THE INFLUENCE OF DIETARY TAPAZOLE AND CHLORTETRACYCLINE ON LOW-LEVEL STILBESTROL IMPLANTED FEEDER LAMBS

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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INTRODUCTION

In the past decade intensive research has been directed toward increased productivity of meat animals by means of chemical stimulation. In general the objectives in this field of investigation have been to increase (1) the availability of nutrients and (2) the metabolic efficiency in animals.

The fact that estrogenic compounds markedly stimulate proteineous growth of ruminant animals has been well established. Higher levels of these materials produce adverse physiological conditions and undesirable carcass characteristics; the desirable stimulation is dependent upon levels of administration. The response from various levels of the synthetic estrogen, diethylstibestrol, was investigated in these experiments. Levels lower than those used by previous investigators were studied.

Since the thyroid gland functions as a regulator of general metabolism, there have been a number of investigations on the alteration of anabolic and catabolic balance through thyroidal control. Due to the undesirable physical nature of chemicals used in this attempt, investigators have not consistently obtained satisfactory results.

The goitrogen used in these studies, 1-Methyl, 2-Mercaptoimidazole (commonly termed tapazole), is the most potent antithyroid compound known. Because of the potency, it was assumed that this drug may be free of the adversities of similar materials previously investigated.

Another attempt to stimulate ruminant performances has been through the use of dietary antibiotics. The response from antibiotics in ruminant animals seems to be greatly depedent upon various environmental factors such as prevalence of disease and physical and nutritional stresses. This is considered to be an explanation of the erratic response from the feeding of antibiotics.

The possibility exists that thyroidal supression may influence the susceptibility of animals to sub-clinical diseases. Furthermore, thyroidal alteration may modify estrogenic stimulation in ruminants. Consequently, the objectives of these investigations were, in part, to determine the combination effects of the administration of tapazole, chlortetracycline and stilbestrol to feed-lot lambs.

REVIEW OF LITERATURE

Numerous workers have well established the fact that the administration of stilbestrol to cattle and sheep increases rates and the efficiency of gain. Because of the great number of published experimental results relative to stilbestrol implantation, this review will be limited only to the pertinent reports.

The value of stilbestrol implantation was first observed by Lorenz (1945) who implanted broilers with approximately 20 milligrams of the "hormone". Because of the amount of stilbestrol used for poultry, workers initially tended to implant much higher levels of stilbestrol in cattle and sheep. Andrews, Beeson and Harper (1949) of Purdue University were the first to report increased body weight gains and improved feed efficiency that resulted from 12 and 24 mg. of stilbestrol subcutaneously implanted in feeder lambs. With an extensive study on the mode of action of stilbestrol in ruminants, Clegg and Cole (1954) observed increased gains in stilbestrol-implanted ewe as well as wether lambs. Many other workers have reported similar findings (Jordan, 1950; Perry _et al_., 1951; O'Mary _et al_., 1952; Means _et al_., 1953; Jordan and Croom, 1956). The implantation of 100-120 mg. of stilbestrol in pasture-fed (Deans _et al_., 1953) and feed-lot steers (Andrews *et al.*, 1954) has resulted in significantly increased rates of gain and feed utilization.

Although these high levels of administration have consistently resulted in a marked growth response, many undesirable physiological effects, commonly referred to as "side effects", have been observed in the stilbestrol treated animals. Several workers have noted abnormal development of urogenital systems of "hormone" implanted cattle and sheep (Bell *et al.*, 1954; Brooks *et al.*, 1954; Jordan, 1953). Greater pelvic measurements were observed by Deans *et al.* (1953). Clegg and Cole (1954) along with many other workers have reported mammary development in both the male and female.

A reduction of carcass quality has been the most widely observed "side effect" that has resulted from stilbestrol implantation. In cattle (Cahill *et al.*, 1954) as well as sheep (Bell *et al.*, 1954) stilbestrol implantation has significantly depressed carcass grade through alteration of the depot fat. Clegg and Cole (1954) compared the following carcass characteristics of implanted steers to similar untreated animals: (1) larger muscle fibers and a more course appearance of the meat, (2) a darker red color of the meat, (3) a reduction of marbling, (4) decreased amounts of both external and internal depot fat, (5) heavier shoulders and rounds but smaller loins and (6) atypical conformation similar to that of stags.

Many studies have been conducted to determine the most satisfactory level of stilbestrol implantation that would result in increased gains without depressing carcass performance. The critical level has been difficult to obtain because of possible interrelationships of the stilbestrol with sex, stage of maturity and inherent metabolic activity of the animal. South Dakota reports (Jordan, 1953) indicated that the severity of stilbestrol "side effects" in lambs increased with age of the animal. Heifers that did not respond to stilbestrol with increased growth exhibited depressed thyroid glands and increased growth hormone concentrations in the anterior pituitary gland. In steers, the stilbestrol influence on the endocrine system has been found to be somewhat different. Stilbestrol implantation has been reported to increase the adrenal and pituitary weights in steers; however, the thyroid gland and the growth hormone content of the anterior pituitary were unchanged (Clegg and Cole, 1954; Cahill et al., 1954). Clegg and Cole (1954) and Whitehair et al., (1953) reported that stilbestrol significantly increased nitrogen retention in steers and in wether lambs respectively. There has been much evidence reported that the growth response from stilbestrol was mediated through an increased protein mass at the expense of adipose tissue (Clegg and Cole, 1954; Cahill et al., 1954).

Much interest has been advanced in the alteration of the thyroidal activity for increased performance of meat animals. The logic of partial suppression of thyroid activity is that a depression of basal metabolism would result and more of the ingested energy may be available for deposition in tissues as fat. While stilbestrol possesses a stimulatory effect on the sex characteristics of an animal (Clegg and Cole, 1954; Ellison and Burch, 1936), hypothyroidism results in depressed sexual activity (Blaxter et al., 1949). Since dietary goitrogens depress metabolic activity, the growth and carcass alteration induced by stilbestrol implantation may be modified when the two drugs are administered simultaneously to an animal. In view of the foregoing conclusions it can be assumed that a goitrogenic drug could not only modify certain deleterious effects of stilbestrol treatment, but possibly cause an accumulative growth response.

Although many substances are known to possess goitrogenic properties, only thiouracil and thiourea have been used to any extent in nutritional research. Experimental results with these materials have not been consistent. Blaxter et al. (1949) in an extensive literature review concluded that the unpalatability of these drugs may have been a confounding factor in many experiments.

