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RESEARCH REPORT

Sheep and Goat, Wool and Mohair--1980

The Texas Agricultural Experiment Station
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PR-3693

DIETARY HABITS OF THE COYOTE -- AN EVALUATION UTILIZING THE AGAR GEL TECHNIQUE

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SUMMARY

The Agar gel diffusion technique was used to analyse for selected (cattle, deer, goat, sheep, rat, rabbit and mouse) mammalian protein in 49 coyote stomachs. Rabbit was the most prevalent item with 55.1 percent of the coyotes having consumed this material. Goats and sheep were the second and third most prevalent food source, with 40.7 (goats) and 26.7 (sheep) percent of the coyotes having consumed these species. In this study only a small percent of the coyotes had consumed the meat of deer or cattle.

INTRODUCTION

Numerous studies have been conducted in which the dietary habits of the coyote have been reported. In most of these studies the reported number or percent of coyotes which had consumed domestic livestock, and especially sheep and goats, was very low. Unfortunately these studies do not often indicate the extent to which various food sources are available. Also most previous studies have depended on visual identification of the components in stomach contents and scats (droppings) by hair type or other distinguishing features. Occasions must occur when meat or blood alone is consumed and thus the techniques employed do not adequately reflect the diet. The use of the immunoprecipitin reaction using the Agar gel diffusion technique offers another potential method of studying the coyote food habits. This technique was reviewed briefly in an earlier report (1).

EXPERIMENTAL PROCEDURE

Coyote stomachs were collected in 13 Texas counties ranging from Brewster and Pecos counties on the West to Lampasas on the East. The counties involved with the number of samples from each were:

Borden-2	Crane-6	Mills-8
Brewster-2	Glasscock-12	Pecos-1
Brown-3	Hamilton-1	Runnels-1
Coleman-2	Lampasas-4	Tom Green-4
	Martin-3	

The contents of 49 stomachs have been analysed to the present. These coyotes or stomachs were largely collected through control efforts of the U. S. Fish and Wildlife Service. Collections were made over the period of January through August. The coyotes were identified by the ranch from which they were taken and the type of livestock present on the ranch. However, it was assumed that all coyotes taken had access to cattle, deer and small rodents. It was also assumed that all coyotes taken within the Edwards Plateau had access to sheep and goats although they may not have been present on the ranch or in the pasture from which the coyotes were taken. This may not have always been true. The analytical technique involves a reaction between a species specific protein and antisera to that specific protein. Thus reactions are expected only to those materials for which antisera was utilized in testing. The antisera utilized were cattle, deer, goat, sheep, rat, rabbit and mouse. The antisera were obtained commercially except for rabbit antisera which was produced locally from domestic rabbits.

RESULTS AND DISCUSSION

The results are shown in Table 1. Approximately one-fourth (24.5%) of the coyotes showed no reaction to the antisera analyses. This may have been due to the fact that the stomach was empty or that the individual coyote had consumed other materials, such as insects, vegetative material, etc. The most prevalent item in the diet was rabbit, with 27 coyotes (55.1%) containing this item. Only one coyote was shown to have consumed deer and two to have consumed cattle. From the total of 49 coyotes eleven (22.5%) had consumed goats and seven (14.3%) sheep. However, when expressed as a function of coyotes thought to have had access to these prey species the percentages were 40.7 and 26.9, respectively. These data appear to suggest a preference for goats over sheep by the coyote. It is known that coyotes prey heavily on goats,[2] but it is not clear whether they prefer goats over sheep. However, it is clear that when these prey species are available, a high percentage of coyotes will feed on sheep and goats.

The procedure involved does not distinguish between carrion and meat from fresh kills. It is generally recognized that when necessary coyotes feed extensively on carrion. However, several reports have shown that coyotes which are experienced in killing exercise a strong preference for fresh kills. It should not be concluded that every coyote which had fed on sheep or goats had killed the species involved. Often only one animal of a pair or family group will kill, but others will feed on the carcass. However, if the killer or killers are removed others will generally assume this role.

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Table 1. Food Habits of Coyotes as Determined by Analysis of Stomach Contents of 49 Coyotes

Type of Protein	Number Consuming*	Percent of Total	Percent of Those Having Access to Indicated Prey Species
Cattle	1	2.0	2.0
Deer	2	4.1	4.1
Goat	11	22.5	40.7
Sheep	7	14.3	26.9
Rat	5	10.2	10.2
Rabbit	27	55.1	55.2
Mouse	2	4.1	4.1
Empty stomach or no reaction	12	24.5	——

*This column will add to more than 49 due to the fact that some coyotes had consumed more than one item tested for.

PR-3694

SHEEP DIETS IN THE "HARD YELLOW LIVER" AREA OF THE NORTHWESTERN EDWARDS PLATEAU

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SUMMARY

Diets of sheep varied seasonally and among years as did forage diversity and availability in a 3-year study (1976-1979) in the "hard yellow liver" area of the northwestern Edwards Plateau. Native grasses contributed 53% to 78% of the average annual diets of sheep, while forbs contributed 22% to 47%. Forbs were highly important in sheep diets (47% of the mean annual diet) during 1976-77, when all sheep in the 137-acre experimental pasture in Reagan County contracted hard yellow liver. Buffalograss, croton, and threeawns were the most important diet components during the study. Fungi were abundant on the native vegetation and in sheep fecal samples during the hard yellow liver year.

INTRODUCTION

Hard yellow liver disease (hepatic fatty cirrhosis) affects sheep, cattle, goats and antelope in parts of five to seven counties of the western Edwards Plateau resource area, and white-tailed deer in La Salle County and portions of adjacent counties in the South Texas Plains. The disease occurs sporadically and causes severe economic hardship to individual ranch firms. Ohlenbusch (3) speculated that a toxic substance in the plants consumed by livestock during wet winters and dry spring seasons caused hard yellow liver disease. He associated occurrence of the disease to (i) Reagan silty clay loam soils, (ii) above-normal rainfall in August-October and a wet winter followed by a dry spring, (iii) relatively light grazing pressure,and (iv) fluctuating nutritional levels in animal diets. The disease has not been reproduced by feeding various amounts of 80 different plants common in the western Edwards Plateau (1).

This study was initiated in 1976 to determine the diets of sheep grazing native rangeland in the "hard yellow liver area" and to document the forages available in an area where the disease frequently occurs (5,6).

EXPERIMENTAL PROCEDURE

A 137-acre pasture on the E.G. Cauble Ranch in central Reagan County was stocked with a flock of pregnant ewes from November 1976 through October 1977 and with a different flock from January 1978 through October 1978. A third flock of pregnant ewes was grazed on the same pasture from January 1979 through September 1979. Vegetation surveys were made at approximately monthly intervals on ten permanently marked sampling transects to determine cover and frequency of plants within all range sites in the experimental pasture. Major range sites in the pasture, their percentage of the total acreage, and soil types included: loamy range site, 71.4%, Reagan silty clay loam; shallow range site, 19.4%, Conger loam, undulating; clay flat range site, 5.6%, Tobosa clay; and lakebed range site, 3.5%, Lipan clay.

Fecal samples were collected from all the sheep at approximately monthly intervals, and approximate dry weight composition of plants in the sheep diets were determined by microscopic examination of plant epidermal tissues in the samples 1/. Precipitation was above the 23-year average (18.4 inches) during 1976 (22.1 inches), and 1978 (22.1 inches) but below the 23-year average in 1977 (17.6 inches) and 1979 (14.4 inches).

RESULTS AND DISCUSSION

All sheep in the flock grazing the pasture from November 1976 through October 1977 contracted hard yellow liver, but no symptoms appeared in either flock grazed on the same pasture from January 1978 through October 1978, or January 1979 through September 1979.

