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The Effect of Low Levels of Diethylstilbestrol and Plant Estrogens Upon Performance of Fattening Lambs[1]

By C. D. Story, W. H. Hale, E. W. Cheng and Wise Burroughs

The excellent feeding properties of good quality legume hay and certain vegetable oil meals have long been recognized by the livestock producer. The observed feeding values of these feedstuffs cannot be attributed entirely to their classical nutrient compositions. It has been long suspected that they contain unidentified factors that are stimulatory to growth.

One group of plant compounds that has recently received considerable attention is the plant estrogens (Bennetts *et al.*, 1946; Curnow *et al.*, 1948; Beck and Braden, 1951; East, 1950; Dohan *et al.*, 1951; and Cheng *et al.*, 1953). *Bartlett et al.* (1948) and Legg *et al.* (1950) suggested that the favorable influence of spring pasture upon milk production might be due to the high estrogenic activity of spring grass. Curnow and Bennetts (1952) reported that the estrogenic activity of subterranean clover was due primarily to 5:7:4 trihydroxy isoflavone (genistein). The glucoside of this compound, genistin, has been isolated from soybean oil meal to the extent of about 0.1% (Walter, 1941). Cheng *et al.* (1953), have shown that the compound isolated from soybean oil meal to contain estrogenic activity. Several other isoflavones isolated from hays and soybean oil meal have been shown to be estrogenic (Cheng *et al.*, 1954).

The effect of diethylstilbestrol (stilbestrol) pellets on weight gains when implanted in proper amounts in cattle and sheep is well known (Sykes *et al.*, 1953). It may be that natural plant estrogens exert a beneficial effect upon cattle and sheep similar to that noted with implanted stilbestrol. The purpose of study reported herein is to determine the value of a crude estrogenic extract from clover hay and genistin isolated from soybean oil meal in the ration of fattening lambs. These experimental products are also compared to stilbestrol added to rations on equivalent estrogenic levels.

Procedure

This study is divided into six individual feeding experiments and one group feeding experiment. The lambs used in all the experiments

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originated in the western United States and the experiments were conducted throughout the year rather than seasonally. The average starting weight for the individually fed lambs was approximately 70 pounds except in experiment 2 and 6 in which the starting weight was approximately 80 pounds. The average starting weight for the group fed lambs was 65 pounds. Wether lambs were used in all individually fed experiments. Mixed wether and ewe lambs were used in the group feed experiment.

In the individual feeding experiments four lambs were allotted at random to treatments from outcome groups based upon weight. In the group fed experiment 5 pens of 20 lambs each were allotted at random to treatments from outcome groups based upon weight. The ewe and wether lambs were equally distributed among lots. In all experiments the lambs were vaccinated for enterotoxemia prior to the start of the experiment. Carcass grades and dressing percentages are available on the major portion of the experimental treatments. All dressing percentages are based on cold carcass weights. Carcass grades are evaluated to the nearest one-third grade. The lambs were weighed at the start of the experiments and every 14 days thereafter.

The individually fed lambs were fed a mixed ration and allowed to feed from an individual self feeder, three hours at each of 2

Table 1
Basal Rations for Individually Fed Lambs

Ground alfalfa hay	50.0
Molasses	10.0
Cracked corn	38.0
Soybean oil meal	2.0
	100.0

daily feedings. The starting ration is listed in Table 1. In all the individually fed experiments except number 1 the hay was reduced and the corn increased by a corresponding amount so that the twentieth day the lambs were receiving a ration that contained 35% hay. All stilbestrol additions were mixed with the ration on the basis of stilbestrol per pound of ration rather than being fed daily as a supplement.

The genistin used was isolated from soybean oil meal as previously described by Cheng *et al.* (1953). In Experiment 1, clover hay which had been shown to contain considerable estrogenic activity was extracted by a similar method. Eight pounds of this extract was added to 100 pounds of the basal ration. In one group the extracted hay replaced the conventional hay of the ration.

The group fed lambs were fed a conventional shelled corn, soybean oil meal, alfalfa hay ration. The stilbestrol additions were

given twice daily in the soybean oil meal supplement. The levels added were based on a consumption of 3 pounds of feed per lamb daily. After the lambs were on full feed, the hay was limited fed so that the approximate grain to roughage ration was 60:40.

Results and Discussion

The weight gains, feed consumption, dressing % and carcass grade of the individually fed lambs are given in Table 2.