Most of the data presented have indicated that antithyroid compounds should be administered only to animals that have attained skeletal maturity. Van der Noot et al. (1948) fed thiouracil to weanling pigs for 97 days with resulting gains of approximately one-third that of the control animals. Similar results were found with young chickens (Glazner and Jull, 1946).

In general, the feeding of thiouracil to poultry has resulted in improved finish and fleshing qualities in the carcass. Andrews and Schnetzler (1946) found that feeding thiouracil to broilers did not increase weight gains; however, the treated birds were considerably fatter. Mixner (1946) reported increased rates of gain in cockerals that were fed a ration containing 0.1 per cent thiouracil. In other experiments (Van der Noot *et al*., 1948; Andrews and Bohren, 1947) fleshing, finish and market grade were consistently improved.

The results of experiments conducted with swine, cattle and sheep have not been as consistent as those with poultry. Reports have varied from increased (Van der Noot *et al*., 1947; Van der Noot *et al*., 1950) to decreased rates of gain (McMillen *et al*., 1946; Van der Noot *et al*., 1950). Similar variable results of experimentation with cattle and sheep have been reported. Andrews and associates (1947) found that thiouracil intakes of 0.175 to 0.544 grams per lamb daily had no effect on the rates of gain. The thiouracil-treated lambs produced carcasses with a higher grade and yield; however, these differences were not statistically significant. An increase in the amount of internal and cod fat was noted but no quantitative measurements were made. The rates of gain of yearling steers that were fed levels of thiouracil ranging from 2.0 to 6.0 grams daily were not significantly different; however, the animals receiving amounts of 2.0 and 4.0 grams daily gained faster and also required less feed per pound of gain than did the control group (Beeson _et al._, 1946). Barrick and co-workers (1949) fed four levels of both thiouracil and propyl-thiouracil to fattening lambs with no resulting differences in growth or carcass performance. New Jersey workers (Van der Noot, Reece and Skelly, 1950) observed depressed gains in lambs fed thiouracil but aged ewes on the same treatment responded with increased gain and feed efficiency.

There have been no reports in the literature concerning the feeding of tapazole to meat animals. Tapazole when incorporated into an implant by Story _et al._ (1956) did not influence steer performance.

The physiological stress predisposed by thyroidal depression may decrease the resistance of animals to disease conditions. Consequently, the incorporation of antibiotics in the rations of tapazole-treated animals could possibly have a synergistic effect.

Antibiotics are well established additives to the rations of swine, poultry and young dairy calves. General observations have been improved growth and feed utilization and a reduction of the incidence of disease. Lassister (1955) has presented a review of antibiotics as growth stimulants for dairy calves.

The results of experiments with dietary antibiotics in mature ruminants have not been as conclusive as those obtained from studies with monogastric animals and young calves. Improvement of feed consumption (Jordan, 1952), reduction of digestive disorders (Kunkel et al., 1956), increased rates of gain and improved feed utilization (Hatfield et al., 1954; Elliot and Ellsworth, 1953; Johnson et al., 1956) have been noted by various workers. In contrast, several workers have reported no effect from dietary antibiotics in lambs (Jordan and Bell, 1954; Bohman et al., 1955; Kunkel et al., 1956). Jordan and others (1956) fed chlortetracycline and stilbestrol singly and in combination to fattening lambs. No differences in rate of gain, feed efficiency, dressing percentage or carcass grade were found.

The mode of action of antibiotics in both monogastric and ruminant animals is not clear. A theory that has received most attention is that antibiotics exert a control on disease producing organisms thus creating a healthier environment. It has been postulated that the effect in ruminants may be a selective or stabilizing influence on the rumen microflora. Coates et al. (1955) advanced the idea that in antibiotic-fed poultry the intestine becomes more permeable to nutrients.

Because of the different possible modes of action of stilbestrol, tapazole and antibiotics, an accumulation of beneficial effects from all three materials could result.

Consequently, the effects on animal performance of these materials administered singly and in all possible combinations were studied.

PROCEDURE

Trial I

One hundred eighteen cross-bred feeder lambs were numbered and randomly allotted to six pens of 15 and two pens of 14 animals. The statistical design was a 2x2x3 split plot, randomized block that incorporated two replications of the following dietary treatments: (1) control, (2) tapazole, (3) chlortetracycline and (4) tapazole and chlortetracycline. The lambs in each pen were randomly divided for three equal sub-treatments and subcutaneously implanted at the base of the ear with the following amounts of stilbestrol: (1) none, (2) 3 mg. and (3) 6 mg. The dietary treatments were randomly assigned by pens and the lambs were allowed five days adjustment to the ration. At this time the lambs were individually weighed and implanted with stilbestrol.

The all-pelleted ration, shown in table 1, was fed *ad libitum* to all lambs. For the respective dietary treatments, chlortetracycline and tapazole were incorporated at the rates of 3.75 mg. and 7 mg. per pound of feed.

Twenty-four hour fecal collections were taken over a period of six days beginning on the thirtieth day of the experiment from six lambs of each of the sub-treatment groups that were implanted with (1) none and (2) 6 mg. of stilbestrol. All rations and feces were analyzed for moisture, crude protein, crude fiber, ether extract, ash, nitrogen-free extract and lignin by approved AOAC procedures (table 1). Apparent digestibility coefficients were determined by means of the lignin ratio technique as outlined by Schneider *et al.* (1955).

TABLE 1. CONSTITUENTS OF THE EXPERIMENTAL BASAL RATION IN TRIALS I AND II

Feed Constituents[a]	Per Cent	Chemical Constituents	Per Cent
Cotton Gin Trash	33.2	Moisture	5.70
Cane Molasses	8.3	Crude Protein	13.90
Barley	19.5	Crude Fiber	14.15
Milo	19.5	Lignin	7.85
Cottonseed Meal	10.5	Ether Extract	1.43
Dehydrated Alfalfa Meal	8.0	N.F.E.	55.09
		Ash	9.73
Trace Mineral Salt	0.5		
Bone Meal	0.5		
Anise (8 oz./Ton)			

[a]Compounded into one-half-inch pellets.