During the "hard yellow liver year", 33 different plants were identified in sheep fecal samples. Diet diversity was highest in February 1977 (18 different foods) and lowest in September and October 1977 (11 different foods). In contrast, only 25 different plants were identified in sheep diets during the second year. Diet diversity in the second year was highest during July (13 different foods) and lowest during June and October (8 different foods). Thirty-seven different plant species were identified in sheep diets during the third year of the study and diet diversity was highest in May (22 different foods) and lowest in July (16 different foods).

Grasses contributed 53% of the average yearlong diet during the "hard yellow liver year" (1976-77), while forbs contributed 47% (Table 1). Grasses and forbs contributed 60% and 40% of the average diet of sheep, respectively, during 1978 and 78% and 22%, respectively, during 1979.

Buffalograss (Buchloe dactyloides) was the most important grass in sheep diets in all 3 years of the study, contributing 33.8%, 42.5% and 40.8% of the average diet during 1976-77, 1978 and 1979, respectively. Other grasses of importance in sheep diets included threeawns (Aristida spp.), burrograss (Scleropogon brevifolius), sand dropseed (Sporobolus cryptandrus) sideoats grama and black grama (Bouteloua curtipendula and B. eriopoda), tobosagrass (Hilaria mutica) and muhlys (Muhlenbergia spp.) (Table 1).

1/ Diet determinations were conducted on a contract basis by Dr. Richard M. Hansen's Composition Analysis Laboratory at Colorado State University Fort Collins, Colorado 80523.

Croton was the most important forb in sheep diets during this 3-year study, contributing 20.2%, 39.9% and 7.8% of the average diet during 1976-77, 1978 and 1979, respectively (Table 1). Other important forbs included filaree (Erodium spp.), bladderpods (Lesquerella spp.) and Nuttall milkvetch (Astragalus nuttallianus). Forbs contributed a higher proportion of sheep diets and were much more abundant during the "hard yellow liver year" than in the other two years of this study. A total of 15 species of forbs was identified in sheep diets during 1976-77, compared to 8 species in 1978 and 22 species in 1979.

Plant species present in the experimental pasture which are known to cause livestock losses or which are closely related to plants known to cause livestock losses in other parts of the United States include croton, Nuttall milkvetch, tansymustard (Descurainia pinnata), silverleaf nightshade (Solanum elaeagnifolium), threadleaf groundsel (Senecio longilobus), locoweed (Astragalus mollissimus), bitterweed (Hymenoxys odorata), trecul stillingia (Stillingia treculiana), and honey mesquite (Prosopis glandulosa Torr. var. glandulosa) (2,4). Tobosagrass (Hilaria mutica) is a dominant plant on the clay flat range sites and tobosagrass ergot (Claviceps cinerea), a fungus, is known to be toxic to cattle (4). Several of the plant species eaten by sheep are commonly infected with fungus. Since many plants are toxic only when infected with fungus (2), plants known to be eaten by sheep were sampled monthly and sent to Dr. Charles Bridges (Department of Veterinary Pathology) for identification and evaluation. During 1976-77 microscopic examination of plants in sheep fecal samples revealed heavy infestations of fungus in epidermal tissues of croton, buffalograss, threeawns, bladderpods, and tobosagrass.

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TABLE 1. MEAN DRY WEIGHT COMPOSITION (%) OF SHEEP DIETS DURING 1976-77, 1978 AND 1979 IN REAGAN COUNTY, TEXAS

Food Items	YEAR		
	1976-77	1978	1979
Grasses and grasslike plants			
Threeawns	5.1	2.9	19.1
Silver bluestem	0.7	0.4	0.2
Sideoats and black grama	1.5	2.3	3.2
Rescuegrass	0.3	t	0.4
Buffalograss	33.8	42.5	40.8
Sedge	0.1	0.2	-
Inland saltgrass	0.8	0.2	0.6
Spikesedge	-	0.1	-
Tobosagrass	1.8	2.5	1.0
Foxtail barley	0.5	t	1.0
Sand muhly and ear muhly	1.7	0.3	4.5
Vine mesquite and Halli panicum	0.6	-	0.6
Tumblegrass	-	t	0.2
Burrograss	3.4	0.6	0.2
Sand dropseed	2.7	7.6	4.3
Texas wintergrass	t	-	-
Slim tridens and white tridens	0.5	0.2	1.6
Unknown grasses	t[1/]	-	0.2
Forbs and other items			
Nuttall milkvetch	2.7	t	1.6
Thistles	t	t	t
Croton	20.2	39.9	7.8
Cryptantha	-	-	t
Tansymustard	0.1	-	0.1
Dogweed	-	-	t
Fleabane	-	-	0.1
Filaree	16.3	t	-
Rushpea	-	-	0.1
Slender janusia	0.1	0.1	0.3

TABLE 1. (Continued)

Food Items	YEAR 1976-77	1978	1979
<u>Forbs and other items (continued)</u>			
Prairie pepperweed	0.1	-	-
Bladderpods	3.3	-	0.6
Machaeranthera	-	-	t
Common horehound	t	-	-
Pricklypear	t	t	0.1
Redseed plantain	0.4	-	t
Knotweed	-	-	0.1
Mesquite	-	-	3.0
Prairie coneflower	0.3	-	t
Clubmoss	0.1	t	0.1
Silverleaf nightshade	0.2	-	0.7
Globemallow	0.5	-	0.1
Trecul stillingia	-	-	0.3
Crownbeard	1.7	-	0.5
Yucca	-	t	-
Lichen	-	t	-
Unknown forbs	0.1	0.1	4.1
Seeds	0.7	-	2.9

1/ trace

SHEEP TOLERANCE TO BITTERWEED POISONING -- VARIATION BETWEEN ANIMALS

M.C. Calhoun and B.C. Baldwin, Jr.

SUMMARY

When lambs were challenged two times with a subacute bitterweed dose, serum concentrations of urea nitrogen, creatinine, lactic dehydrogenase and glutamic-oxalacetic transaminase increased after each challenge. Each challenge consisted of bitterweed given (via rumen tube) at 0.25% of live weight (air-dry basis) daily for four consecutive days. A 17-day recovery period followed the first bitterweed challenge. Average serum values returned to their pre-treatment levels during this time. Increases in serum constituents as a result of the second challenge were similar to those obtained with the first challenge indicating a lack of adaptation to bitterweed in this study. There was a wide range of increases in blood serum constituents after bitterweed exposure, indicating considerable variation among sheep in tolerance to bitterweed. However, bitterweed tolerance scores of individual sheep were repeatable (r = .70). Sheep which were relatively bitterweed tolerant the first time they were challenged, tended to remain tolerant when rechallenged. Likewise, susceptible sheep tended to remain susceptible when rechallenged with a subacute bitterweed dose. The screening procedure described in this study could be used in a sheep selection program to identify animals that are resistant to the toxic effects of bitterweed.

INTRODUCTION

Bitterweed (Hymenoxys odorata) first appeared as a poisonous plant problem on Texas sheep ranges in the early 1920's (4). Since that time, considerable research efforts have been expended to find ways to reduce sheep losses from bitterweed poisoning. These have ranged from those involving grazing management systems, herbicide treatments and various range supplements and feed additives to more basic studies to define the toxic principle present in the bitterweed plant. However, one approach to reducing sheep losses on bitterweed pastures appears to have been largely overlooked, ie., selection of sheep that are resistant to bitterweed poisoning.

One of the earliest observations in bitterweed research was the tremendous variation in amounts of bitterweed necessary to produce signs of poisoning in individual sheep. For example, the following statement was taken from the Texas Agricultural Experiment Station's Bulletin No. 433, published in 1931.

