticide to determine if fenvalerate can accumulate in tissues of agricultural animals.

EXPERIMENTAL

Feed was treated with a fenvalerate formulation (Pydrin, Shell Development Co.) dissolved in acetone and then mixed to yield a ration which contained 45 ppm of the insecticide. The feed mixture contained the following percentages of ingredients: corn (34), soybean meal (30), alfalfa (30), limestone (4), calcium phosphate (1), gypsum (0.4), and salt (0.6). Two 3-month-old male lambs consumed the feed for ten days, eating about 0.45 kg per day. Another lamb was fed an untreated grain mixture to serve as a control.

Animals were slaughtered after ten days and their kidneys, livers, leg muscles and renal fat were removed, then chopped and freeze-dried before analysis. Samples (0.5 g each of kidney, liver and muscle; 1.0 g of fat) were extracted with hexane in a micro-Soxhlet apparatus for six hrs. Extracts were partitioned with acetonitrile (PESTICIDE ANALYTICAL MANUAL 1971) followed by Florisil column chromatography (SHELL DEVELOPMENT CO. 1978).

Gas chromatography was performed by using a ^{63}Ni electron-capture detector and a 180 cm x 4 mm i.d. glass column packed with 3% OV-17 on 100-120 mesh Gas Chrom Q. Nitrogen was used as carrier gas at 60 cc/min and as purge gas at 40 cc/min. Column oven temperature was 250 C; inlet, 280 C; and detector, 305 C. Fenvalerate eluted as two peaks, retention times 12.8 and 14.0 min, each representing two sets of enantiomers (LEE et al. 1978). Peak areas were summed for each sample and compared with a six-point standard curve to obtain quantitative data.

0007-4861/81/0027-0869 $01.00

Procedural recovery of fenvalerate was assessed by fortifying each of the control tissues with the insecticide before extraction. Liver, kidney and muscle were fortified at the 200 ppb level and fat at 3.4 ppm.

RESULTS AND DISCUSSION

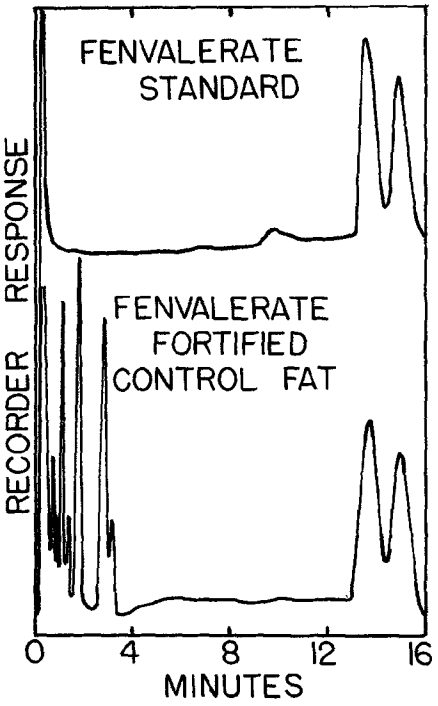
Extracts of tissues and organs from the control lamb showed no peaks interfering with the fenvalerate determination. Recoveries of fenvalerate from the fortified control tissues were: liver, 86%; kidney, 96%; muscle, 116%; and fat, 84%. No correction was made to the quantitative data. The limit of detection of fenvalerate under these experimental conditions was estimated to be about 50 ppb.

Table 1 gives the amount of fenvalerate found in the various tissues and organs analyzed. It is clear that the insecticide accumulates in the animals' fat with much smaller residues present in the other tissues. Similar results were obtained when rats were administered radiolabeled fenvalerate (OHKAWA et al. 1979).

As noted below, the two fenvalerate gas chromatographic peaks each represent a pair of its enantiomers. Under two different sets of gas chromatographic conditions, LEE et al. (1978) and HILL (1981) used authentic enantiomer pair standards to determine the elution order as RS + SR followed by the more insecticidal RR + SS. Presumably, our elution order is the same because our column (OV-17) is intermediate in polarity between the ones employed by LEE (OV-101) and HILL (OV-210). In any case, the ratio of the areas of these peaks $\left(\frac{\text{Peak 1 (RS, SR?)}}{\text{Peak 2 (RR, SS?)}}\right)$ is 1.08 both for the insecticide fed to the lambs and for the insecticide recovered from the fortified control fat (Figure 1). In contrast, the fenvalerate isolated from lamb No. 1 fat has a peak area ratio of 0.76 (Figure 2) and that from lamb No. 2 fat, 0.78. These data indicate that there is a selective metabolism of one or both of the first eluting enantiomers or a selective retention of one or both of the later eluting pair. In this regard, SODERLUND & CASIDA (1977) have shown that there are enantiomer dependent differences in metabolism rates when fenvalerate is hydrolyzed and oxidized by mouse liver microsomal enzymes.

Table 1. Residues (ppm, dry weight) of fenvalerate in tissues of the lambs fed the insecticide.

Tissue	Lamb No. 1	Lamb No. 2
Liver	0.1	0.1
Kidney	0.16	0.15
Muscle	0.29	0.15
Fat	4.4	3.6



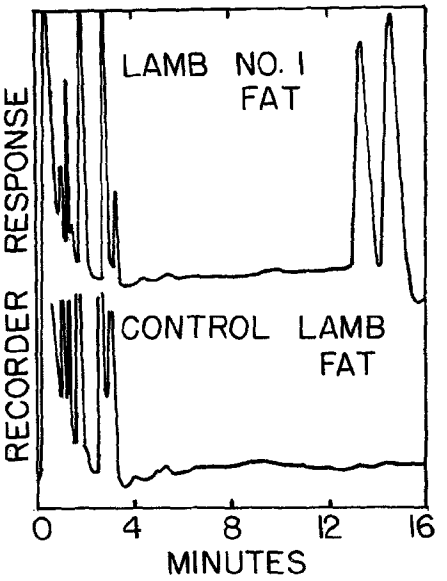


Figure 1. (Left) Gas chromatograms of 0.82 ng of fenvalerate standard and control fat fortified with 3.4 ppm of fenvalerate.

Figure 2. (Right) Gas chromatograms of fat samples from lamb No. 1 and the control lamb.

Acknowledgments. We are grateful to Shell Development Company for samples of fenvalerate. We thank B. McGee and R. E. Moore for feeding the lambs and W. H. Gutenmann and C. A. Bache for assistance in obtaining the tissue samples.

REFERENCES

HILL, B. D.: J. Agric. Food Chem. 29, 107 (1981).

LEE, Y. W., N. D. WESTCOTT, and R. A. REICHLE: J. Assoc. Off. Anal. Chem. 61, 869 (1978).

OHKAWA, H., H. KANEKO, H. TSUJI, and J. MIYAMATO: J. Pestic. Sci. 4, 143 (1979).

PESTICIDE ANALYTICAL MANUAL: Vol. 1, U.S. Dept. of Health, Education and Welfare, Food and Drug Administration, Washington, D.C., revised, Section 211.14a (1971).

SHELL DEVELOPMENT CO.: Determination of SD 43775 Residues in Crops, Animal Tissues, Soil and Water. Method MMS-R-478-1. Modesto, CA, April, 1978.

SODERLUND, D. M. and J. E. CASIDA: ACS Symp. Ser. No. 42, 173 (1977).

WSZOLEK, P, C., D. H. LEIN, and D. J. LISK: Bull. Environm. Contam. Toxicol. 24, 296 (1980).

WSZOLEK, P. C., N. A. LAFAUNCE, T. WACHS, and D. J. LISK: Bull. Environm. Contam. Toxicol. 26, 262 (1981).