Effect of Dalapon Ingestion on Performance of Dairy Cattle and Levels of Residue in the Milk

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Thirty-four dairy cows representing four different breeds were fed dalapon at a level equivalent to 300 p.p.m. based on dry-weight intake of forage. A maximum residue value of 2.45 p.p.m. was obtained within 7 days after dalapon feeding started. No significant differences were obtained in the response of four breeds used in the study. Feeding dalapon at a level of 300 p.p.m. based on dry-matter intake had no detrimental effects on the animals with respect to milk production, butterfat percentage, body weight, feed intake, or animal behavior. Within 3 days after dalapon feeding stopped, the level of dalapon residue in the milk approached 0.11 p.p.m.

The herbicide 2,2-dichloropropionic acid (dalapon) has been shown to be effective in the control of grass in forage legumes. Early residue studies on forage legumes, alfalfa, and birds'-foot trefoil have shown a maximum residue level of dalapon at approximately 300 p.p.m. by a spring application of 10 pounds per acre.

The experiment reported herein was initiated to determine the level of residue of dalapon in milk from animals fed dalapon at a constant feeding level of 300 p.p.m., the residue as a function of time, the residue as a function of breed, and the effect of dalapon on the quality and quantity of milk production.

Materials and Methods

The feeding trial was conducted through the cooperation of the Department of Animal Husbandry, Cornell University. Thirty-four cows of four different breeds were selected from the college herd: six Jerseys, 16 Holsteins, six Guernseys, and six Brown Swiss. Animals were selected which varied widely in the following categories: age, number of lactations, stage in lactation, time between freshening and breeding, and milk production. These variations would be representative of the average dairy herd.

To avoid any disturbance to the animals which might have thrown them off feed, they were not moved to a central

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Table I. Average Total Pounds Dry-Weight Feed Intake per Day of Hay and Silage

Animal No.[a]	Breed	Week of Feed Standardization, Lb.	Week of Dalapon Feeding, Lb. 1st	2nd	3rd	Av. for 3-Week Dalapon Feeding, Lb.
1	J	22.0	23.8	23.9	24.0	23.9
2	J	14.6	15.7	16.8	15.9	16.1
4	J	17.5	17.6	18.1	18.2	18.0
8	H	21.8	20.9	22.8	22.6	22.1
10	H	26.3	18.4	20.2	18.0	18.9
13	H	32.5	32.6	32.3	33.1	32.7
16	H	32.2	33.7	35.6	35.7	35.0
17	H	24.0	25.7	26.6	26.7	26.3
21	G	29.5	18.0	20.5	21.6	20.0
22	G	18.6	18.0	21.0	20.6	19.9
24	G	24.5	25.0	25.0	25.6	25.2
27	BS	26.1	29.7	30.7	30.9	30.4
30	BS	19.3	21.2	22.4	21.3	21.6
32	BS	20.8	16.5	19.8	21.8	19.4

[a] Corresponds to cow numbers in other tables.

Table II. Blank Determinations on Control Milk, Sampled January 15, 1956

Sample No.[a]	Weight, Grams	Unhydrolyzed Dalapon, γ	Hydrolyzed Dalapon, γ	Total Dalapon, γ	Dalapon, P.P.M.
1	251.9	1.3	8.7	12.8	0.05
2	250.2	1.4	4.3	5.8	0.02
3	252.1	1.2	5.0	7.6	0.03
7	249.8	4.3	9.7	10.8	0.04
9	250.0	1.6	5.2	7.2	0.03
11	250.2	0.4	5.7	10.6	0.04
13	252.4	5.6	5.1	..	..
15	250.6	1.5	3.4	3.8	0.02
17	250.1	1.4	7.5	12.2	0.05
23	250.5	0.6	9.1	17.0	0.07
24	251.8	3.1	7.6	9.0	0.04
27	252.3	1.7	8.1	12.8	0.05
28	250.0	2.0	12.0	20.0	0.08
29	250.9	0.8	5.5	9.4	0.04
32	249.9	1.3	7.0	11.4	0.05
34	250.0	1.7	7.5	11.6	0.05
				Av for all animals	0.036

[a] Corresponds to cow number in other tables.