* This research was supported in part by a grant from the Natural Fibers and Food Protein Commission of Texas. Appreciation is expressed to Jerry Murphy (Garden City, Texas) for allowing collection of bitterweed plants on his property and to Dr. B.J. Camp for determination of the hymenoxon content of this collection.

"The susceptibility of sheep to bitterweed poisoning seems to vary with different individuals. In some cases, as little as 500 grams of immature green bitterweed, when given over a period of two days, was sufficient to cause the death of the animal. Other animals have been found that tolerated much larger amounts without succumbing to bitterweed poisoning" (2).

In the study of Hardy, et al. (2) as little as 500 g (1.1 lb) was adequate to kill some sheep; at the other extreme was a sheep which consumed 14,514 g (32 lb) of immature green bitterweed plant over a 50-day period without exhibiting signs of bitterweed poisoning. Variation among individuals in susceptibility to bitterweed poisoning is still evident in the sheep population (1,6). However, no efforts have been made to determine the incidence of tolerant sheep in the population. Therefore, the objectives of this research were: (1) the development of procedures for measuring variation among sheep in tolerance to bitterweed poisoning and (2)determination of the repeatability of these measurements in individuals rechallenged with a uniform bitterweed dose.

EXPERIMENTAL PROCEDURE

Sixteen Rambouillet, wether lambs (73.1 lb) were individually housed in 4' x 6' raised pens with expanded metal floors and fed a pelleted diet (ad libitum). 1/ After a 2-week uniformity period, bitterweed 2/ was administered (0.25% of live weight, air-dry basis) daily for four consecutive days. This was accomplished by mixing the bitterweed (ground to pass a 1-mm screen) with 1.5 l of warm water and pouring the resulting suspension into the rumen, through a stomach tube. Blood samples were collected by jugular venipuncture, initially, and again 24 hours after the last bitterweed dose. Lambs were allowed seventeen days to recover. They were then rechallenged using the same bitterweed dose and blood sampling procedures.

Changes in serum concentrations of urea nitrogen, creatinine, lactic dehydrogenase and glutamic-oxalacetic transaminase were used to assess bitterweed tolerance. Lambs were ranked based on the difference between initial and final blood values for each of these constituents. The lamb with the least change was assigned one and so on. These rank scores were totaled for the four serum measurements to obtain a bitterweed tolerance score for each lamb. The lamb with the lowest total was the most tolerant and the one with the highest score the most susceptible to bitterweed. The agreement between the two sets of tolerance scores was determined by calculating the correlation coefficient (5).

1/ The percentage ingredient composition was: 55.35 dry-rolled sorghum grain, 29.9 cottonseed hulls, 7.75 cottonseed meal, 4.0 molasses, 1.5 calcium carbonate, 1.0 vitamin, mineral and antibiotic premix and 0.5 salt.

2/ Bitterweed used was a composite of plants collected from an irrigated field two miles west of Garden City, Texas during April and May of 1978. It was dried in a forced draft oven at < 150° F. The average hymenoxon concentration of this collection was .96% (air-dry basis) (3).

RESULTS AND DISCUSSION

One lamb became crippled during the recovery period and was removed from the study. The information from a second lamb was not used because its serum urea nitrogen and creatinine levels did not return to pre-challenge levels after the first bitterweed dose and its urea nitrogen and creatinine responses were several fold greater when rechallenged.

Serum concentrations of urea nitrogen, creatinine, lactic dehydrogenase and glutamic-oxalacetic transaminase increased each time lambs were challenged with bitterweed (Table 1). In general, serum values returned to their pre-treatment levels during the 17-day recovery period. Average increases in serum constituents were similar for both bitterweed challenges, indicating there was not adaptation to bitterweed as a result of the first challenge.

Variation among lambs in response to a uniform bitterweed dose is evidenced by the range in serum values obtained for individual lambs in this study (Table 2). However, the responses of individual lambs tended to be similar each time they were challenged with bitterweed (Table 2, Figure 1). Estimates of the agreement between responses when lambs were challenged two times with bitterweed were obtained by calculating correlation coefficients (r) for the serum constituents. For urea nitrogen, $r = .45$ ($P>.10$) and for creatinine $r = .47$ ($P<.10$). The correlations for the serum enzymes were: $r = .76$ ($P<.01$) and $r = .78$ ($P<.01$), respectively, for lactic dehydrogenase and glutamic-oxalacetic transaminase.

The association between bitterweed tolerance scores obtained when lambs were challenged two times with a subacute dose of bitterweed was good ($r = .70$, $P<.01$) (Figure 1). In general, lambs that were relatively tolerant to bitterweed, remained tolerant when rechallenged; likewise, susceptible lambs tended to remain susceptible. However, there were three notable exceptions. Lamb #52 had an initial bitterweed tolerance score of 23 and a score of 45 the second time. Lamb #42 with an initial score of 30 scored 46 the second time. When the response of these two lambs is considered along with the lamb excluded from the summary, it is apparent that these exceptions are lambs that responded considerably greater the second time they were challenged; indicating the possibility of some tissue damage resulting from the first bitterweed dose (Table 2, Figure 1).

The screening procedure described in this report could be used in a sheep selection program to identify individuals that are resistant to the toxic effects of bitterweed. Furthermore, knowledge of the variation among sheep in susceptibility to bitterweed poisoning should be considered in planning and conducting bitterweed experiments, as this is probably a major contributing factor to variations in results obtained in bitterweed research. Preliminary exposure to bitterweed would provide information on the relative susceptibility of individual animals to bitterweed poisoning. Covariance analyses could then be used to adjust for differences in individual animal response and increase the precision of bitterweed experiments.

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TABLE 1. MEAN INITIAL AND FINAL VALUES AND CHANGES IN SERUM CONCENTRATIONS OF UREA NITROGEN, CREATININE, LACTIC DEHYDROGENASE AND GLUTAMIC-OXALACETIC TRANSAMINASE IN LAMBS CHALLENGED TWO TIMES WITH A SUBACUTE BITTERWEED DOSE 1/ 2/

CRITERION	INITIAL	S.E.M.3/	FINAL	S.E.M.	CHANGE
1st Bitterweed Challenge					
Urea nitrogen, mg/dl	7.7	.87	44.8	3.46	37.1
Creatinine, mg/dl	.92	.03	2.37	.16	1.45
Lactic dehydrogenase, IU/1	499	13.8	815	60.2	316
Glutamic-oxalacetic transaminase, IU/1	100	2.7	569	66.1	469
2nd Bitterweed Challenge					
Urea nitrogen, mg/dl	9.0	.83	40.1	4.57	31.1
Creatinine, mg/dl	.91	.05	1.96	.18	1.05
Lactic dehydrogenase, IU/1	503	21.9	888	53.5	385
Glutamic-oxalacetic transaminase, IU/1	98	3.5	536	40.4	438

1/ Data are based on information from 14 lambs.
2/ Each challenge consisted of bitterweed given (via rumen tube) at 0.25% of live weight (air-dry basis) daily for 4 consecutive days. There was a 17 day recovery period between bitterweed challenges.
3/ Standard error of the mean.