In experiment 1 the estrogenic activity of the hay was predetermined by mouse uterine assay and the extract added to the molasses at a level of 2-3 mcg. of equivalent stilbestrol activity per pound of ration. If the original hay contained factors that were growth stimulatory it was believed that these factors would appear in the hay extract and the feeding of the hay extract would permit a much higher level of these factors to be fed as compared to hay feeding alone. One group of lambs was implanted with 15 mg. stilbestrol as the growth promoting properties of this estrogenic compound, when implanted in ruminants was well known. Stilbestrol was also added at a level comparable to the estrogenic activity of the hay extract. The addition of 2 mcg. of stilbestrol per pound of ration or the 15 mg. stilbestrol implant increased rates of gain over the control by approximately 40%. The hay extract promoted rate of gain similar to that of the extracted hay which was approximately 10% above that of the controls. The hay extract and orally fed stilbestrol appeared to improve carcass quality whereas the stilbestrol implant lowered carcass quality.

In experiment 2 several levels of stilbestrol were tested along with one level of genistin. The 0.2 gm. genistin addition per pound of ration was equivalent in estrogenic activity to 4 mcg. of stilbestrol per pound of ration. The 1.5 mcg. stilbestrol addition resulted in a 26% increase in rate of gain. The higher levels appeared to decrease rate of gain when compared to the 1.5 mcg. level. Actually the highest level tested resulted in lower gains than the control. The genistin addition caused a 15% increase in rate of gain. On the basis of estrogen activity and response to stilbestrol in this experiment this approximate response might have been expected from the addition of 4 mcg. of stilbestrol per pound of ration.

Experiment 3 was conducted during late spring and early summer. The only animals available were ones approximately 1 year of age. All other experiments reported in this paper were conducted with lambs approximately 6-8 months of age. In this experiment no response was observed with any treatment except the 12 mg. stilbestrol implant. The lack of response on this experiment has no readily

Table 2

Weight Gains, Feed Intake, Dressing Percent and Carcass Grade of Individually Fed Lambs Fed Low Levels of Diethylstilbestrol and Genistin

Experiment 1.—Fed 63 days

	Addition to Basal Ration				
	0	2 mcg. DES[1] per lb.	Hay Extract	Extracted Hay	15 mg. DES Implant
Average daily gains, lb.	.34	.48	.37	.39	.49
Average daily feed, lbs.	2.72	3.20	2.92	3.13	3.00
Dressing percent	47.34	49.14	47.47	48.16	43.45
Grade[2]	5.75	6.00	6.75	5.75	5.00

Experiment 2.—Fed 42 days

	Micrograms DES per lb. Ration					0.2 gm. genistin per lb. ration
	0	1.5	3.0	6.0	12.0	
Average daily gains, lb.	.46	.58	.53	.49	.40	.53
Average daily feed, lbs.	3.62	4.19	3.72	3.69	3.31	3.58
Dressing percent	44.05	42.76	43.66	43.06	44.33	43.37
Grade	6.75	6.75	6.25	5.50	6.00	6.25

Experiment 3.—Fed 66 days

	Micrograms DES per lb. Ration						Grams genistin per lb. ration			12 mg. DES Implant
	0	0.5	1.0[3]	2.0	4.0	8.0	0.1	0.2	0.4	
Average daily gains, lb.	.36	.35	.32	.36	.34	.30	.33	.34	.32	.48
Average daily feed, lbs.	3.68	3.61	3.44	3.61	3.61	3.63	3.76	3.50	3.25	3.45
Dressing percent	48.05						49.98			47.60
Grade	5.75						5.75			3.25

Experiment 4.—Fed 70 days

	Micrograms DES per lb. Ration					
	0	2.0	4.0	16.0	80.0	160.0
Average daily gains, lb.	.40	.47	.41	.35	.35	.40
Average daily feed, lbs.	3.76	3.68	3.36	3.31	3.28	3.29
Dressing percent	52.22	50.90	51.23	51.38	50.27	50.68

Experiment 5.—Fed 56 days

	Micrograms DES per lb. Ration								
	0	0.5	1.0	2.0	4.0	8.0	150.0	12 mg. DES Implant	0.15 gm. genistin per lb. ration
Average daily gains, lb.	.48	.49	.54	.50	.43	.51	.48	.54	.52
Average daily feed, lbs.	4.34	4.15	4.27	4.46	4.08	4.42	3.79	3.52	4.40
Dressing percent	45.60	46.99	46.55	48.88	49.04	46.22	49.29	45.35	47.70
Grade	6.00	5.50	6.25	6.00	6.00	5.75	5.50	4.25	6.25

Experiment 6.—Fed 56 days

	Micrograms DES per lb. Ration					
	0	0.5	1.0	2.0	300.0	12 mg. DES Implant
Average daily gains, lb.	.38	.36	.25	.48	.41	.34
Average daily feed, lbs.	4.11	3.76	3.25	4.03	3.60	3.66

[1]Diethylstilbestrol.
[2]A numerical value of 6 is equivalent to choice minus.
[3]3 lambs in this treatment as 1 lamb died.

available explanation. A contributing factor may have been the age of the animals. The stilbestrol implant apparently lowered carcass grade.