Table III. Dalapon Residue in Milk by Breed and Date of Sampling

Cow No.	Breed[a] of Animal	Blank Level for Corr. 12/15	During Dalapon Feeding 12/22	12/29[b]	1/5	Mean during Feeding	Dalapon Feeding Stopped 1/8	1/12	Mean by Breeds over Dates 12/22	12/29	1/5	1/8	1/12
						P.P.M.							
1	J	0.05		0.88									
2	J	0.02	1.92[b]	1.23	1.48	1.54	0.16	0.06					
3	J	0.03		1.02									
4	J	0.02		1.42									
5	J	0.04	1.00	0.89	1.09	0.99	0.13	0.03				Jersey	
6	J	0.04	1.53	1.23	1.13	1.30	0.11	0.06	1.48	1.11	1.23	0.13	0.05
7	H	0.04		0.75									
8	H	0.02	1.30	0.69	1.35	1.11	0.11	0.07					
9	H	0.03		1.12									
10	H	0.02		1.20									
11	H	0.04		1.09									
12	H	0.03		1.26									
13	H	0.04		0.71									
14	H	0.04	1.03	0.74	2.07	1.28	0.18	0.08					
15	H	0.02	1.88[b]	1.44	1.46	1.59	0.09	0.03					
16	H	0.03		1.41									
17	H	0.05	2.09[b]	1.03	1.45	1.52	0.09[b]	0.00					
18	H	0.03		1.00									
19	H	0.03	2.45[b]	1.69	2.01	2.05	0.21	0.09					
20	H	0.05		1.29									
21	H	0.03	1.45[b]	1.19	1.44	1.36	0.15	0.05				Holstein	
22	H	0.05		0.90					1.70	1.09	1.63	0.14	0.05
23	G	0.04	1.25	1.20	1.19	1.21	0.08	0.01					
24	G	0.04		1.02									
25	G	0.03		1.22									
26	G	0.02	0.61	0.85	1.32	0.93	0.10	0.04					
27	G	0.05		1.11								Guernsey	
28	G	0.05	2.45[b]	1.45	1.96	1.95	0.09	0.02	1.44	1.14	1.49	0.09	0.04
29	BS	0.04	1.21	0.87	1.34	1.14	0.06[b]	0.06					
30	BS	0.03		0.89									
31	BS	0.04		0.92									
32	BS	0.05		0.78									
33	BS	0.04	1.13	0.84	0.86	0.94	0.09	0.04				Brown Swiss	
34	BS	0.05	0.63	1.46	1.16	1.08	0.07[b]	0.04	0.99	0.96	1.12	0.07	0.04
Mean of dates over all breeds		0.036	1.46	1.08	1.42		0.115	0.045					

[a] J Jersey; H Holstein; G Guernsey; BS Brown Swiss.
[b] Av., duplicate samples.

location or group. Instead, the stanchions to which they were accustomed were modified to prevent: adjacent animals from consuming the grain, silage, and hay fed and the animals on the feeding trial from throwing or pushing the feed into the alleyway and mixing it with that of adjacent cows. By this procedure, accurate weigh-backs of roughage not consumed were obtained.

To establish the level of roughage intake as silage and hay, all animals were started on an alfalfa, corn silage, and grain concentrate mixture for 7 days prior to the start of dalapon feeding. This 7-day period will be referred to as the standardization period. To minimize any influence of diet on animal behavior or results, all hay was obtained from the same lot, one silo of corn silage was reserved for experimental animals, and the grain concentrate was obtained from a single bulk mix.

Records of daily roughage consumption were kept during the standardization period and throughout the experiment. At weekly intervals, the dry-weight intake of each animal was calculated and the amount of dalapon to equal 300 p.p.m. was determined. The total daily dalapon requirement was fed in two equal parts, morning and evening.

The values used for dry-matter determinations—hay at 80% and silage at 30%—were based on oven-dry samples of roughages used. The dalapon fed during any 1 week was based on roughage consumption of the preceding week.