TABLE 2. INCREASES[1/] IN SERUM CONCENTRATIONS OF UREA NITROGEN, CREATININE, LACTIC DEHYDROGENASE (LDH) AND GLUTAMIC-OXALACETIC TRANSAMINASE (GOT) AND RESPONSE RANKS[2/] AND TOLERANCE SCORES[3/] OF INDIVIDUAL LAMBS CHALLENGED TWO TIMES WITH A SUBACUTE BITTERWEED DOSE[4/]

ITEM	UREA NITROGEN (mg/dl)		CREATININE (mg/dl)		LDH (IU/1)		GOT (IU/1)		BITTERWEED TOLERANCE SCORE 2/	
Challenge	1	2	1	2	1	2	1	2	1	2
Sheep No.									SCORE	SCORE
55	23.8[1/](3)[2/]	11.3(1)	0.89(2)	0.49(2)	190(3)	200(2)	198(2)	340(2)	10	7
53	20.3(1)	14.2(2)	0.67(1)	0.27(1)	209(4)	394(10)	316(4)	376(5)	10	18
50	36.9(9)	34.0(9)	1.27(7)	0.59(4)	53(1)	118(1)	243(3)	343(3)	20	17
52	35.0(7)	46.8(12)	2.24(13)	1.28(10)	150(2)	403(11)	191(1)	456(12)	23	45
47	26.9(5)	15.8(3)	1.38(8)	0.87(8)	255(6)	333(6)	329(5)	345(4)	24	21
49	28.9(6)	16.8(4)	0.90(3)	0.51(3)	297(9)	361(7)	410(8)	436(9)	26	23
42	21.9(2)	33.2(8)	1.12(5)	1.65(12)	362(11)	707(13)	723(12)	560(13)	30	46
37	43.4(10)	36.4(10)	2.51(14)	1.52(11)	223(5)	272(3)	403(7)	261(1)	36	25
46	35.0(8)	27.5(7)	1.13(6)	0.85(7)	373(12)	389(9)	518(10)	426(8)	36	31
58	25.8(4)	42.4(11)	1.65(9)	2.24(14)	327(10)	286(4)	735(13)	383(6)	36	35
36	47.0(11)	22.0(6)	1.69(10)	0.74(6)	293(8)	296(5)	455(9)	441(10)	38	27
59	60.9(14)	16.8(5)	2.09(12)	0.73(5)	265(7)	423(12)	379(6)	417(7)	39	29
56	55.4(12)	64.5(14)	1.08(4)	1.24(9)	498(13)	365(8)	603(11)	447(11)	40	42
38	58.5(13)	54.6(13)	1.73(11)	1.79(13)	933(14)	824(14)	1057(14)	896(14)	52	54

1/ Increases reported in this table are the differences between the initial and final serum concentrations.
2/ Values in parenthesis are response ranks. Lambs were ranked from 1 to 14 according to their differences (response) between initial and final concentrations for each serum constituent. The smallest response was assigned a rank of one.
3/ A bitterweed tolerance score was calculated for each lamb by adding together the ranks obtained for each of the four serum constituents. Low scores indicate bitterweed tolerant and high scores bitterweed susceptible sheep.
4/ 0.25% of live weight (air-dry basis) daily for 4 consecutive days.

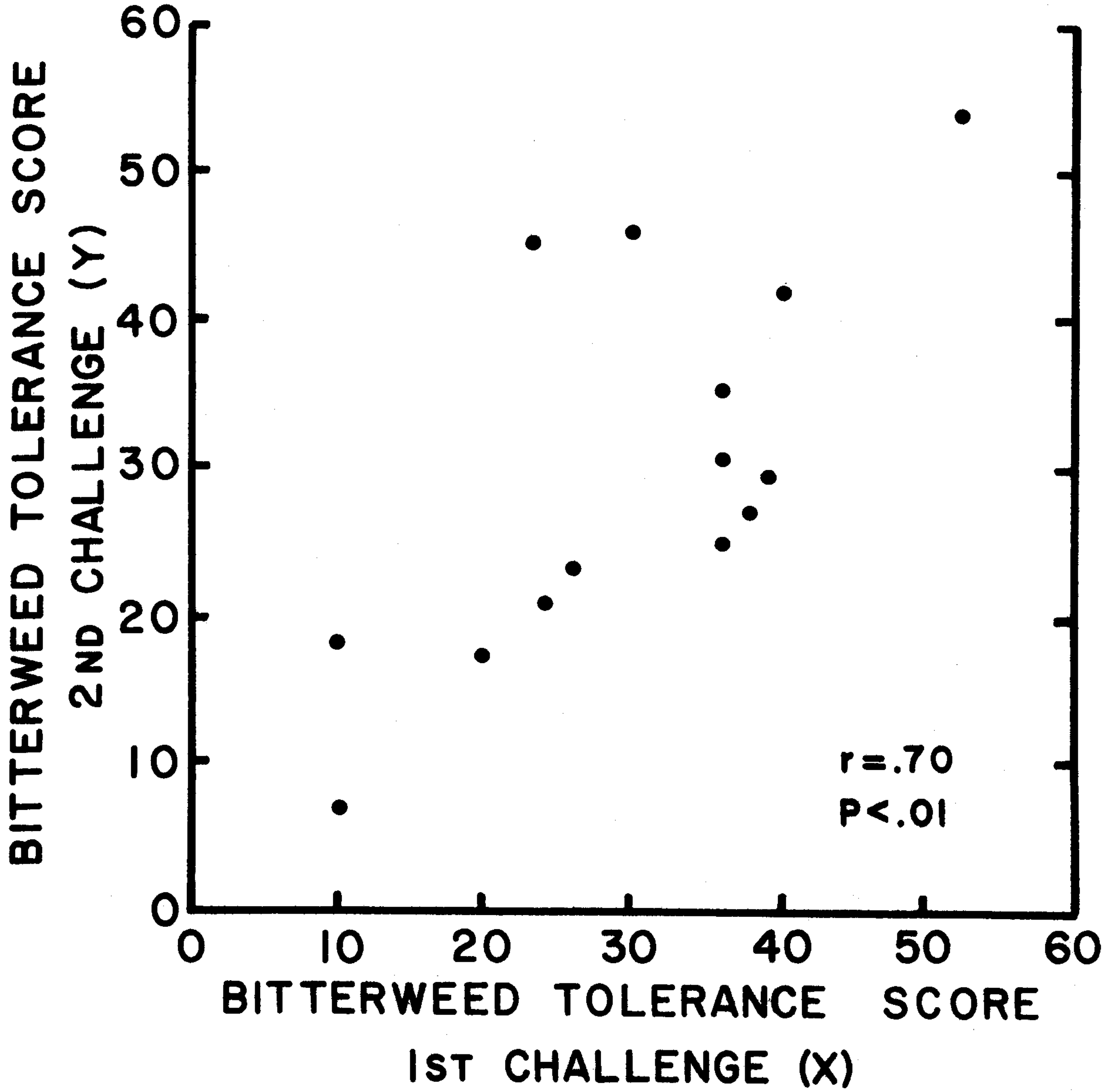

FIGURE 1. Association between bitterweed tolerance scores obtained when lambs were challenged two times with bitterweed. Each challenge consisted of air-dry bitterweed administered at 0.25% of live weight, daily, for four consecutive days. There was a 17-day recovery period between challenges. Lambs with low scores are relatively more bitterweed tolerant than lambs with higher scores.

EFFECT 2,4-D ON HYMENOXON LEVELS AND TOXICITY OF BITTERWEED

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SUMMARY

Spraying bitterweed with 2,4-D (1.54 lb acid equivalent per acre) reduced its hymenoxon content from .93% (air-dry basis), initially, to .76% 28 days after spraying. The hymenoxon content of unsprayed bitterweed did not change during the experiment and averaged 1.02%. Sprayed bitterweed was toxic to grazing ewes and when force-fed to penned wether lambs. Estimates of sprayed bitterweed intake of grazing ewes were 1.36 and 1.97% of live weight per day (fresh basis) for two groups of 12 ewes kept on the plots for 14 and 21 days, respectively. Five of 12 ewes on the plots for 21 days died after they were removed. None of the ewes on the sprayed plots for 14 days died. Control ewes on unsprayed plots did not eat bitterweed. These estimates of bitterweed intake are many times the reported minimum acute lethal dose (1.3% of live weight) indicating that either the estimates of bitterweed intake of these grazing ewes are in error or ewes continuously exposed to bitterweed are more tolerant than pen fed wether lambs.