All lambs were individually weighed at 0, 21, 42 and 54 days of the experimental period. At 54 days, two and three of the heaviest lambs respectively were selected from each replicated sub-treatment group for slaughter. These

60 lambs were designated as Group A. The remaining 58 animals, designated as Group B, were individually weighed at 75 days and sent to market. Feed consumption was recorded by pen for each weigh period. All lambs were subjected to an overnight stand without feed before they were shipped to market. On-truck weights and 24-hour chilled carcass weights were used to calculate dressing percentage. Carcass grades were recorded as high choice, low choice, high good or low good as indicated by a federal grader and designated numbers 1, 2, 3 and 4 respectively for statistical treatment. All results were subjected to analyses of variance using unweighted sub-treatment means as outlined by Snedecor (1955).

Trial II

Forty ewe and forty wether lambs were randomly allotted to eight pens of five ewe and five wether lambs each. The statistical design was a 2x4 randomized block that incorporated two replications of the following dietary tapazole treatments imposed on both sexes: (1) none, (2) 3.5 mg., (3) 7.0 mg. and (4) 14.0 mg. per pound of feed. All lambs were subcutaneously implanted at the base of the ear with 3 mg. of stilbestrol. All rations were formulated to contain 7.0 mg. of chlortetracycline per pound. The tapazole treatments were randomly assigned by pen and the lambs were allowed five days adjustment to the ration. At this time the lambs were individually weighed and implanted with stilbestrol. The composition of the basal ration fed *ad libitum* in this trial was identical with the ration fed in Trial I (table 1).

All lambs were individually weighed at 0, 21, 42 and 68 days of the experimental period. Feed consumption was recorded by pen for each weigh period. All lambs were trucked 120 miles to market. Off-truck live weights and warm carcass weights were obtained for the calculation of dressing percentage. Carcass grades were recorded as prime, high choice, average choice, low choice and good as indicated by a federal grader and designated numbers 1, 2, 3, 4 and 5 respectively for convenience of statistical treatment. All data were subjected to analyses of variance as outlined by Snedecor (1955).

RESULTS AND DISCUSSION

Trial I

Rates of Gain: The average influence of the dietary and stilbestrol treatments are shown in table 2; the respective statistical treatment of the data are presented in table 6.

When all levels of stilbestrol treatment were considered neither chlortetracycline nor tapazole fed singly or in combination significantly influenced rates of gain. As indicated in the literature review, similar results have been reported. Jordan and Bell (1954) and Kunkel *et al.* (1956) found no effect from feeding antibiotics to lambs while Barrick *et al.* (1949) reported no differences in lamb gains resulting from the administration of various levels of the goitrogen, thiouracil.

The lack of a response from antibiotics in this trial may have been due in part to an absence of disease conditions. The facilities used in this experiment had not been previously inhabited by sheep. Moreover, no evidence of disease or infection was detected throughout the study in any lambs.

As shown in table 6, highly significant linear and quadratic effects of stilbestrol implantation were found. This is further illustrated in figures 1 and 2. The average daily gain of lambs implanted with 3 mg. of stilbestrol was 12 per cent higher than that of the lambs implanted with 6 mg. This was due to an interaction effect of the 3 mg. level of implanted stilbestrol with dietary tapazole (table 6). This interaction will be considered later in the discussion. When all dietary treatments were considered, the beneficial effects of the 3 mg. and 6 mg. levels of stilbestrol implantation were of comparable value.

No significant difference was found between the rates of gain of implanted lambs fed with and without chlortetracycline for 54 days (table 6). However, in the lambs marketed at 75 days (Group B) highly significant linear and quadratic interactions of the antibiotic and stilbestrol occurred. Since the heaviest lambs were marketed at 54 days (Group A), the lack of antibiotic response in these lambs may have been due in part to the fact that these animals were thriftier and less susceptible to stress. Furthermore, it can be noted that the animal behavior of treatment replications of Group B when compared to Group A was of a more homogenous nature as shown by the reduced error (B) in table 6. For the lambs fed for 75 days the greatest antibiotic response was in those animals implanted with 6 mg. of stilbestrol. In contrast, no differences in lamb performance were observed by Jordan et al. (1956) when stilbestrol and chlortetracycline was fed singly and in combination.

It is shown in table 6 that a significant quadratic and a non-significant linear interaction of dietary tapazole and implanted stilbestrol occurred. As graphically illustrated in figures 1 and 2, the lambs implanted with 3 mg. of stilbestrol that were fed tapazole gained markedly faster than other treatment groups. In contrast, tapazole-fed lambs implanted with 6 mg. of stilbestrol gained only slightly more than the non-implanted tapazole-fed lambs; neither of these two groups gained as fast as those lambs that received no treatment (table 2). Apparently the value of dietary tapazole for increased lamb gains is dependent upon the level of implanted stilbestrol. This interaction was further investigated in Trial II.

Furthermore, these data indicate that the variation of the magnitude of the stilbestrol response reported by others (Clegg and Cole, 1954; Andrews _et al._, 1956) may be due, for the most part, to the variable metabolic rates of the experimental animals.

Although the data presented in table 2 and figures 1 and 2 show that lambs treated with 3 mg. of stilbestrol and fed the combination of chlortetracycline and tapazole gained faster than any other treated group, this difference was due only to an additive effect.

Feed Consumption and Efficiency: Since stilbestrol implanted and non-implanted lambs were fed together by pen, only the influence of dietary additives on feed consumption

TABLE 2. THE INFLUENCE OF CHLORTETRACYCLINE, TAPAZOLE AND STILBESTROL IMPLANTATION ON RATES OF GAIN IN FATTENING WETHER LAMBS

	Mg. Implanted Stilbestrol	Number of Lambs			Average Initial Weight			Average Daily Gain		
		Group A	Group B	Total	Group A	Group B	Avg.	Group A	Group B	Avg.
Control	0	5	5	10	73.8	60.2	67.0	.515	.533	.534
	3	5	4	9	72.2	66.2	69.6	.565	.506	.563
	6	5	5	10	72.0	65.6	68.8	.578	.523	.578
	Average				72.7	63.8	68.4	.553	.521	.558
Chlor-tetra-cycline	0	5	5	10	66.2	57.4	61.8	.468	.375	.454
	3	5	5	10	65.4	63.8	64.6	.516	.485	.577
	6	5	5	10	70.0	60.0	65.0	.648	.506	.611
	Average				67.2	60.4	63.8	.544	.455	.528
Tapazole	0	5	5	10	66.6	63.0	64.8	.406	.426	.445
	3	5	5	10	62.2	60.6	61.7	.583	.567	.600
	6	5	4	9	62.0	60.8	61.4	.501	.426	.512
	Average				63.7	61.6	62.7	.497	.473	.519
Chlor-tetra-cycline & Tapazole	0	5	4	9	70.8	61.8	66.8	.476	.350	.412
	3	5	5	10	70.2	65.4	67.8	.733	.605	.701
	6	5	5	10	71.4	66.0	68.7	.616	.451	.478
	Average				70.8	64.5	67.7	.608	.469	.576