In experiment 4 higher levels of stilbestrol were fed than in previous experiments. The 2 mcg. level increased rate of gain by 18% of the controls. The higher levels tested appeared to depress gain when compared to the 2.0 mcg. level.

With experiment 5, the 1.0 mcg. level of stilbestrol gave a response similar to the 12mg. stilbestrol implant. A 13% response was noted with both of the above treatments. The 0.15 gm. genistin addition resulted in only an 8% increase in rate of gain. The marked depression in rate of gain by feeding the higher levels of stilbestrol was noted in this experiment.

In experiment 6 the 2 mcg. level of stilbestrol resulted in a 26% increase in rate of gain. No response was noted due to the 12 mg. stilbestrol implant.

Table 3

Weight Gains, Feed Intake, Dressing Percent and Carcass Grade of Group Fed Lambs Fed Low Levels of Diethylstilbestrol, 20 lambs per lot, fed 89 days

	Micrograms DES per lb. Ration				12 mg. DES
	0	2.0	80.0	160.0	Implant
Average daily gains, lb.	.42	.42	.42	.40	.48
Average daily feed, lbs.	3.19	3.24	3.19	2.95	3.23
Dressing percent	52.52	52.64	51.74	51.34	50.23
Grade	5.68	5.70	4.85	5.00	4.14

The results of the group feeding trial are presented in Table 3. In the results presented the ewe and wether lambs have been grouped together, as no difference in response was noted between sexes. The only response noted in this trial was with the 12 mg. stilbestrol implant. The lower levels of stilbestrol fed did not stimulate rates of gain. The 12 mg. stilbestrol implant markedly reduced carcass grade and appeared to reduce dressing percentage.

In 5 out of 7 experiments the 1-2 mcg. of stilbestrol per pound of ration stimulated rate of gain in growing fattening lambs. In the 5 individual feeding trials that showed response to the oral stilbestrol the average for the six individual feeding experiments was 21%. As mentioned previously the one individual feeding trial in which no response to low level stilbestrol feeding was observed, was conducted with nearly mature lambs. No explanation is available for the lack of response noted in the group feeding experiment.

In the four experiments implanted with 12 mg. of stilbestrol on which carcass data are available there was a definite lowering of grade together with a decrease in dressing percentage. In general,

dressing percentage and carcass grade were equal to or slightly higher in the stilbestrol fed animals when compared to the control. A similar indication was also noted when genistin was fed. Feed consumption was affected little if any by the stilbestrol feeding. With the lambs fed the hay extract there appeared to be a marked effect upon carcass grade suggesting that certain compounds were in the extract which caused an increased deposition of fat, thus improving carcass grade.

The data presented above suggest that low level estrogenic activity in a lamb fattening ration (natural or added) results in improved rate of gain and possible improvement in carcass quality in some instances. The results obtained in this group of experiments are not entirely consistent among experiments. Later work (Hale *et al.*, 1955) with higher levels of stilbestrol feeding of lambs (2-3.5 mg. stilbestrol per lamb per day) gave more consistent results. However, with the higher levels of feeding no improvement in carcass grade or dressing percentage was noted. In fact, at the 3.5 mg. level per pound or ration, a decrease in carcass grade occurred.

The data presented in these experiments would support the idea that low level estrogenic activity found in legume forages contributes to the good feeding qualities of these forages. Whether the effects of these low level estrogen feeding rates are upon the physiological processes of the animal or upon rumen metabolism cannot be stated at this time.

Summary

Six individual lamb feeding experiments and one group feeding experiment were conducted to determine the effect of low level stilbestrol and plant estrogen supplementation upon weight gains with fattening lambs. In the individual lamb feeding experiments mixed rations were fed and a standard shelled corn, soybean oil meal, alfalfa hay ration was fed in the group feeding experiment.

The plant estrogen treatments were fed genistin isolated from soybean oil meal and a crude methanol extract from clover hay that contained estrogenic activity. The levels of stilbestrol fed ranged from 0.5 mcg. to 160 mcg. per pound of ration.

In 5 of the 6 individual lamb feeding experiments a growth response was noted at the 1.0-2.0 mcg. stilbestrol level of feeding. The average response for the six trials was 21%. No response was noted in the group feeding trial. In two of three experiments genistin increased rate of gain when compared to the controls. Data from certain of the experiments in the study reported herein suggest that low level feeding of estrogenic material to fattening lambs improved carcass grades.

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