Reduction of Chlorinated Hydrocarbon Residues in Swine[1]

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The occurrence of residues of chlorinated hydrocarbon insecticides in animal tissue has been well established in the literature. Thomas et al (1); Fahey and Brindley, (2); Entomology Research Division (3) are three authors who reported the contamination of beef tissues resulting from the feeding of treated forage or permitting livestock to forage on pesticide treated crops. Davich et al (4), reported the occurrence of insecticide residues in swine tissues taken from animals permitted to feed on clover pasture treated with insecticides.

Street (5), reported the reduction of dieldrin storage in tissue of rats treated with DDT. Cook and Wilson (6), Wilson and Cook (7), and Cook (8), have shown that dieldrin is constantly being recycled from the blood of cattle to the gastro-intestinal tract, that phenobarbital increases levels of many liver microsomal detoxifying enzymes, and that charcoal can be utilized as an antidote for dieldrin poisoning in ruminants. Since swine are monogastric animals rather than ruminants and under farm conditions are under a fat accumulation regime rather than a maintenance or loss diet as are milking cattle, doubts arose as to the possibility of utilizing this technique in eliminating dieldrin residues in swine.

Preliminary experiments showed that feeder pigs permitted to forage in stover grown on aldrin or heptachlor treated soil may accumulate up to 0.1 ppm of dieldrin or heptachlor epoxide. The purpose of this study was to determine whether phenobarbital and charcoal would reduce the storage of dieldrin in the fatty tissue of swine.

Materials and Methods:

Twenty-four 40# feeder pigs were selected for uniformity and were placed in a concrete floored feeding pen on December 12, 1969. These hogs were fed a free choice ration of ground shelled corn plus protein to which had been added 5 ppm of actual dieldrin. All hogs were kept on this ration for 46 days until January 27 when four animals were sacrificed. At this time, kidney leaf fat and belly fat from just beneath the surface of the skin were sampled, frozen and held at -15°C. until analysis.

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At the same time the remaining 20 hogs were split into two equal groups and separated by a dividing panel. One group of hogs was placed on an insecticide-free corn-protein supplement ration and held on this ration for the duration of the experiment.

The second group of 10 animals were fed a similar corn-protein supplement ration to which had been added phenobarbital at the rate of 125 grams per ton of feed. In addition, charcoal in the form of briquets were supplied (free choice) to the swine at the rate of 1/2 pound charcoal per head per day. Charcoal in briquet form is avidly sought after and consumed by swine.

On February 24, 1970, 28 days after start of the treatment, 5 hogs from each pen were sacrificed and fat samples taken as before. In addition, hams and bacons were taken from the carcasses and upon completion of the smoking process, fat samples were taken from these pieces.

The remaining hogs were kept on their respective feeding regimes and on March 24, 1970, were sacrificed and samples were taken in the same manner as on February 24.

Analysis:

All analytical data were calculated to ppm of dieldrin in hexane soluble lipids. The fatty tissue samples were mixed with anhydrous sodium sulfate (25 grams of fatty tissue to 50 grams sodium sulfate) and blended with 200 ml hexane. The hexane solution was filtered and the solvent removed. Samples of soluble lipids (5 grams) were dissolved in 25 ml hexane, quantitatively transferred to a 125 ml separatory and extracted 4 times with acetonitrile. The acetonitrile was transferred to a 1 litre separatory funnel containing 600 ml water and extracted 2 times with 100 ml hexane. The hexane solution was dried with anhydrous sodium sulfate and evaporated to about 10 ml on a rotary evaporator. The samples were transferred to a florisil column, washed with hexane and the dieldrin eluted from the column with 25% ether/hexane. The solvent was removed in a rotary evaporator and the sample diluted to a convenient volume for GLC analysis.

GLC analyses were made with an Aerograph 1200 instrument using a 1/8 inch by 5 foot glass column. The column was packed with 2% SE-30 and 3% QF-1 on Chromosorb W 60-80 mesh. Parameters employed were:

Detector	Electron Capture 250 mc
Temperatures	
Detector block	220°C
Column	190°C
Injector	200°C
Carrier Gas:	Nitrogen 60 ml/min.

Results:

TABLE 1

Dieldrin Residues in Soluble Lipides from Swine

Date	Sample Area	P. P. M. Dieldrin[a,b] Control Animals	Phenobarbital-charcoal treated animals
January 27	Leaf fat	1.04 ± .08	
	Belly fat	0.89 ± .02	
February 24	Leaf fat	0.45 ± .16	0.13 ± .03
	Belly fat	0.48 ± .14	0.15 ± .03
	Smoked ham	0.44 ± .19	0.14 ± .04
	Smoked bacon	0.39 ± .17	0.14 ± .03
March 24	Leaf fat	0.13 ± .02	0.02 ± .01
	Belly fat	0.18 ± .04	0.04 ± .02
	Smoked ham	0.16 ± .03	0.02 ± .01
	Smoked bacon	0.15 ± .03	0.03 ± .01

As may be sen by the data in Table 1 by January 27, 1970, the animals had accumulated dieldrin in both leaf and belly fat at about 1 ppm. By February 24, 1970, the animals fed a plain corn-protein diet had diluted out or lost a considerable percentage of the accumulation and contained at this point only about .45 ppm in leaf fat and .48 ppm in belly fat with comparable amounts in both the bacon and ham fat samples. The hogs on the phenobarbital-charcoal regime had reduced the amounts of dieldrin markedly to the point where the amount of material in leaf fat was .13 ppm, belly fat .15 ppm and the bacon and ham fat samples were also in this range.

On March 24, 1970, further reduction of dieldrin residues had occurred in both treated and untreated animals. The untreated animals had reduced their residues to an average of .13 ppm in leaf fat, 1.8 ppm in belly fat and .16 ppm in the ham and .15 ppm in the bacon fat samples. The treated animals showed marked reductions in residues to an average of .02 ppm in the leaf fat, .04 ppm in belly fat and .02 ppm and .03 ppm in the ham and bacon fats respectively.

Discussion:

On the basis of the data presented, it is apparent that cycling of dieldrin in the swine system was similar to that of ruminants.

[a] Mean of observations on five animals.

[b] ± standard deviation

Normal excretion and degradation plus dilution can reduce dieldrin residues by 50% in a 28 day period and by 90% in a 56 day period under the conditions above. When phenobarbital and charcoal are added to the diet of young hogs containing 1 ppm dieldrin, further reductions take place. A 28 day treatment period reduces residues almost 90% while a 56 day treatment period reduced the amount of dieldrin in hog fat by about 98%.

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