INTRODUCTION

Grazing sheep have been observed to safely consume normally lethal amounts of bitterweed (*Hymenoxys odorata*) after the plant was sprayed with 2,4-D (2,4-dichlorophenoxy)acetic acid (6). Bitterweed sprayed with 2,4-D also had lower hymenoxon 1/ levels; varying from seven-eighths to half that of unsprayed bitterweed (2). However, when dried bitterweed was force-fed to penned sheep in subacute studies, there was no difference in toxicity of sprayed compared to unsprayed bitterweed (2). This experiment was conducted to obtain additional information on the effects of spraying with 2,4-D on the hymenoxon concentration of bitterweed and its toxicity under grazing conditions, as well as when force-fed to penned sheep.

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* This research was supported in part by the Natural Fibers and Food Protein Commission of Texas.

1/ Hymenoxon, an α, β-unsaturated sesquiterpene lactone, is the major toxic constituent in bitterweed (5).

EXPERIMENTAL PROCEDURE

The field portion of this study was conducted at the Texas Range Station, Barnhart, between March 6 and April 3, 1979. Eight, 1-acre plots were fenced in an old field heavily infested with bitterweed. Six were adjacent plots along a north-south fenceline on the east side of the field. These plots, plus two, unfenced, 1-acre plots along the south side of the field, were sprayed with 2,4-D 2/ at 7:35 a.m. on March 6, 1979. The other two fenced plots were located to the north and west and were left unsprayed as were two adjacent, unfenced 1-acre plots. The aboveground standing crop of bitterweed was estimated at selected intervals by clipping. Bitterweed was also collected for hymenoxon analysis (4).

Mature Rambouillet ewes (in the last month of pregnancy) were used in the field-grazing experiment. The day after spraying with 2,4-D (considered day 1 of the experiment) six ewes were assigned at random to each of two unsprayed bitterweed plots, and six ewes were placed in two of the sprayed plots. These sheep were observed daily for evidence of bitterweed poisoning and blood samples were taken from ewes and lambs when evidence of bitterweed toxicity appeared and/or when they were removed from the plots. On day 14, six additional ewes were placed in each of two additional sprayed plots.

The 12 ewes which were placed on the sprayed bitterweed plots on March 7 were bled on March 23 (day 17) and then rebled and removed (along with their lambs) on March 27 (day 21). All remaining ewes and lambs were bled on April 4, 1979. At that time, the 12 control sheep had been on the unsprayed bitterweed plots for 28 days, and the second group of 12 sheep on sprayed bitterweed for 14 days.

To determine the relative toxicity of sprayed and unsprayed bitterweed, fresh bitterweed was harvested from the plots and force-fed to sheep in individual pens at the Research and Extension Center near San Angelo. Eight lambs (four each were assigned to unsprayed and sprayed bitterweed) were administered this bitterweed daily for 3 days. The bitterweed dose was 0.25% of live weight per day on an oven-dry basis (0.83% of live weight on a fresh, green basis). Because this level produced rapid poisoning, a second group of eight lambs were administered one-half of this dose for 4 days.

2/ Propylene glycol butyl ether esters of (2,4-dichlorophenoxy)acetic acid (ESTERON 99 concentrate) was used in a 1:8 (v:v) diesel oil-water emulsion carrier. Application was with a fixed wing airplane at the rate of 1.54 lb acid equivalent/acre.

RESULTS AND DISCUSSION

Bitterweed plants were in a rapid vegetative growth stage when sprayed, mostly 2 to 3 inches tall. Weather and plant conditions were excellent for rapid absorption and translocation of herbicide, and the sprayed bitterweed showed signs of herbicide phytotoxicity (epinasty and turgidity) within 24 hours. The effects of spraying were more definite with time; however, most of the bitterweed was not killed by this application of 2,4-D.

On March 6, the mean hymenoxon concentration of bitterweed (air-dry basis) was 1.10% for the plants collected from the unsprayed plots and .93% for the plants from the plots sprayed with 2,4-D. On April 3 (day 28) hymenoxon concentrations were 1.06 and .76% for bitterweed from the unsprayed and sprayed plots, respectively.

The results of the pasture study support previous observations (1) that sheep are generally reluctant to eat bitterweed unless alternative forage is severely limited. At initiation of this study there was an abundance of Nuttall milkvetch (*Astragalus nuttallianus*) available in all plots, but it appeared to be somewhat more plentiful in the unsprayed plots. Growth of milkvetch was depressed by 2,4-D; consequently sheep in the sprayed plots consumed what was available during the first 10 days. In contrast, there was still a limited amount of milkvetch available after 28 days in one of the unsprayed plots and a considerable amount in the other. As long as milkvetch and some grass were available, there was no evidence of sheep consuming bitterweed plants and no signs of poisoning in any of the plots. However, because of the close proximity of small bitterweed plants to desirable forage, these sheep may have occasionally consumed some bitterweed while grazing forbs and grasses. When these palatable forages became limited, sheep on the sprayed plots were observed selecting and eating bitterweed.

Signs of bitterweed poisoning were evident in several ewes grazing the sprayed bitterweed plots by the 17th day (March 23). Depression, weakness, emaciation and occasionally a green nasal discharge were observed. Serum glutamic-oxalacetic transaminase (GOT) and gamma glutamyl transpeptidase (GGTP) activities were increased (Table 1). Poisoned ewes became progressively worse and five of the 12 ewes assigned to the sprayed bitterweed plots (on March 7) died shortly after removal from the plots on March 27 (21 days). The same pattern of response was observed with the second set of 12 ewes placed on sprayed bitterweed plots on March 20 (14 days post-spraying). However, these ewes remained on the plots for only 14 days and although several became sick, none died.

The estimated bitterweed intake of ewes grazing the sprayed bitterweed plots was 0.74 lb/ewe/day (oven-dry basis) for the 21-day period the first group of 12 ewes was kept on the plots and 0.51 lb/ewe/day for the 14-day period the second group was on the plots. These estimates of daily bitterweed consumption are believed to be conservative since they have been decreased by one-half to account for assumed trampling losses.

Only two bitterweed plants which had been grazed by sheep were found in the unsprayed plots and none of the 12 sheep died, although one was unable to stand without assistance on the 28th day. However, this was believed to be due to starvation and not bitterweed poisoning. Since sheep grazing the unsprayed plots did not eat bitterweed, it is not possible to draw any conclusions from the field study on the effects of 2,4-D on the toxicity of bitterweed. Furthermore, since palatable and nutritious alternatives to bitterweed were available for ewes grazing the unsprayed plots, it is also impossible to draw conclusions concerning the effects of spraying with 2,4-D on the relative palatability of bitterweed to sheep.

When bitterweed was harvested (on day 15 and 16) and force-fed to penned sheep, both unsprayed and sprayed bitterweed produced poisoning. Three daily doses of bitterweed administered at 0.25% of live weight (oven-dry basis) killed 3 of 4 sheep receiving unsprayed bitterweed and 1 of 4 receiving sprayed bitterweed. The bitterweed dose for these lambs averaged 0.23 lb/day. Feed intake was greater and changes in blood constituents were less for sheep receiving sprayed bitterweed (Table 2).