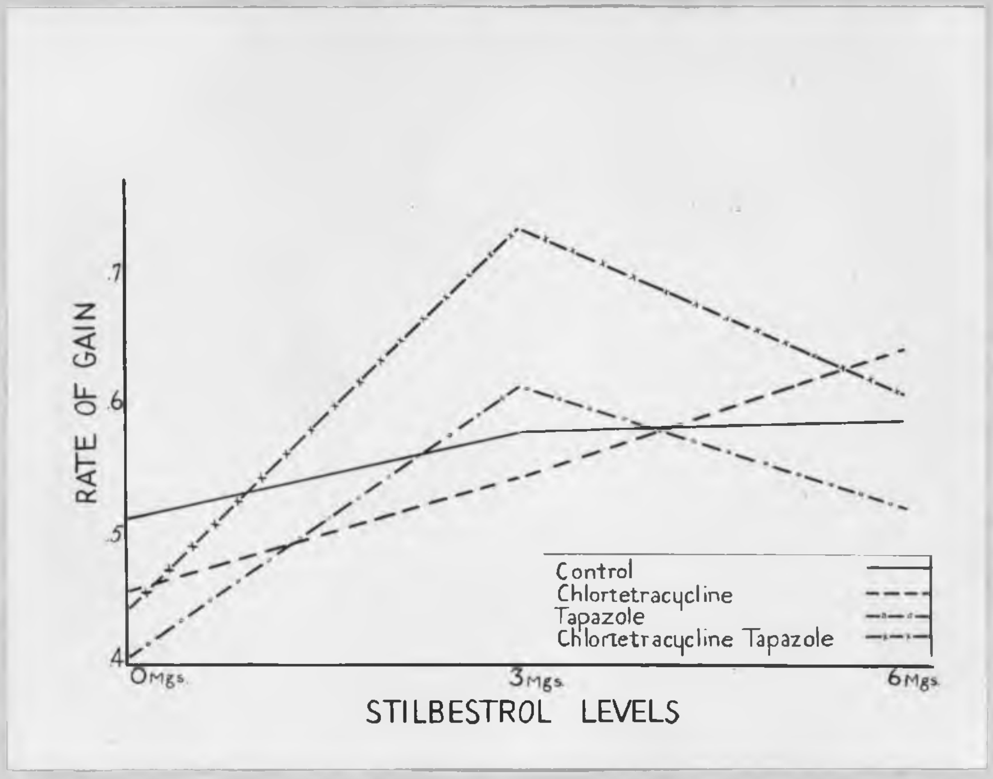

Figure 1. The effect of the level of stilbestrol implantation on chlortetracycline and tapazole-fed lambs marketed at 54 days.

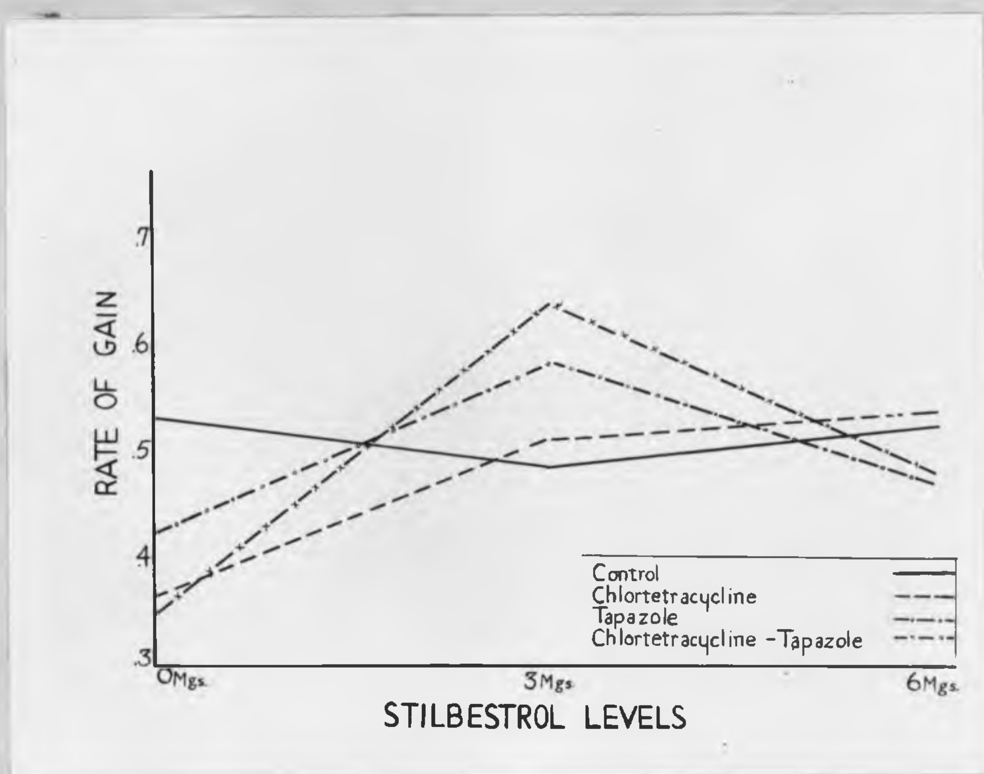

Figure 2. The effect of the level of stilbestrol implantation on chlortetracycline and tapazole-fed lambs marketed at 75 days.

could be measured (table 3). In this respect, no significant differences were found. As previously discussed, dietary treatments did not significantly influence rates of gain. Consequently, no significant dietary effect on feed efficiency could be expected.