The silage and hay for each animal were weighed before being placed into the manger. Just prior to the next feeding period weigh-backs were taken on any roughage not consumed. Some excess hay appeared desirable to be certain the animals had access to all the roughage desired. An effort was made to keep the weigh-backs of hay or silage at less than 5 pounds for any one feeding period.

The level of 300 p.p.m. of dalapon was based on the dry-weight intake of silage and hay as previously discussed. To be certain the animals would consume dalapon, it was added to 1 pound of grain concentrate and fed just prior to milking. When the animal had consumed this 1-pound sample, the remainder of grain concentrate (based on milk production) was fed. During the first 7 days of dalapon feeding, some animals exhibited a dislike for dalapon mixed with 1 pound of grain. After the first week, dalapon for these animals was mixed with the total grain concentrate fed. Thereafter, little trouble was encountered during the course of the experiment in getting the dalapon consumed by either method.

During the 7-day standardization period, the dalapon-feeding period, and the 7-day period following the end of dalapon-feeding, duplicate milk samples were taken both morning and evening. Samples were taken on the third and seventh days of the standardization period, the seventh, 14th, and 21st days after dalapon feeding started, and the third and seventh days after dalapon feeding had been stopped. The sample from the seventh day of the standardization period was used for blank determination on control milk.

Milk samples were taken from the

Table IV. Actual Amount of Dalapon Fed by Weekly Periods during Feeding Trial

(Based on actual dry matter consumed)

Cow No.	Breed of Animal	Weeks First	Weeks Second	Weeks Third	Av. Fed during 3 Weeks	Av. Fed during Last 2 Weeks	Mean by Breeds over Weeks First	Mean by Breeds over Weeks Second	Mean by Breeds over Weeks Third
					P.P.M.				
1	J	260	232	300	264	266			
2	J	380	340	320	347	330			
3	J	356	300	282	313	291			
4	J	356	319	282	319	300			
5	J	285	243	300	276	272		Jersey	
6	J	380	340	300	340	320	336	296	297
7	H	300	276	312	296	294			
8	H	363	243	330	312	287			
9	H	315	329	300	315	315			
10	H	406	283	300	330	292			
11	H	406	268	347	340	308			
12	H	352	310	321	328	315			
13	H	340	238	310	296	274			
14	H	566	222	287	358	255			
15	H	329	346	236	304	291			
16	H	340	273	282	298	278			
17	H	443	288	325	352	307			
18	H	352	333	279	321	306			
19	H	352	310	269	310	290			
20	H	352	346	279	326	313			
21	H	431	300	255	329	278		Holstein	
22	H	493	340	283	372	312	384	294	295
23	G	424	300	315	346	308			
24	G	424	300	332	352	316			
25	G	380	300	315	332	308			
26	G	313	248	274	278	261			
27	G	325	248	274	282	361		Guernsey	
28	G	424	285	315	341	300	382	280	304
29	BS	321	246	321	296	284			
30	BS	391	288	276	318	282			
31	BS	409	300	314	341	307			
32	BS	470	345	363	393	354			
33	BS	310	230	300	280	265		Brown Swiss	
34	BS	600	383	345	443	364	417	299	320
Mean of dates over all breeds		381	293	301	325	297			

milking-machine pail immediately after weighing. Each sample, consisting of 250 ml., was placed in a 1-pint cardboard ice cream carton in a deep-freeze unit immediately after milking.

Analytical determinations on all samples were made by the Cornell Pesticide Residue Laboratory by the standard method for dalapon determination developed by Kutschinski (*7*).

Daily observations were made on each animal by those directing the research. To check on any possible physical effects, a member of the staff of the New York State College of Veterinary Medicine performed periodic checks on all animals. General appearance, physical condition, body temperature, any effects of dalapon on mouth, tongue, and throat tissue, and any changes in manure or urine condition were checked.

To determine whether animals fed dalapon produced milk with an off-flavor or odor, a taste panel was established with the cooperation of the Department of Dairy Industry. Two taste tests were employed for dalapon-fortified milk and milk from animals fed dalapon.