None of the lambs administered bitterweed at 0.125% of live weight for 4 days died. Changes in blood constituents were less than was observed when the bitterweed level was 0.25% of live weight per day (Tables 2 and 3). The only indication that sprayed bitterweed was less toxic was the increased feed intake ($P<.05$) observed for lambs receiving sprayed material (Table 3). However, lambs receiving sprayed bitterweed also had higher serum GOT ($P<.05$) activities which would indicate it was more toxic. The difference in the hymenoxon percentages of the bitterweed used in the pen-feeding studies was .10%. The value for unsprayed bitterweed was slightly higher, being 1.11% compared with 1.01% for sprayed bitterweed.

The tendency for hymenoxon content of bitterweed to decrease after spraying with 2,4-D is consistent with earlier observations (2). It is not clear whether sprayed bitterweed with a lower hymenoxon level is less toxic than unsprayed weeds harvested from the same site. In a previous study, sprayed bitterweed with a hymenoxon content of 1.6% was as toxic as unsprayed material containing 2.3% hymenoxon (2). However, in the first pen feeding study reported in this paper (Table 2) bitterweed harvested from plots sprayed with 2,4-D at Barnhart appeared to be considerably less toxic than the unsprayed weed, but there was little difference in hymenoxon content of the bitterweed due to spraying with 2,4-D.

Regardless of the relative toxicity of sprayed and unsprayed bitterweed it is obvious that sprayed bitterweed is toxic to sheep. However, there is considerable discrepency between the amounts required to kill sheep reported by previous researchers (1) and the estimates of bitterweed consumption obtained in this study. Boughton and Hardy (1) reported that the minimum lethal dose of fresh green bitterweed growing during a year of normal rainfall and range vegetation was approximately 1.3% of the body weight of the sheep. During a drouth year, the minimum lethal dose was 0.5% of the body weight. It was also determined that bitterweed poisoning was cumulative when less than the minimum lethal dose was fed over a period of time. The estimated fresh green bitterweed intake of ewes grazing the sprayed bitterweed in this study was 1.97% of live weight per day for the 21-day period the first group of 12 ewes was kept on the plots and 1.36% for the 14-day period the second group was on the plots. At this level of intake it is difficult to explain why all of these ewes were not dead in a few days. A couple of possible explanations are: either the estimates of bitterweed intake (based on disappearance of bitterweed plants from the plots) were in error or mature ewes are more tolerant of bitterweed than the younger sheep (primarily wethers less than 2 years old) which were used in the pen feeding studies (1,2).

In the initial observation on 2,4-D and bitterweed, it was estimated that a group of ewes consumed an estimated average of 100 lb of bitterweed (fresh weight basis) during a 50 to 60-day period following spraying (6). The fact that grazing ewes were able to successfully consume "lethal" amounts of bitterweed for extended periods in two separate experiments suggests the difference may be in the sheep. Considerable variation in susceptibility exists in the sheep population (3) and some genetic selection for tolerance to bitterweed may have occurred over the years in a ewe flock continuously exposed to bitterweed pastures. Development of tolerance to bitterweed with repeated exposure may also be a contributing factor.

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TABLE 1. RECTAL TEMPERATURES AND BLOOD MEASUREMENTS OF EWES GRAZING UNSPRAYED BITTERWEED AND BITTERWEED SPRAYED WITH 2,4-D AT THE TEXAS RANGE STATION. BARNHART, TEXAS (MARCH, 1979)

CRITERION	SAMPLING DATE	BITTERWEED PLOTS UNSPRAYED	BITTERWEED PLOTS 2,4-D SPRAYED	
Ewes No.		12	12	
Rectal Temperature, °F	3-23	104.0	103.8	N.S.
Hematocrit,	3-7	31.8	34.4	
% RBC 1/	3-23	34.2	36.6	N.S.
Serum Urea	3-7	25.8	23.1	
Nitrogen, mg/dl	3-23	34.1	22.1	P<.01
S-GOT, 2/	3-7	74	76	
Sigma-Frankel, U/ml	3-23	112	156	P<.10
γ-GTP,	3-7	24.6	24.4	
Units/ml 3/	3-23	30.6	79.2	P<.05

1/ Packed red blood cell volume as a percentage of whole blood volume.
2/ Serum glutamic-oxalacetic transaminase activity.
3/ Serum γ-glutamyl transpeptidase activity.

TABLE 2. FEED INTAKE, RECTAL TEMPERATURE AND SOME BLOOD CONSTITUENTS IN SHEEP FORCE-FED HARVESTED BITTERWEED. (TRIAL 1, SAN ANGELO)

CRITERION		BITTERWEED SOURCE 1/ UNSPRAYED	BITTERWEED SOURCE 1/ 2,4-D SPRAYED	
Lambs Started No.		4	4	
Lambs Died No.		3	1	
Feed Intake, lb/day 2/		0.34	1.01	P<.10
Rectal Temperature, Ave. °F		102.8	103.3	P<.10
Hematocrit, %RBC 3/	Initial	41.0	35.8	
	Final	62.7	45.0	P<.10
Icteric Index	Initial	10.1	10.4	
	Final	43.1	32.1	N.S.
Serum Urea Nitrogen, mg/dl	Initial	9.2	8.3	
	Final	36.6	21.0	N.S.
S-GOT, Sigma Frankel	Initial	79	56	
Units/ml 4/	Final	477	411	N.S.
γ-GTP, Units/ml 5/	Initial	47	39	
	Final	408	310	N.S.

1/ Bitterweed was harvested from unsprayed plots and plots sprayed with 2,4-D at the Texas Range Station at Barnhart on March 21 and 22, 1979. It was stored frozen until used for this study. The bitterweed dose was 0.83% of live weight on a fresh, green basis administered daily for 3 days.
2/ Average feed consumption, in lb/day, for the 3 days bitterweed was given.
3/ Packed red blood cell volume as a percentage of whole blood volume.
4/ Serum glutamic-oxalacetic transaminase activity.
5/ Serum γ-glutamyl transpeptidase activity.

TABLE 3. FEED INTAKE, RECTAL TEMPERATURE AND SOME BLOOD CONSTITUENTS IN SHEEP FORCE-FED HARVESTED BITTERWEED (Trial 2, San Angelo).

CRITERION		BITTERWEED SOURCE 1/ UNSPRAYED	2,4-D SPRAYED	
Lambs Started, No.		4	4	
Lambs Died No.		0	0	
Feed Intake, lb/day 2/		0.69	1.25	P<.05
Rectal Temperature, Ave. °F		103.2	103.0	N.S.
Hematocrit, %RBC 3/	Initial	33.8	32.4	
	Final	37.3	35.3	N.S.
Icteric Index	Initial	10.7	11.1	
	Final	12.3	12.8	N.S.
Serum Urea Nitrogen, mg/dl	Initial	9.4	8.7	
	Final	25.4	23.7	N.S.
S-GOT, Sigma-Frankel	Initial	54	66	
Units/ml 4/	Final	60	158	P<.05
γ-GTP, Units/ml 5/	Initial	37	33	
	Final	32	60	N.S.

1/ Bitterweed was harvested from unsprayed plots and plots sprayed with 2,4-D at the Texas Range Station at Barnhart on March 21 and 22, 1979. It was stored frozen until used for this study. The bitterweed dose was 0.415% of live weight on a fresh, green basis administered daily for 3 days.

2/ Average feed consumption, in lb/day, for the 4 days bitterweed was given.

3/ Packed red blood cell volume as a percentage of whole blood volume.

4/ Serum glutamic-oxalacetic transaminase activity.

5/ Serum γ-glutamyl transpeptidase activity.