The data presented in table 3 shows slightly increased feed consumption and decreased efficiency of feed utilization by tapazole-treated lambs. In view of this evidence it can be assumed that tapazole did not influence palatability of the rations. Palatability has been of major concern in

TABLE 3. THE INFLUENCE OF CHLORTETRACYCLINE AND TAPAZOLE ON FEED CONSUMPTION AND FEED EFFICIENCY IN FATTENING WETHER LAMBS

Treatment	Average Daily Feed Consumption (lbs.)			Feed/Pound Gain (lbs.)		
	Groups A & B[a]	Group B[b]	Avg.	Groups A & B[a]	Group B[b]	Avg.
Control	3.63	5.06	3.85	6.54	9.28	6.90
Chlortetracycline	3.54	4.54	3.69	6.54	11.54	6.89
Tapazole	3.55	4.53	3.87	7.16	8.60	7.44
Chlortetracycline & Tapazole	3.92	4.51	4.02	6.51	11.93	7.47

[a]Values for groups A and B are for a 54 day feeding period.

[b]Values for group B are for an additional 21 day feeding period.

the use of other antithyroid materials. For example, Andrews *et al.* (1947) reported that thiouracil caused reduced feed intake because of the bitterness and the unpalatability of this material.

Digestibility of Nutrients: The average influence of treatments on the apparent digestibility of nutrients is summarized in table 4.

The greatest mean differences occurred in crude fiber digestion, but these differences did not approach statistical significance. It was concluded that neither chlortetracycline, tapazole nor stilbestrol effected the digestibility of nutrients by lambs in this study. Relatively high levels of antibiotics have been shown to decrease digestibility of nutrients, particularly that of crude fiber (Bell *et al.*, 1950; Horn *et al.*, 1955). However, Tillman and MacVicar (1956) observed decreased digestibility of dry matter, crude protein, crude fiber and nitrogen-free extract in sheep fed a lower amount of chlortetracycline than that used in this study.

With respect to the influence of stilbestrol on digestibility of nutrients, results in accord with those obtained in this study have been reported. While Clegg and Cole (1954) and Jordan (1953) observed increased nitrogen retention digestibility of nutrients was unaffected.

TABLE 4. THE INFLUENCE OF CHLORTETRACYCLINE, TAPAZOLE AND STILBESTROL IMPLANTATION ON DIGESTIBILITY OF NUTRIENTS BY FATTENING LAMBS[a] (TRIAL I)

	Implanted Stilbestrol Mg.	No. Lambs	Dry Matter	Crude Protein	Crude Fiber	Ether Extract	Ash	Nitrogen-Free Extract
Control	0	4	62.74	56.38	28.19	75.82	47.58	76.01
	6	5	63.64	54.03	27.17	77.82	53.05	77.39
	Avg.		63.24	55.07	27.62	76.93	50.62	76.77
Chlor-tetra-cycline	0	6	62.10	55.45	24.50	71.97	52.56	76.23
	6	6	63.21	57.40	27.87	73.09	54.99	75.57
	Avg.		62.66	56.42	26.18	72.53	53.77	75.90
Tapazole	0	6	62.42	55.88	23.90	77.29	53.34	75.74
	6	6	63.60	56.39	23.31	75.44	53.75	77.23
	Avg.		63.01	56.13	23.60	76.36	53.54	76.48
Chlor-tetra-cycline & Tapazole	0	5	63.37	56.39	23.31	75.44	53.75	77.23
	6	6	62.44	55.86	22.66	63.88	55.20	76.01
	Avg.		62.91	56.10	22.95	69.13	54.54	76.56

[a]Expressed as per cent of nutrient digested.

Carcass Evaluation: Carcass characteristics as influenced by treatments are presented in table 5. Statistical analyses of these data revealed no significant trends or treatment effects, even in those lambs implanted with 6 mg. of stilbestrol.

Many workers have reported lowered carcass grades resulting from stilbestrol implantation (O'Mary *et al.*, 1952; Bell *et al.*, 1953; Wilkinson *et al.*, 1955 and others). Although these workers implanted lambs with levels of stilbestrol higher than those administered in this trial, Jordan (1953) reported lowered carcass grades in lambs implanted with 6 mg.

None of the other commonly reported "side effects" such as rectal prolapse (Bell *et al.*, 1954) and blockage of urinary tract (Jordan, 1953) were observed in this study.

TABLE 5. THE INFLUENCE OF CHLORTETRACYCLINE, TAPAZOLE AND STILBESTROL IMPLANTATION ON CARCASS CHARACTERISTICS OF WETHER LAMBS

Treatment	Implanted Stilbestrol Mg.	Average Carcass Grade[a]	Average Dressing Per Cent[b]
Control	0	2.2	50.2
	3	2.0	49.2
	6	2.4	50.8
	Average	2.2	50.1
Chlortetracycline	0	2.4	52.6
	3	2.2	50.5
	6	2.7	48.3
	Average	2.4	50.5
Tapazole	0	2.4	50.9
	3	2.1	48.7
	6	2.8	49.2
	Average	2.3	49.0
Chlortetracycline + Tapazole	0	2.4	50.5
	3	2.3	48.2
	6	2.2	50.1
	Average	2.3	49.6

[a]The numbers 1, 2, 3 and 4 were assigned to the grades high choice, low choice, high good and low good respectively for statistical treatment.

[b]Off-truck live weights and chilled carcass weights were used to calculate dressing per cent.

TABLE 6. ANALYSIS OF VARIANCE OF TREATMENT EFFECTS (TRIAL I)

Source[a]	df	Mean Squares				
		Gain[b] (54 days)	Gain[b] (75 days)	Carcass Grade	Dressing Per Cent	Feed/Pound Gain (lbs.)
Replicates	1	12.54	1.13	.0008	4.34	.35
Diets	3	27.11	26.44	.0561	1.83	---
C	(1)	35.57	23.06	----	.80	---
T	(1)	.58	48.94	----	4.68	---
CT	(1)	44.61	5.07	----	.01	---
Error (A)	3	45.20	94.50	.8381	1.86	.43
DES	2	155.42**	212.63**	.3056	8.77	---
L	(1)	211.41**	145.69**	.2258	10.08	---
Q	(1)	99.73*	280.13**	.3852	6.52	---
DES X Diets	6	25.37	60.75**	.1075	2.98	---
CL	(1)	23.32	91.69**	----	----	---
TL	(1)	.87	.56	----	----	---
CTL	(1)	.87	7.88	----	14.63	---
CQ	(1)	2.04	52.31**	----	----	---
TQ	(1)	111.68*	209.81**	----	----	---
CTQ	(1)	13.41	.06	----	----	---
Error (B)	8	11.08	1.86	.1837	4.34	---
Treatments	3	-----	-----	----	----	.20

[a]C---Chlortetracycline, T---Tapazole, DES---Diethylstilbestrol, L---DES Linear, Q---DES Quadratic.