Pasteurized milk was fortified at the following values of dalapon based on acid equivalent: 0.10, 0.25, 0.50, 1.0, 1.5, 2.0, 4.0, 8.0, and 80 p.p.m. The fortified milk samples, under code letters with several no-dalapon checks included, were submitted to seven experienced taste panelists.

In addition, two Jersey cows were fed dalapon at a rate of 300 p.p.m. per day on the basis of dry-matter intake as described in the procedure for the feeding trial. At the end of 7 days, milk was collected from each animal in the morning and afternoon. The morning and afternoon milk were combined and submitted to the panel for testing. The milk was tested undiluted and at dilutions of 1:1 and 1:10 with milk containing no dalapon.

Results and Discussion

Panel Tests for Taste and Odor. None of the panel members was able to detect any off-odor or off-taste at any level of dalapon used in either dalapon-fortified milk or milk from cows fed dalapon. In other words, dalapon values approximately 40 to 80 times the amount found in milk from animals fed dalapon at a rate of 300 p.p.m. did not reduce milk quality as judged by taste. Therefore, it appears doubtful under normal dilutions of fluid milk processed for human consumption whether values exceeding those tested would be realized.

Body Weight. All animals were weighed three times during the experiment to check the gain or loss in body weight: on December 1, 1956, 1 week before the start of the experiment; on January 2, 1957, 25 days after the experiment started; and on January 14, 1957, at completion of the experiment.

Of 34 animals involved, 24 gained, eight lost, and two showed no change in weight during the experiment.

The minimum gain or loss in body weight was zero and the maximum was +55 and −80 pounds, respectively. As with variation in feed intake, the maximum gain or loss was with the Holsteins. This may be attributed to the larger number of animals involved.

Based on studies of changes in body weight of dairy animals, variations of the magnitude recorded in this experiment would be considered normal. Combining this with daily observations, there is no evidence that dalapon affected body weight.

Feed Intake. Many conditions influence the actual feed intake of dairy animals. Some are naturally choosy in their diet, while others are heavy eaters and such quality values as color, odor, botanical composition, or changes in concentrate mixture made little or no difference in the quantity eaten.

Of the animals used in this experiment, the Jerseys were the most consistent in eating habit; the Guernseys, Brown Swiss, and Holsteins followed. The variation in Holstein eating habit may be attributed to the larger number and the difference in body weight of animals used, compared to the other breeds.

A summary of the average total dry-weight intake per day of representative animals is shown in Table I. These data would not indicate any wide variations over the recorded 4-week period of the experiment which might be attributed to dalapon feeding.

The consistency of feed intake by each animal would lend support to the method used for determining the daily dalapon requirement of the animals used. However, the question might be raised as to the difference in dalapon levels in the milk had the daily intake of dalapon been in the forage rather than added to the grain concentrate. It is possible that from forage containing dalapon, the chemical would be more slowly absorbed from the intestine, resulting in lower levels in the milk

Changes in Butterfat Percentage. To check on any possible detrimental

Table V. Standard Deviation and Standard Error for Each Sampling Date by Breeds

Date		Jersey	Holstein	Guernsey	Brown Swiss	Total
	SD	0.46	0.53	0.93	0.31	
12/22	SE	0.27	0.22	0.54	0.18	0.15
	SD	0.22	0.29	0.20	0.25	0.25
12/29	SE	0.08	0.07	0.08	0.10	0.04
	SD	0.21	0.32	0.41	0.24	0.35
1/5	SE	0.12	0.13	0.24	0.14	0.09
	SD	0.02	0.08	0.01	0.01	0.11
1/8	SE	0.01	0.03	0.01	0.01	0.04
	SD	0.02	0.03	0.01	0.01	0.02
1/12	SE	0.01	0.01	0.01	0.01	0.01

Table VI. Comparison of Dalapon Residue and Milk Production from Different Animals

