Feeding Phenobarbital and Activated Carbon to Accelerate
Dieldrin Residue Removal in a Contaminated Dairy Herd

D. G. BRAUND 1 and B. E. LANGLOIS
Department of Animal Sciences, University of Kentucky, Lexington 40506
and
D. J. CONNER and E. E. MOORE
Kentucky State Department of Health, Frankfort 40601

Abstract

Feeding of phenobarbital and activated carbon apparently was effective in accelerating removal of dieldrin in a 105-cow dairy herd. After one week of treatment, residue had declined about 64% compared with 36% for the control group. At 22 days milk residue in the treated group was about one-half that of the control group. The time during which the milk had to be withheld from market was shortened by at least one month for the treated group.

Introduction

Pesticide residues in milk and dairy products represent a difficult situation for the dairy industry. The widespread use of pesticides on farms, drift problems, pooling of milk from many dairy farms in a milkshed, and the rapidity with which milk must be processed and distributed contribute to this industry problem. In addition, a demand has arisen in recent years for adequate controls to protect both the consumer and the natural environment.

Various State and Federal agencies are constantly monitoring milk and dairy products to ascertain the presence of pesticides and other adulterants. As a result of this monitoring, in March 1969 dieldrin was detected in Cottage cheese in an adjoining state and traced to the milk produced by a herd of 105 cows in Kentucky. Consequently, the sale of approximately 1,800 kg of milk per day was prohibited. Subsequent investigation revealed the source of contamination to be oats purchased for dairy feed that were contaminated with aldrin. This pesticide is readily converted to dieldrin in the body of beef and dairy cattle, pigs, sheep, rats, and poultry (1).

Decontamination of dieldrin residues from rats and ruminants may be accelerated by feeding certain drugs or activated carbon (charcoal) or both (2,4,7,8,9,11,14,15,16,17).

The following field experiment was designed to determine if feeding phenobarbital and activated carbon would accelerate removal of dieldrin residue from animals in the aforementioned herd. The highest priority objective was to get the dieldrin residue in the milk low enough to meet Food and Drug Administration (FDA) zero tolerance so it could be returned to the market. Thus, milk residue was the only criterion to ascertain efficacy of the treatment.

We realized that additional data on residue in feces, urine, blood, saliva, bile, carcass tissue, etc. would have been useful. However, since this was a field trial involving a private herd which was not under the direct experimental supervision and control of the authors, it was not possible to obtain these data.

Experimental Procedures

Two bulk tanks on the farm made possible the separation of the herd into a control group of 55 cows and a treated group with 50 cows, and, thus, the entire milk production from each group was kept separate. Since the necessary length of the treatment period could not be determined at the beginning of the experiment, cows with less than 60 days remaining in their lactation were arbitrarily assigned to the control group so that the treatment could not be interrupted by a dry period.

Prior to and during the trial, samples of all feedstuffs including water were analyzed for chlorinated hydrocarbon residues. The only pesticide compound detected was aldrin in the purchased oats as previously described. These oats were consumed prior to the start of the trial and no further chlorinated hydrocarbon pesticides were ingested or otherwise used during the experiment.

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1 Present address: Director of Dairy Livestock Research, Agway Inc., Syracuse, New York.
The diet for the control group consisted of pasture and a concentrate of ground ear corn, protein supplement, and a vitamin-mineral supplement. The treated group consumed similar pasture and concentrate but, in addition, were fed limited amounts of average quality corn silage after the evening milking.

Treated cows each received about 0.91 kg of powdered activated carbon\(^2\) per day mixed with the corn silage at the evening feeding. A total of 45.5 kg of carbon was spread over the total corn silage and mixed by running the endless chain feeder for several minutes. Because the supply of silage became exhausted, the concentrate was the carbon carrier after the 26th day. The carbon initially was mixed at 5.0% of the final concentrate mixture. However, the powdery nature of the carbon caused a dust problem in the milking parlor, and the level was then reduced to 3.75% of the concentrate. Carbon was fed in the concentrate for the last 41 days of the study.

Cows in the treated group also were fed 10 mg of phenobarbital per kilogram of body weight per day or an average of 5 g per cow daily. The drug was divided into two equal doses, mixed with the concentrate in the feed manger of the milking parlor, and consumed during the AM and PM milking. Phenobarbital was fed to this group for only the first 24 days of the study and then discontinued whereas feeding of carbon was continued until the end of the study.