EXTRACTION PROCEDURE FOR ISOLATION OF PHOTOSENSITIZING AGENT FROM FUNGUS GROWING ON KLEINGRASS

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and Charles H. Bridges

SUMMARY

An efficient bulk extraction method has been developed for the isolation of sporidesmin from ryecorn cultures of *Pithomyces charatarum*. From 32 bulk extractions, an average yield of 165.5 mg of sporidesmin-benzene solvate per kilogram of culture material was attained. This represents an increased yield of 28-65% over published results. The isolation technique can be conducted under normal laboratory procedures without the degradation of sporidesmin. This procedure will enhance the evaluation of fungus isolated from Kleingrass for the presence of the photosensitizing compound, sporidesmin.

INTRODUCTION

Sporidesmin, a mycotoxin produced by the fungus *P. chartarum*, has been incriminated as the toxic principle in the mycotoxicosis of facial eczema observed in sheep and cattle (3). A similar syndrome in sheep has been observed in Texas where sheep graze Kleingrass. Taber (4) isolated *P. chartarum* from pastures of Kleingrass during periods of photosensitization of sheep that were grazing Kleingrass.

Various methods for the isolation of sporidesmin have been described (1,2,3,5). Ryecorn, barley, and wheat are the most practical substrates for bulk sporidesmin production due to higher yields and ease of extraction.

EXPERIMENTAL PROCEDURE

Ryecorn (35 g) was added to Erlenmeyer flasks (500 ml), filled with tap water and allowed to soak overnight. The water was decanted from the flasks, and then the flasks were autoclaved (15 p.s.i., 120^{o}C, 30 min). Each flask was inoculated with a culture of *P. chartarum* and incubated in the dark for 28 to 31 days at ambient temperature. For optimal yields, 150-250 g batches of culture material were extracted with benzene overnight on a mechanical shaker in the dark. The benzene extracts were concentrated to dryness with a rotary evaporator. The residue was extracted twice with a mixture of methanol:water (70:30) in the dark. The methanol extracts were combined and then extracted with hexane in a separatory funnel. The hexane extract was discarded. Water was added to the aqueous methanol solution, and a fine precipitate formed as the methanol content was diluted to approximately 35%. The precipitate was discarded using filtration and the filtrate was extracted with benzene in a separatory funnel. The benzene extracts were combined and evaporated to dryness. In order to isolate pure sporidesmin, the crude residue was transferred to a silica gel column. When the column was eluted with benzene:ethyl acetate (95:5), the first 110 ml eluate was discarded and the sporidesmin was displaced from the silica gel column in the following 120 ml of eluate.

RESULTS

Based on 32 extraction batches, the average yield of crude sporidesmin was 263 mg per kilogram of ryecorn medium. After repeated recrystallization, 1177 mg of pure sporidesmin were obtained from 7.11 kg of culture medium. This yield represented an increase of 28-65% over yields published in scientific literature. The material isolated as sporidesmin was identified by means of spectroscopy, chromatography, and melting point determinations.

With this technique, isolates of P. chartarum from Kleingrass can be evaluated for their ability to produce sporidesmin. In addition, fungi isolated from different geographical areas can be grown under different environmental conditions to ascertain if temperature, light, darkness, nutrients, etc. will influence the production of sporidesmin by the organism.

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PR-3698

THE EFFECTS OF DIETARY SUPPLEMENTS ON CHRONIC BITTERWEED (HYMENOXYS ODORATA) POISONING IN SHEEP

Lynn O. Post and E. Murl Bailey, Jr.

SUMMARY

The results from these studies suggest that non-protein nitrogen supplementation in sheep on bitterweed appears to potentiate the toxic effects of bitterweed, whereas supplementation with natural protein sources plus sodium sulfate may produce a real reduction in bitterweed toxicity to sheep.

INTRODUCTION

Bitterweed is one of the most important toxic range plants in the Southwest. This lethal plant continues to be a major obstacle to sheep production in Texas. Previous studies have characterized the mean lethal, acute and subacute, and chronic doses. Chemicals and other feed supplements have reduced but have not prevented bitterweed toxicity. A recent acute study has shown great promise for a cheap and practical way of controlling bitterweed poisoning in sheep. A high protein and an inorganic sulfur source decreased toxicity of bitterweed to sheep by the factor of 2.

Experiments were designed to establish a subacute to chronic dose of bitterweed in lambs that would induce death within 30 days by the voluntary consumption of a ration which contained bitterweed and also to determine the effects of dietary supplementation on the chronic intake of bitterweed. A basal pelletized ration consisting of ground milo and alfalfa leaf meal was developed and had a protein equivalent of 13.3%. Blood measurements of packed cell volume, total serum proteins, thiol concentrations, serum glutamic transaminase, blood urea nitrogen, and creatinine were monitored during the 5-month trial.

EXPERIMENTAL PROCEDURE

Trial I consisted of 5 lambs in each of three groups. One group received no bitterweed, the high-dose group received a maximum dose of bitterweed of 1 gm/kg/day (20 mg/kg of hymenoxon), and the low-dose group received up to 0.5 gm/kg/day (10 mg/kg of hymenoxon). The high-dose group developed signs of intoxication after an average of 47 days compared to an average of 83 days for the low-dose group. The onset of signs was accompanied by a significant increase in the packed cell volume, total serum proteins, and blood thiol concentrations. The increased thiol concentrations were probably due to an elevation of the red blood cells rather than to dehydration. Packed cell volumes rose before elevations in the total serum proteins became significant. After the initial onset of signs in the high-dose lambs, a tolerance to bitterweed became apparent. Approximately twice as much bitterweed was required to reinduce the signs of intoxication. The high and low dose sheep maintained their initial body weights while the control sheep gained about 20 kilograms during the trial.

The second experiment consisted of 5 groups of 4 sheep each. The group received the following diets, respectively: 1 group received the basal diet in which bitterweed was mixed; the second group received bitterweed plus basal diet plus urea; the third group received bitterweed plus basal diet plus soybean meal; the fourth group received the basal diet plus urea plus sodium sulfate; and the fifth group received bitterweed plus the basal diet plus soybean meal plus sodium sulfate. The soybean meal and urea were used to adjust the rations to a 20% protein equivalent and the sodium sulfate was administered at a rate of 340 mg/kg/day. Each animal received the equivalent of 1 gm/kg/day of bitterweed (20 mg/kg of hymenoxon). The high protein diets did not significantly reduce the toxicity of bitterweed; however, urea appeared to potentiate the toxic effects of bitterweed in this study. The urea group developed signs of bitterweed intoxication after 14 days while the urea-sodium sulfate group developed signs within 27 days. The sheep receiving both the soybean meal and the soybean meal-sodium sulfate diets developed signs after 57 days in this experiment. The control group receiving the basal diet plus bitterweed developed signs after 38 days.

PR-3699

A COMPARISON OF FINNCROSS AND RAMBOUILLET EWES UNDER RANGE CONDITIONS

Maurice Shelton and Don Spiller

SUMMARY

Data are reported on the performance of Rambouillet and crossbred Finnish Landrace X Rambouillet ewes managed under range conditions in Edwards County. The ewes were mated for a single annual lambing in January or February. The data suggest the potential for 25-30 percent increase in the number of lambs produced by the crossbred ewes. Fleece weights and ewe body weight for Finncross ewes were below that of the Rambouillet ewes. Based on present price structures, an estimated advantage of approximately $20 in income might be realized from the crossbred ewe throughout her productive life. However, producers should keep in mind that this is only one experience involving relatively small numbers, and the same results may not be obtained under other conditions.