Breed	Cow No.	Av. Milk Produced/ Day, Lb.	1st Week Dalapon Fed of Each Feeding, Grams	First Sampling Date Residue in Milk, P.P.M
Jersey	2	27	1.9	1.92
	5	54	1.9	1.00
Holstein	14	38	3.4	1.03
	17	73	3.4	2.09
	19	32	3.4	2.45
Guernsey	23	42	2.4	1.24
	26	44	2.4	0.61
Brown Swiss	29	24	3.0	1.21
	34	28	3.0	0.63

Table VII. Actual Amount Fed in Milk and Per Cent Recovered in Milk by Weekly Intervals during Feeding

	First Week			Second Week			Third Week		
Cow No.	Fed, p.p.m.	In milk, p.p.m.	Recovered in milk, %	Fed, p.p.m.	In milk, p.p.m.	Recovered in milk, %	Fed, p.p.m.	In milk, p.p.m.	Recovered in milk, %
1	260			232	0.88	0.379	300		
2	380	1.92	0.505	340	1.23	0.362	320	1.48	0.463
3	356			300	1.02	0.340	282		
4	356			319	1.42	0.445	282		
5	285	1.00	0.351	243	0.89	0.366	300	1.09	0.363
6	380	1.53	0.403	340	1.23	0.362	300	1.13	0.377
7	300			270	0.75	0.272	312		
8	363	1.30	0.358	243	0.69	0.284	330	1.35	0.409
9	315			329	1.12	0.340	300		
10	406			283	1.20	0.424	300		
11	406			268	1.09	0.407	347		
12	352			310	1.26	0.406	321		
13	340			238	0.71	0.298	310		
14	566	1.03	0.182	222	0.74	0.333	287	2.07	0.721
15	329	1.88	0.571	346	1.44	0.416	236	1.46	0.619
16	340			273	1.41	0.516	282		
17	443	2.09	0.472	288	1.03	0.358	325	1.45	0.446
18	352			333	1.00	0.300	279		
19	352	2.45	0.696	310	1.69	0.545	269	2.01	0.747
20	352			346	1.29	0.373	279		
21	431	1.45	0.336	300	1.19	0.397	255	1.44	0.565
22	493			340	0.90	0.265	283		
23	424	1.25	0.295	300	1.20	0.400	315	1.19	0.378
24	424			300	1.02	0.340	332		
25	380			300	1.22	0.407	315		
26	313	0.61	0.195	298	0.85	0.343	274	1.32	0.482
27	325			248	1.11	0.448	274		
28	424	2.45	0.578	285	1.45	0.509	315	1.96	0.622
29	321	1.21	0.377	246	0.87	0.354	321	1.34	0.417
30	391			288	0.89	0.309	276		
31	409			300	0.92	0.307	314		
32	470			345	0.78	0.226	363		
33	310	1.13	0.365	230	0.84	0.365	300	0.86	0.287
34	600	0.63	0.105	383	1.46	0.384	345	1.16	0.336
Mean of dates, over-all breeds	381	1.46	0.386	293	1.08	0.370	301	1.42	0.482

Recovery, %, mean of all breeds over dates for 64 samples was 0.3999%.

effects of dalapon on butterfat percentage, weekly samples were taken for butterfat determination. Accepted standard procedures were followed in taking the sample and determinations were made by the personnel of the Dairy Industry Department of Cornell University.

Variations in butterfat percentage were within the expected range for the different breeds. Changes of the magnitude obtained can be expected from day to day or from week to week as influenced by: stage in lactation, environmental and physical conditions surrounding the animals, completeness of milking, and possibly variations in quality of feed consumed.

Compared with butterfat tests of the remainder of the herd not receiving dalapon, there is no evidence of any effect of dalapon on butterfat test or quality of fat as observed visually in stored samples.

Milk Production. Based on the daily record of milk produced during the feeding trial, evidence of any effect on total milk production of animal or breed is lacking. The production of test animals was considered normal, taking into consideration stage of lactation, which is the primary consideration in healthy animals. Variations were those anticipated for dairy animals. Cow 34 dropped markedly in production during the first week of dalapon feeding, but apparently not as a result of dalapon feeding. Veterinary examination indicated intestinal trouble resulting in lower feed consumption than normal.