[b]Mean squares calculated from total gain.

*P < .05 **P < .01

Trial II

Rates of Gain: The influence of levels of tapazole on lamb gains is summarized in table 7. Appropriate statistical analysis of total gain is shown in table 10.

Neither sex nor level of tapazole significantly influenced lamb gains. Statistical analysis revealed a significant cubic interaction of sex and level of tapazole. As illustrated in figure 3, the ewe lambs receiving 7.0 mg. of tapazole per pound of feed gained considerably less than the ewe lambs fed either the higher or the lower level. No logical explanation of this phenomenon can be advanced other than the normal biological variation of the lambs used in this experiment.

Although no significant differences in lamb gains could be attributed to the addition of tapazole, there was a definite trend (table 7 and figure 3) with both the ewe and wether lambs fed 3.5 mg. of tapazole per pound of feed gaining slightly more than the control animals. The magnitude of response from the combination of dietary tapazole and 3 mg. of implanted stilbestrol in this trial was considerably different from that observed in Trial I. Since the lambs used in both experiments were essentially of the same type, a possible explanation of the different response may be the effect of certain factors on metabolic rates. Since thyroxine output varies considerably with the season of the year,

TABLE 7. THE INFLUENCE OF VARIOUS LEVELS OF TAPAZOLE IN STILBESTROL IMPLANTED EWE AND WETHER LAMBS ON RATES OF GAIN

Tapazole/ Pound Feed	Number of Lambs			Avg. Initial Weight			Avg. Daily Gain		
	Wethers	Ewes	Total	Wethers	Ewes	Average	Wethers	Ewes	Average
None	10	10	20	64.8	61.3	63.0	.557	.586	.572
3.5 mg.	10	10	20	62.0	57.6	59.8	.573	.607	.590
7.0 mg.	10	10	20	64.6	58.8	61.7	.579	.494	.536
14.0 mg.	10	10	20	64.7	60.1	62.4	.552	.547	.550
Average				64.0	59.5	61.8	.566	.559	.562

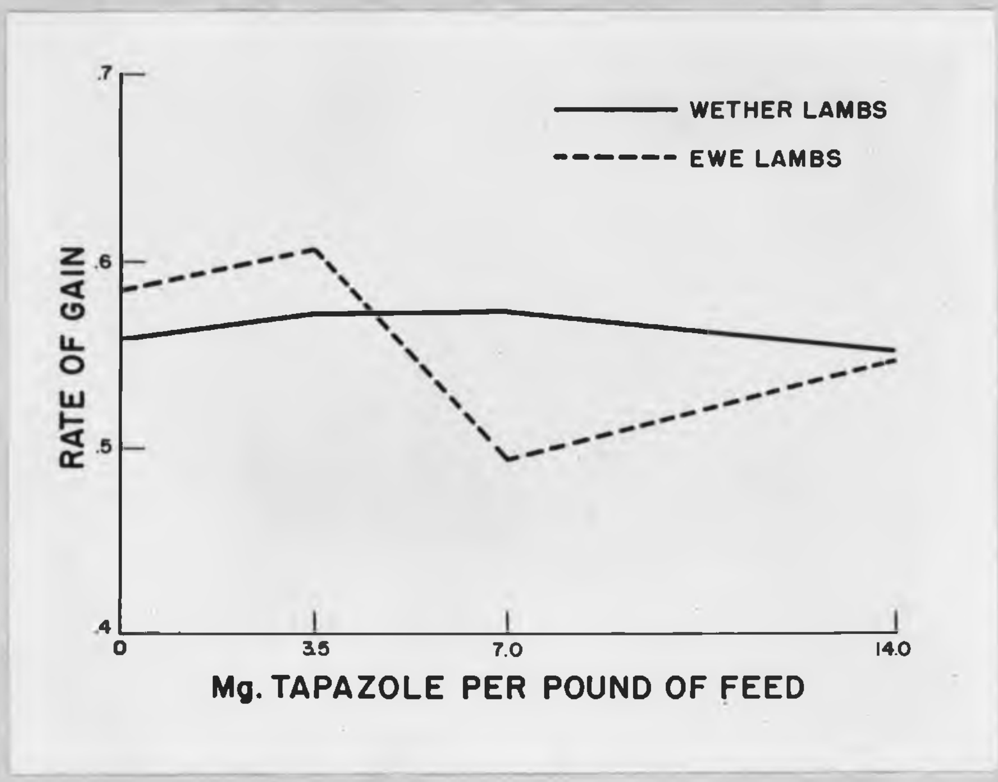

Figure 3. The effect of level of tapazole on rates of gain of stilbestrol-implanted ewe and wether lambs.

(Henneman *et al*., 1955) this fact could, in part, explain the existing differences in the performance between the lambs in Trial I and those in Trial II. Trial I was conducted during mid-winter while Trial II was conducted during the late summer and early fall months

Feed Consumption and Efficiency: Since both ewe and wether lambs were fed together by pen only the influence of level of tapazole could be determined (table 8). Statistical analysis revealed no significant differences in consumption or feed efficiency (table 10).

TABLE 8. FEED CONSUMPTION AND FEED EFFICIENCY AS INFLUENCED BY VARIOUS LEVELS OF TAPAZOLE IN STILBESTROL IMPLANTED EWE AND WETHER LAMBS

Tapazole/ Pound Feed	Avg. Daily Feed Consumption (lbs.)	Feed/ Pound Gain (lbs.)
None	4.35	7.60
3.5 mg.	4.20	7.12
7.0 mg.	4.14	7.71
14.0 mg.	3.92	7.12
Average	4.15	7.39

Although lambs in Trial I consumed more feed when tapazole was added to the ration, in Trial II there was a progressive decrease in feed consumption with increasing amounts of tapazole in the ration. This further exemplifies the indications that time of year or environmental temperatures may alter the response from goitrogenic materials.

Carcass Evaluation: Carcass grades and dressing percentages as influenced by treatments are presented in table 9. Statistical analyses revealed no significant affect in either respect.

