DDT Contamination of Feed Grains and Forages in Pennsylvania[1]

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Introduction

It is well known that very small quantities of DDT may be found in meat, milk and poultry products (1, 2). These range from the lowest limits of confidence of the analytical method upward with an occasional instance of residues of 1 p.p.m. or higher. It is also recognized that DDT contained in and ingested with feed may accumulate in animal or poultry body tissues or be excreted in eggs or milk.

Federal tolerances established by the U. S. Food and Drug Administration for DDT in raw animal and poultry products range from 0 to 7 p.p.m. depending on the product. For meats such as beef which have DDT tolerances of 7 p.p.m., the tolerance can be met quite easily with routine care in selection of the feeds and the elimination or reduction in the use of DDT on the farm. With other products such as eggs and milk where zero tolerances are in effect it often has been difficult or impossible for farmers to produce products free from DDT in spite of all efforts to eliminate recognized sources of DDT exposure.

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In an attempt to learn of the source of this DDT contamination, samples of forages and feeds to be fed to dairy animals, beef cattle, and poultry including broilers and laying hens were collected from Pennsylvania farms.

Methods

One hundred eighty-six (186) samples from 82 farms were collected during the calendar year 1965.

Samples were stored in moisture-proof polyethylene bags. All samples contained approximately 5 pounds of material collected from 20 different sites in the lot, thus a hay sample represented a composite from 20 bales and a grain sample a composite from 20 bags or 20 sites in a bin. Bacause of the impossibility of top-to-bottom sampling of silos each silage sample represented a composite of 20 sites from the level exposed at the time of sampling. Samples of silage were kept frozen until they were extracted.

In all instances these samples were from feed or forage grown on the farm or purchased from commercial feed distribution firms and were intended for livestock or poultry on the farm.

Samples were collected only from those farmers who kept accurate records of pesticide applications and could answer questions on the history of pesticide treatments on their farms. Thus it is recognized that the samples analyzed in this study can not be considered a truly random selection of feed stuffs in the statistical sense because there was a built-in bias in selecting farms for the collection of the feed samples.

DDT had not been used on any of the farms where crops were sampled for at least three years prior to the collection of samples.

The samples were classified as follows: pure alfalfa hay, mixed legume and grass hay, alfalfa-grass silage, corn silage, farm-grown grains, corn purchased from feed mills or distribution centers, commercial mixed feeds, and commercial feed supplements and concentrates. The latter three classes of feed were not produced on the farms, and hence were of unknown history. All forages sampled were grown on the farm where the sample was taken.

Analytical Methods

The samples of dry hay and whole grains were ground in a Wiley Mill. The mixed feeds and concentrates were not re-ground. A 100-gram sample of each of the dried materials was extracted for 16 hours in a large Soxhlet apparatus with redistilled n-hexane. The extract was concentrated in a Kuderna-Danish apparatus to a volume of two ml. Samples of silage were chopped in a Hobart food chopper, and a 100-gram aliquot blended in an Omni-Mixer for several minutes with a mixture of redistilled n-hexane and isopropyl alcohol (2:1). After the solvent was decanted off, the sample was blended again with chloroform-methanol (1:1). The extract was combined with the n-hexane-isopropyl alcohol extract, washed with water in a separatory funnel to remove the alcohols, filtered through anhydrous sodium sulfate to remove most of the water, stored over anhydrous sodium sulfate, and later concentrated in a Kuderna-Danish

evaporator to two ml. This double extraction of fresh plant materials has been found to be more efficient than extraction with one solvent mixture (3).

Aliquots of the concentrated extracts were injected into a Research Specialties gas chromatograph equipped with five-foot glass columns packed with Chromosorb W using DC 200 and QF-1 as stationary phases; these instruments were equipped with electron capture detectors. The limit of confidence of this analytical procedure was 0.003 p.p.m. for p,p'-DDT. Samples containing less than this amount were considered to have no DDT residue.

Results and Discussion

Table 1 summarizes the information obtained from analysis of the collected samples. The results given are for p,p'-DDT. Although other pesticide materials as well as other isomers of DDT and its metabolites were occasionally present the occurrences of these other compounds were irregular and it was not considered advisable to include them in this report. The results are recorded in p.p.m. based on the feedstuff as sampled. No attempts were made to determine moisture contents or to convert results to standard moisture levels. It should be recognized in evaluating the results that the moisture contents of the two silage categories were higher than those of the hay and grain samples.

On this basis 54 percent of the forage and 62 percent of the grain and supplement samples contained detectable quantities of DDT ranging from 0.003 p.p.m. to a high of 0.150 p.p.m. for forage and

TABLE 1

p,p'-DDT Occurring in Feed Stuffs Sampled

Forages	Total Number Samples	Number of samples in p.p.m. ranges listed below: No Residue	0.003-0.010	0.011-0.050	0.051-0.100	>0.100	Maximum level detected
Alfalfa hay	50	20	4	21	4	1	0.14
Mixed hay	24	17	0	6	0	1	0.14
Alfalfa grass silage	12	5	3	3	1	0	0.06
Corn silage	18	6	3	7	1	1	0.15
Total	104	48	10	37	6	3	0.15*
Feed grains and supplements							
Grains grown on the farm[1]	26	10	3	10	2	1	0.33
Purchased grain[2]	12	5	0	1	5	1	0.14
Commercial mixed feed	34	13	2	15	2	2	0.19
Commercial feed supplements	10	3	1	3	2	1	0.12
Total	82	31	6	29	11	5	0.33*

[1] Oats, corn, barley.

[2] All samples were corn.

* Maxima.

0.330 p.p.m. for grains. In both categories the majority of the samples that contained DDT ranged from 0.011-0.050 p.p.m. with 66 percent of the forages and 57 percent of the feeds falling within that range.

In light of these levels found in forages and feeds it is to be expected that small quantities of DDT will be present in meat, milk and poultry products from animals and poultry consuming these feeds.

The source of the p,p'-DDT in these forages and feeds is more difficult to determine. Contamination of other pesticides with DDT at the time of manufacture is possible but it seems unlikely that this form of contamination would be widespread. It has been pointed out that at least one chlorinated hydrocarbon insecticide is absorbed into the plants through the roots (4); this probably occurs on soils containing DDT. Another possibility is aerial drift of DDT from other agricultural operations in the vicinity where DDT may be used on potato fields or orchards, for example. This would account for some erratic high levels observed from time to time but again would not be expected to be a widespread source of contamination.

Some recent results by Antommaria et al. (5) working with DDT in airborne particulates may offer a clue to a major source of DDT contamination of feeds. In this June to December study these workers found that particulates in the air over Pittsburgh contained a maximum of 1.14 μg (on respirable particulates) and 1.22 μg

(on non-respirable particulates) of DDT per 1000 cubic meters of air sampled. The highest levels occurred in the July 6-20 collection period. Although these quantities are extremely minute, if particulates in air in other portions of the state contain DDT and if some of these particulates eventually land on soils and crops this may explain the occurrence of DDT in feeds grown at considerable distance from any known DDT applications.

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