Animal Behavior. Daily observations at time of feeding indicated little or no variation among the four breeds regarding the consumption of dalapon with the grain concentrate mixture. During the first week of dalapon feeding, individual animals (Jersey 2, Holsteins 10, 14, 15, 18, and 21, Guernsey 28, and Brown Swiss 34) did not eat all the 1-pound grain sample to which dalapon was added. However, on mixing it with the total grain to be fed, no further trouble was encountered. In general, the animals exhibited no distaste for the chemical and once accustomed to the change in feeding practice reacted normally.

Examination by the veterinarian before the feeding trial started, 2 weeks after dalapon feeding started, and at the end of the experiment showed no abnormal symptoms by any of the animals in the experiment.

In summary, feed consumption, general appearance, physical condition, body temperature, mouth, tongue, and throat tissue, and manure and urine were not affected by dalapon feeding.

Dalapon Residue in Milk. Blank Determinations. Representative values obtained for blank determinations on control milk sampled the day before dalapon feeding started are shown in Table II. These values ranged from 0.02 to 0.08 with an average of 0.036 for all breeds and compare favorably with those obtained by Kutschinski (7). Blank values obtained for each animal were used to correct all dalapon determinations made on samples run from each successive sampling date for each animal.

Residue as a Function of Time. Data in Table III show conclusively that animals fed dalapon at a constant rate of 300 p.p.m. based on dry-matter intake as hay and silage produce milk containing residues of dalapon. Values obtained over a 3-week feeding interval ranged from a low of 0.61 p.p.m. up to a maximum of 2.45 p.p.m. of dalapon. Since highest and lowest values were obtained in the first sampling date, 7 days after dalapon feeding started, the data suggest that a maximum level of dalapon residue can occur within 7 days when a constant level of feeding is maintained.

In most residue studies, particularly with insecticides, a normal build-up in residue usually occurs within the first week. In this experiment, the first sampling date was 7 days after dalapon feeding started. More frequent sampling earlier might have picked up this build-up if it occurred at all. The mean values by dates in this experiment over all breeds show a much lower value for the 14-day samples than for either the 7- or 21-day samples, 1.08, 1.46, and 1.42 p.p.m., respectively (Table III). Data in Table IV show the actual parts per million on the basis of actual dry matter consumed. The means for dates, over all breeds, show a relatively higher parts per million fed in the first week over the last two. This may be a partial answer to the high level in the first week. However, a close comparison of Tables III and IV indicates that on an individual basis, several animals in the first week approached the 300 p.p.m. level of feeding, but nevertheless dalapon residues were among the higher levels within breeds (animals 15 and 19). Figure 1 also shows consistently high levels within breeds for the first sampling date. Unquestionably, a marked variability can occur among animals as to the level of dalapon residue in the milk.

Frequency curves for parts per million of dalapon by number of animals are shown in Figure 2. Only values of the