As previously discussed in Trial I, an implantation of 3 mg. of stilbestrol did not alter carcass quality. Since carcass quality was unaffected by stilbestrol treatment in these studies any possible modifying effect of tapazole may have been obscured. Methods more accurate than federal carcass grade and dressing percentage need be employed to determine the influence of tapazole on relative fat content of lamb carcasses.

TABLE 9. CARCASS CHARACTERISTICS AS INFLUENCED BY VARIOUS LEVELS OF TAPAZOLE IN STILBESTROL IMPLANTED EWE AND WETHER LAMBS

Tapazole/ Pound Feed	Average Carcass Grade[a]			Average Dressing Per Cent[b]		
	Ewes	Wethers	Average	Ewes	Wethers	Average
None	2.0	2.2	2.1	55.05	55.07	55.06
3.5 mg.	2.2	2.5	2.35	54.46	55.39	54.92
7.0 mg.	2.5	2.1	2.3	53.93	54.31	54.12
14.0 mg.	2.6	2.7	2.65	55.54	54.31	54.92
Average	2.32	2.38	2.35	54.75	54.77	54.76

[a]The numbers 1, 2, 3, 4 and 5 were assigned to the grades prime, high choice, average choice, low choice and good, respectively for statistical treatment.

[b]Off-truck live weights and warm carcass weights were used to calculate dressing per cent.

TABLE 10. ANALYSIS OF VARIANCE OF TREATMENT EFFECTS (TRIAL II)

Source	df	Mean Squares			
		Total Gain	Carcass Grade	Dressing Per Cent	Pounds Feed/ Pound Gain
Replicates	1	19.00	.200	44.007**	.432
Level of Tapazole	3	51.66	1.033	3.563	.201
Sex Effect	1	4.00	.450	.001	---
Sex X Tapazole	3	70.66	.350	4.579	---
Sex X Tapazole Cubic	(1)	208.91*	---	------	---
Error	71	52.08	.541	3.333	.038[a]

[a]Three degrees of freedom.

*P < .05

**P < .01

SUMMARY

Wether lambs (118) implanted with 0, 3 and 6 mg. of stilbestrol were fed a basal ration with tapazole and chlortetracycline added singly and in combination. The following influences on rates of gain were found:

1. No effect from dietary treatments alone.
2. Both the 3 and 6 mg. levels of stilbestrol implantation increased gain.
3. Lambs that were fed chlortetracycline and implanted with stilbestrol gained more than the animals that received these treatments singly.
4. The rates of gain of lambs administered the combination of 3 mg. of implanted stilbestrol and dietary tapazole were considerably greater than when these treatments were administered singly.
5. The most rapid gain occurred in lambs implanted with 3 mg. of stilbestrol and fed chlortetracycline and tapazole.

There was no influence of dietary treatments on feed consumption or efficiency of utilization. The digestibility of nutrients was unaffected by any treatments. No "side effects" were observed in the live animals and no differences in carcass grade or dressing percentage were found.

A second trial was conducted to study the combination effects of dietary tapazole and implanted stilbestrol. Forty ewe and 40 wether lambs, implanted with 3 mg. of stilbestrol, were fed four levels of tapazole. The following effects on rate of gain were observed.

1. Ewe lambs that were fed 7.0 mg. of tapazole per pound of ration gained less than those on other treatments. It was concluded that this effect was probably one of chance variation only.
2. All lambs fed 3.5 mg. of tapazole per pound of ration gained more than the control animals, however these differences were not statistically significant.

Neither feed consumption nor efficiency of utilization was influenced by any treatment. No differences in carcass grade or dressing percentage could be attributed to any treatment.

The difference in the magnitude of increased gain between similarly treated tapazole-fed lambs of Trial I and II could have been due to a possible environmental effect.

LITERATURE CITED

Andrews, F. N., W. M. Beeson, E. R. Barrick and Claude Harper. 1947. The influence of thiouracil and thiourea on the growth and fattening of lambs. J. Anim. Sci. 6:3.

Andrews, F. N., W. M. Beeson and Claude Harper. 1949. The effect of stilbestrol and testosterone on the growth and fattening of lambs. J. Anim. Sci. 8:578.

Andrews, F. N., W. M. Beeson and F. D. Johnson. 1954. The effects of stilbestrol, dienestrol, testosterone and progesterone on the growth and fattening of beef steers. J. Anim. Sci. 13:99.

Andrews, F. N. and B. R. Bohren. 1947. The influence of thiouracil and stilbestrol and stilbestrol on growth fattening and feed efficiency of broilers. Poultry Sci. 26:447.

Andrews, F. N. and E. E. Schnetzler. 1946. Influence of thiouracil on growth and fattening in broilers. Poultry Sci. 25:124.

Andrews, F. N., M. Stob, T. W. Perry and W. M. Beeson. 1956. The effect of oral and subcutaneous estrogen and androgen administration on the growth and carcass quality of lambs. J. Anim. Sci. 15:575.

Barrick, E. R., W. M. Beeson, F. N. Andrews and Claude Harper. 1949. The influence of thiouracil, propylthiouracil and thyroprotein on the growth and fattening of lambs. J. Anim. Sci. 8:243.

Bell, M. C., C. K. Whitehair and W. D. Gallup. 1950. The effect of aureomycin on digestion in steers. J. Anim. Sci. 9:647.

Bell, T. D., W. H. Smith and H. B. Erhart. 1954. The effect of stilbestrol upon lamb performance in the feed lot. J. Anim. Sci. 13:425.

Beeson, W. M., F. N. Andrews and P. T. Brown. 1946. The effect of thiouracil on the growth and fattening of yearling steers. J. Anim. Sci. 5:394.

Blaxter, K. L., E. P. Reineke and E. W. Crampton. 1949. The role of thyroidal materials and synthetic goitrogens in animal production and an appraisal of their practical use. J. Anim. Sci. 8:307.

Bohman, V. R., J. E. Huntes and L. Walker. 1955. Antibiotics and B-vitamins for lambs. J. Anim. Sci. 14:111.

Brooks, C. C., G. B. Garner, M. E. Muhren and W. H. Pfander. 1954. Effect of some steroid compounds on ovine rumen function. Science 120:455.