After initial data indicated beneficial effects of the combined treatment of drug and carbon, it was planned to feed only carbon to the control group to ascertain its effectiveness independent of drug action. However, because of communications, both carbon and phenobarbital were fed to control animals, starting on the 26th day. The drug was fed for six consecutive milkings before being discontinued whereas feeding of carbon was continued until the end of the study.

Milk samples for analysis were from the bulk tank containing the total milk from each group at Day 0 and at approximately weekly intervals thereafter until Day 64. A final sample was taken on Day 84 for a terminal reference. Contents in the bulk tanks represented two to four milkings at the time of sampling. In addition, individual milk samples were obtained from several cows in each group at 0, 8, and 15 days. Composite samples from a

2 Darco S-51, supplied by Atlas Chemical Company, Wilmington, Delaware.

Results and Discussion

Projection of the decontamination rate after 22 days of treatment indicated that dieldrin residue in the milk fat should be less than the acceptable level within two weeks. Therefore, feeding of phenobarbital to the treated group was stopped after 24 days to ensure that the milk would be free of drug residue when pesticide residue was within tolerance. This was necessary since phenobarbital has not been approved by the FDA for accelerating removal of pesticide residues. Hence, the presence of any drug residue or metabolite in the milk would constitute adulteration. The present recommendation (4) is that milk should not be marketed until seven days after cessation of phenobarbital feeding. Dieldrin residue in milk from the treated group was below the acceptable level 10 days after cessation of phenobarbital feeding. Analysis of the milk indicated the absence of detectable residues of phenobarbital at this time.

The treated group was observed closely by a veterinarian after drug administration was started. Because phenobarbital is a sedative some animals appeared lethargic; however, no serious or long term effects due to the drug were observed.

The dieldrin concentrations in the milk from each group were determined independently by both the State Department of Health in Frankfort and the Department of Animal Sciences at the University of Kentucky. The results in Figure 1 are determinations in the University laboratory. Data from the Department of Health laboratory showed a similar trend. During the 30 days before initiation of this experiment, analysis of composite herd samples by the Department of Health on seven different dates indicated that dieldrin decreased only slightly in the whole milk.

On Day zero, milk from the treated group had higher initial dieldrin residue than did that from the control group. This was probably due in part to the treated group containing more cows in the early stages of lactation. Approx-
nately 59% of the total herd production was produced by the treated group even though it had fewer cows than the control group. Dairy animals during early lactation secrete higher concentrations of dieldrin and total daily excretion of the pesticide is greater than in latter lactation (3).

After one week of treatment residue had declined about 64% compared with 36% for the control group. These data on bulk milk were confirmed with samples from individual cows in each group and composite samples from a subgroup of 12 cows within each group. Results are in Table 1.

During the second week, concentration in the milk from the control group increased sharply. The composition and source of the milk could have been changed considerably at this time because 11 cows were dried off in two days and four fresh cows were added to the group. These cows had consumed the contaminated oats during the latter weeks of their previous lactation. At 22 days milk residue in the treated group was about one-half that in the control group.

The increase in dieldrin concentration at Day 26 for the treated group probably was caused by the short-time inadvertent addition of four fresh cows by the herd owner. These animals were soon withdrawn from the treated group and placed with the control cows. About 35 days were required for residue in the treated group to decrease below the acceptable level. However, residue in the control group did not decrease below this limit until about the 50th day and during this time they were fed phenobarbital three days and carbon for the last 24 days.

The results of this study indicate that decontamination can be accelerated by feeding phenobarbital and activated carbon. The time during which the milk had to be withheld from the market was shortened by at least one month.

Dieldrin is recycled in the animal body (5). Since this herd had been contaminated about six weeks before the start of this study, much of the pesticide had already been deposited in the body fat of the cows. Thus, the probable action of activated carbon was to adsorb whatever dieldrin molecules were still recycling by way of saliva, bile, and other digestive secretions, and to remove them by fecal excretion. Activated carbon was probably less effective in this situation than when it is fed concurrently with the contaminated feed stuffs (11,17).

Phenobarbital apparently stimulates the liver microsomal enzyme systems to produce enzymes capable of metabolizing dieldrin into water-soluble metabolites which are removed from the body by way of urine (8,9,16). Phenobarbital induces drug-metabolizing enzymes in the cow, calf, goat, sheep, and pig (6).

Davies et al. (10) reported that phenobarbitone and phenytoin reduced pesticide residues in humans. They stated that the most promising use of these drugs appears to be in accelerating decontamination of animals providing food for human consumption. The results of the study reported here support that statement.

Feeding phenobarbital to lactating dairy cows is not presently cleared by FDA. Any dairyman finding herd contamination should contact his veterinarian and local health and FDA officials before making treatments.
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References