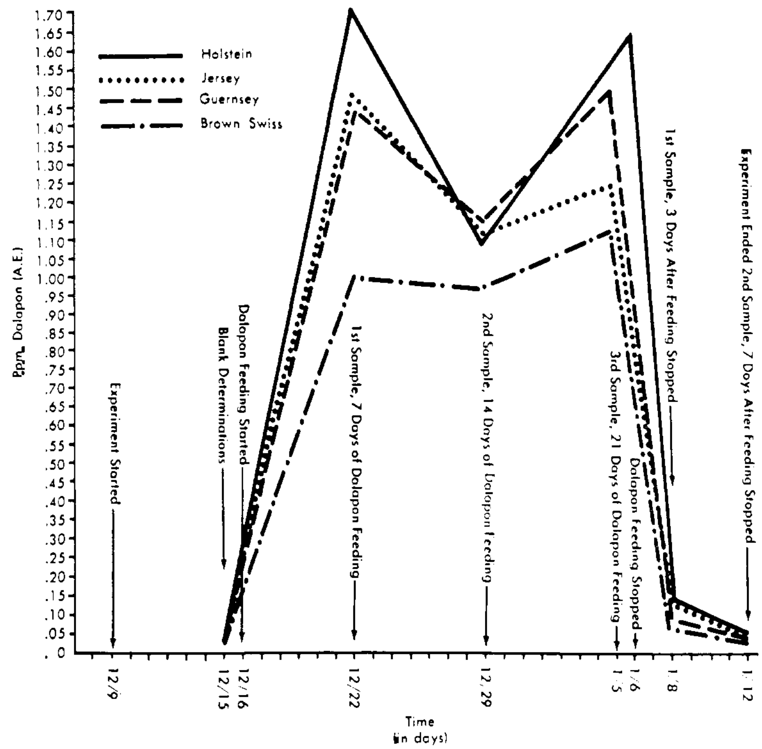

Figure 1. Mean values of dalapon residue by breeds during feeding trial

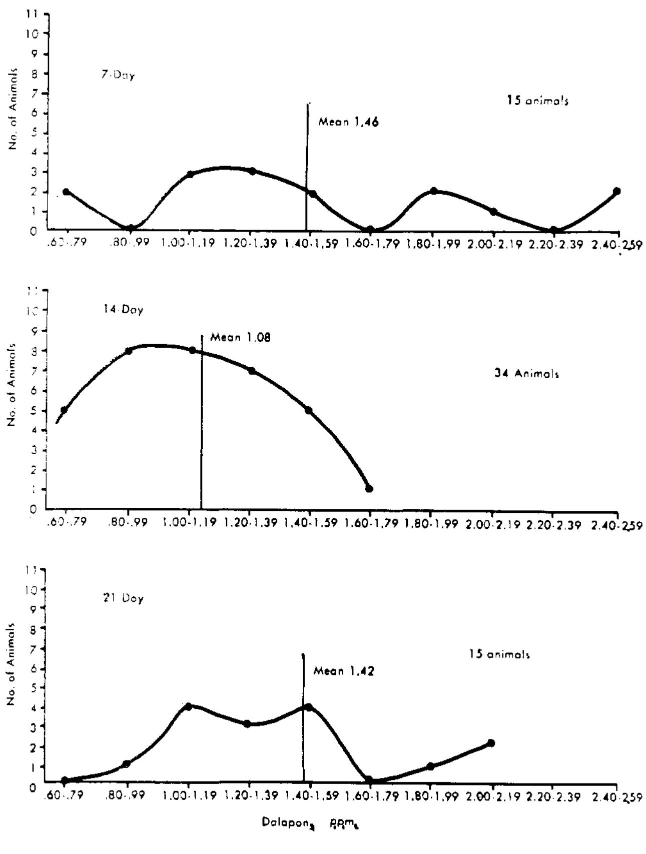

Figure 2. Frequency curves of dalapon residue and number of animals sampled at 7, 14, and 21 days after feeding had been started

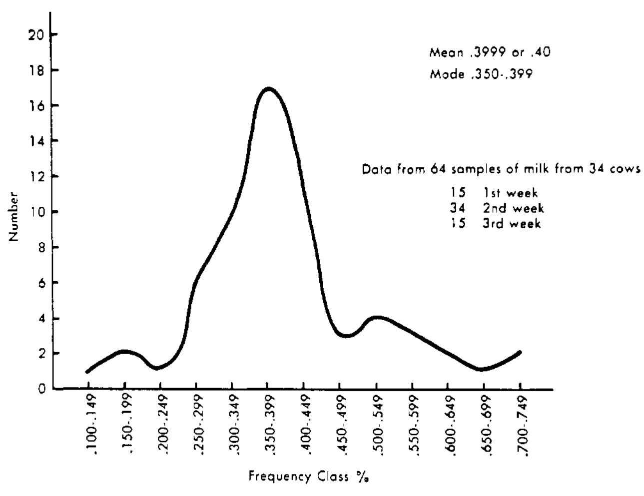

Figure 3. Frequency distribution of percentage of ingested dalapon appearing in milk

14-day sampling resemble a normal frequency curve. The number of animals on each side of the mean, disregarding animals included at the point nearest the mean, represents the most interesting point reference in the curves. For the 14-day samples, 13 animals fall on each side of the mean, whereas for the 7- and 21-day samples greater numbers of animals at the higher levels had greater influence on the mean than the greater number at lower levels.