Cahill, V. R., E. W. Klosterman, F. E. Deatherage and L. E. Kunkle. 1954. The possible functions of diethylstilbestrol as observed in beef carcass evaluation and certain associated glands. J. Anim. Sci. 13:968.

Clegg, M. T. and H. H. Cole. 1954. The action of stilbestrol on the growth response in ruminants. J. Anim. Sci. 13:108.

Coates, M. E., M. K. Davies and S. K. Kon. 1955. The effects of antibiotics on the intestine of the chick. Brit. J. Nutr. 9:110.

Deans, D. D., W. J. Van Arsdell, E. P. Reineke and L. J. Bratzler. 1953. Effect of progesterone-stilbestrol implants on the rate of gain and carcass characteristics of steers. J. Anim. Sci. 12:901.

Elliot, R. F., and S. A. Ellsworth. 1953. The effect of aureomycin and type of ration on fattening lambs. J. Anim. Sci. 12:914.

Ellison, E. T. and J. C. Burch. 1936. The effect of estrogenic substances upon the pituitary, adrenals and ovaries. Endocr. 20:746.

Glazner, E. W. and M. A. Jull. 1946. Effects of thiouracil, dessicated thyroid and stilbestrol derivatives on various glands, body weight and dressing appearance in the chicken. J. Poultry Sci. 25:236.

Hatfield, E. E., U. S. Garrigus and H. W. Norton. 1954. Antibiotic supplements in rations for growing lambs. J. Anim. Sci. 13:715.

Henneman, H. A., E. P. Reineke and S. A. Griffin. 1955. The thyroid secretion rate of sheep as affected by season, age, breed, pregnancy and lactation. J. Anim. Sci. 14:419.

Horn, L. H., Jr., R. R. Snapp and L. S. Gall. 1955. The effect of antibiotics upon the digestion of feed nutrients by yearling steers with bacteriological data. J. Anim. Sci. 14:243.

Johnson, W. P., R. F. Elliot and A. L. Shor. 1956. The effect of chlortetracycline on the incidence of entero-toxemia and weight gains in lambs maintained under commercial feed-lot conditions. J. Anim. Sci. 15:781.

Jordan, P. S., R. M. Jordan and H. G. Croom. 1956. Effect of chlortetracycline, stilbestrol and chlortetracycline-stilbestrol supplements on fattening lambs. J. Anim. Sci. 15:188.

Jordan, R. M. 1950. The effect of stilbestrol on fattening lambs. J. Anim. Sci. 9:383.

Jordan, R. M. 1952. Aureomycin supplements in lamb feeding rations. J. Anim. Sci. 11:566.

Jordan, R. M. 1953. Effect of stilbestrol on suckling and fattening lambs. J. Anim. Sci. 12:670.

Jordan, R. M. 1953. Effect of level of stilbestrol on growth and fattening of lambs. J. Anim. Sci. 12:680.

Jordan, R. M. and T. O. Bell. 1954. Aureomycin supplements for suckling lambs. J. Anim. Sci. 13:450.

Jordan, R. M. and H. G. Croom. 1956. The effect of various implants on fattening lambs. J. Anim. Sci. 15:1003.

Kunkel, H. O., L. V. Packett, Jr., M. Hoelscher and J. H. Bridges. 1956. Chlortetracycline supplements in self-fed rations for lambs. J. Anim. Sci. 15:770.

Lassister, C. A. 1955. Antibiotics as growth stimulants for dairy cattle. J. Dairy Sci. 38:1102.

Lorenz, F. W. 1945. The influence of diethylstilbestrol on fat deposition and meat quality in chickens. J. Poultry Sci. 24:128.

McMillen, W. N., E. P. Reineke and L. J. Bratzler. 1946. The effect of thiouracil on efficiency of gains and carcass quality in fattening swine. J. Anim. Sci. 5:419.

Means, T. M., F. N. Andrews and W. M. Beeson. 1953. The effects of hormones on the growth and fattening of lambs. J. Anim. Sci. 12:176.

Mixner, J. P. 1946. Effect of feeding thiouracil on body weight of new Hampshire cockerals. Poultry Sci. 25:536.

O'Mary, C. C., A. L. Pope, G. D. Wilson, R. W. Bray and L. E. Casida. 1952. The effects of diethylstilbestrol, testosterone and progesterone on the growth and fattening and certain carcass characteristics of Western lambs. J. Anim. Sci. 11:656.

Perry, T. W., F. N. Andrews and W. M. Beeson. 1951. The effects of stilbestrol on suckling lambs. J. Anim. Sci. 10:602.

Schneider, B. H., B. K. Soni and W. E. Ham. 1955. Methods for determining consumption and digestibility of pasture forages by sheep. Wash. Agric. Exp. Sta. Tech. Bul. 16.

Snedecor, G. W. 1955. Statistical methods. 5th ED. Collegiate Press, Inc., Ames, Iowa.

Tillman, Allen D. and R. MacVicar. 1956. The effect of chlortetracycline upon digestion of ration components, retention of nitrogen and volume of urine excreted by sheep with observation on rectal temperatures. J. Anim. Sci. 15:211.

Story, C. D., F. X. Gassner, W. E. Connell and L. E. Washburn. 1956. Hormones, drugs and similar substances for fattening steers. Proc. Amer. Soc. Animal Prod. West. Sec. XXXII.

Van der Noot, G. W., R. P. Reece and W. C. Skelly. 1947. The effect of thiouracil in the ration of growing swine. J. Anim. Sci. 6:12.

Van der Noot, G. W., R. P. Reece and W. C. Skelly. 1948. Effect of thyroprotein and of thiouracil alone and in sequence in the ration of swine. J. Anim. Sci. 7:84.

Van der Noot, G. W., R. P. Reece and W. C. Skelly. 1950. Effects of methyl thiouracil in the ration of lambs and aged ewes. J. Anim. Sci. 9:3.

Whitehair, C. K., W. D. Gallup and M. C. Bell. 1953. Effect of stilbestrol on ration digestibility and on calcium, phosphorus and nitrogen retention in lambs. J. Anim. Sci. 12:331.

Wilkinson, W. S., C. C. O'Mary, G. D. Wilson, R. W. Bray, A. L. Pope and L. E. Casida. 1955. The effect of diethylstilbestrol upon growth, fattening and certain carcass characteristics of full-fed and limited-fed Western lambs. J. Anim. Sci. 14:866.