Data clearly indicate that relatively high residue values do occur. The frequency, however, of excessively high values of dalapon exceeding 2.0 p.p.m. at a feeding of 300 p.p.m. may be extremely small. Only 7% of the samples tested for residue in this experiment exceeded 2.0 p.p.m.

RESIDUE AS A FUNCTION OF BREED. Animals were selected at varied stages of lactation and levels of milk production. The mean values for dalapon residues between and within breeds were nonsignificant. Although they were nonsignificant, a high degree of variability among dairy animals in respect to dalapon residue in milk does occur as shown in Table III. Standard deviations and standard errors for each sampling date are listed by breeds in Table V.

RESIDUE AS A FUNCTION OF MILK PRODUCTION. It is not unreasonable to assume some direct relation between residue in milk and milk production level. Based on results of this study, there appears to be no correlation between these two factors. Again, this leads to the conclusion that individual animals can vary as to their response to dalapon feeding. To clarify this point, several animals were selected for specific examples of variability (Table VI).

By comparing animals 2 and 5, one could suggest a direct correlation between milk production and dalapon residue. However, the remaining animals tend to disprove this point rather conclusively. Residue values in milk from animals 14 and 17 are completely opposite the values for animals 2 and 5; while animal 19, which about equals animal 14 in milk production, had over twice the dalapon residue.

The feeding of a constant level of dalapon based on dry-matter intake brought about some fluctuations in actual parts per million fed as shown in Table IV. As the experiment progressed, the dosage level approached the 300-p.p.m. feeding level more consistently— anticipated intake approached actual intake. However, variability is still evident in the second and third sampling dates of the feeding period.

PER CENT OF INGESTED DALAPON RECOVERED IN MILK. Percentages of dalapon recovered in milk based on actual parts per million fed during each weekly period are shown in Table VII. These values vary from a high of 0.747% to a low of 0.105%. The mean value for recovery over all breeds based on 64 samples was 0.3999%. Figure 3 shows this relation clearly.

RATE OF DALAPON DISAPPEARANCE WITH TIME. Data in columns 6 and 7 (Table III) represent the corrected dalapon residue in milk from all animals on the third and seventh days, respectively, after dalapon feeding had been stopped. Data indicate a rapid drop in residue to an average of 0.11 p.p.m. in 3 days and 0.045 p.p.m. in 7 days.

Data in Table VII also suggest that about 0.4% of dalapon ingested by a dairy animal may be in milk as a residue.

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INSECTICIDE RESIDUES

Aldrin and Dieldrin Content of Body Tissues of Livestock Receiving Aldrin in Their Diet

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SINCE it was first discovered that DDT and other chlorinated hydrocarbon insecticides (*2, 3*) are stored in the fat of beef cattle and excreted in the milk of dairy cows, practically all of these insecticides have been studied to determine the contamination resulting from the feeding of known levels in the diet.

Claborn *et al.* (*4*) reported on feeding studies of sheep and cattle where aldrin was added to the diet. Residues in the fat were calculated from organic chlorine determinations and reported as aldrin. Present information suggests that these results should have been calculated as dieldrin, because Bann and coworkers (*1*) have shown that aldrin undergoes a rapid epoxidation to dieldrin in the animal's body and that the dieldrin metabolite is stored in the fat. The conversion was shown to take place in pigs, rats, poultry, and dairy cows from oral ingestion, and in beef cattle and sheep following subcutaneous injections.

Since aldrin had been demonstrated as an effective insecticide against forage-feeding insects at low application rates, it was deemed desirable to make further studies with dosages lower than those reported by Claborn (*3, 4*) and to use the more sensitive and specific methods of analysis for determining aldrin (*7*) and dieldrin (*6*). Accordingly, in 1956 a study was carried out to determine these residues in the tissues of cattle, sheep, and hogs fed on normal diets artificially contaminated with aldrin.

Experimental

Two animals of each kind were fed control rations with no aldrin added. On the basis of prior experience and

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