INTRODUCTION

Landrace or Finnish Landrace sheep, as implied in the name, were developed in Finland and found their way to this country *via* Ireland and Canada. The breed is noted for its early sexual maturity and high lambing rate. Due to the great diversity in environment it may be assumed that adaptation to conditions of the Southwest presents problems for this breed. However, it appears desirable to evaluate crossbred ewes carrying a portion of Finn breeding under Texas conditions. Two Finnish Landrace rams were obtained by the Texas Station through the courtesy of the U. S. Meat Animal Research Center in 1970. These were used to produce crossbred ewes and to produce a flock of grade Finnsheep. One of the first studies completed was designed to evaluate the ovulation rate and seasonal breeding tendency of these crossbreeds(1). This study confirmed that these crossbred ewes were more seasonal than Rambouillet, but within the fall breeding season had an ovulation rate more than double that of the Rambouillet. A second study consisted of evaluating the half Finn ewes in comparison with other types for accelerated lamb production under range conditions(2). The results were not particularly encouraging and did not favor the Finncross ewes. This present study consisted of evaluating the lamb production of these crossbred ewes based on an annual spring lambing under range conditions.

EXPERIMENTAL PROCEDURE

Two Finn rams were used to produce FI Rambouillet X Finn crossbred ewes. These were utilized in a comparison with grade Rambouillet ewes at the leased Hill Ranch in Edwards County between Sonora and Rocksprings, Texas. A total of 25 crossbred and 105 Rambouillet ewes was utilized. At the initiation of the experiment labor and physical facilities did not permit pen or shed lambing and only pasture or group data were collected. Both groups of ewes were run together except at lambing when they were lambed in separate pastures. Both groups of ewes were bred to lamb first at two years of age and continued until their sixth lambing at seven years of age. Both groups were managed under typical range conditions, but were supplied with salt-controlled feed supplements (protein and energy) as needed during winters. Feeding levels were variable, but were comparable to or slightly above that of commercial practice. Individual fleece weights (May) and annual body weights (July or August) were collected on the ewes. The lambing rates reported represent the number of lambs weaned except for 1977 (4 years of age) and 1980 (7 years of age) in which marking percentages were used. Weaning records for 1980 season are not available as of this writing. Breeding season was initiated in July for the first three years and was delayed to August in the latter years. This choice of breeding season may well have had an effect on the results obtained.

RESULTS AND DISCUSSION

The results obtained are shown in Table 1 and Figure 1. These data clearly show an increased lamb production, but lower body weights and markedly lower fleece weights for the crossbred ewes. Under the nutritional stress of gestation or lactation the crossbred ewes shed wool badly on the belly or legs and at times over the entire body. Weaning weights of the lambs for the two types appear to be comparable. However, the higher lambing rate of the crossbred ewes would indicate an increased number of twins and thus the level of lactation may actually favor the crossbred group.

When the ewes were mated or exposed in July there was a noticeable tendency for the crossbred ewes to lamb later than the Rambouillet. The earlier report concerning the ovulation rate of Finn X Rambouillet ewes indicated that they reached their highest ovulation rate in September (a mean of 3.15). These data were not available at the start of this study, but in retrospect it appears desirable that these ewes be mated later in the year in order to get maximum advantage of this characteristic.

The earlier study indicated an ovulation rate for the Finncross ewes to be approximately double that of Rambouillet ewes. The present study indicates that this full difference was not realized in lamb production. Apparently the ovum which were ovulated are not being fertilized or implanted or the lambs are not surviving. In this study the increase in lambs produced was only on the order of 30 percent.

The numbers in this study were too small to comment on ewe survival, but on the limited scale involved there was no indication of a decreased survival rate for the crossbred ewes.

Assuming the average ewe remains in a range flock for four seasons or slightly less, the crossbred ewe would produce the equivalent of approximately one more lamb in her lifetime. Actually the mean number of productive years for most range ewes is slightly less than four years

(6 years of age) since some die or must be removed at younger ages. Based on these assumptions (one additional lamb weighing 60 pounds and selling for $.70 per pound) we may estimate an increased income of $42 per lifetime. In practice this must be discounted for:

a. less wool (estimate $12.00),
b. less valuable wool (estimate $3.25),
c. reduced market value of aged ewes (estimate $2.00),
d. reduced value of the wether lambs when the ewe lambs are produced for replacements (estimate $2.50),
e. perhaps increased ram cost (estimate $.50).

When these deductions are made, approximately one half the advantage for the crossbred ewe is accounted for. The remaining difference appears to be real and important, but some producers will not perceive this as a warranted disruption of their finewool breeding program. However, the expected financial gain from the crossbred ewe would be increased as production conditions are improved. Thus breeding in September, under good feed conditions and lambing under confinement conditions where a high proportion of the additional lambs can be raised, should provide a much greater advantage for the Finncross ewe. Conversely as feed and management conditions are reduced over those used in this study, the expected response or advantage for the crossbred ewe may be below that realized in this study.

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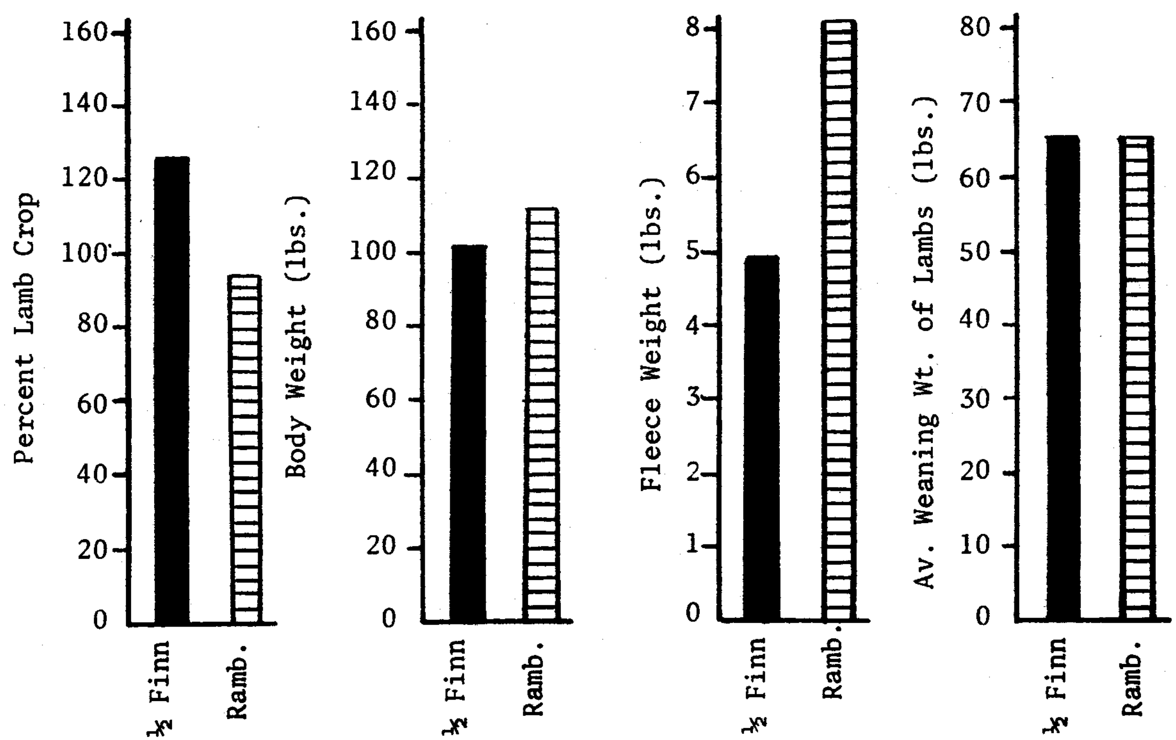
Table 1. Comparative Performance Data for Rambouillet and Finn X Rambouillet Cross Ewes

Year	Type of Ewe	Ewe Age (yr.)	Lamb Crop (%)	Av. Lamb Wt. (lb.)	Fleece Wt. (lb.)	Ewe Weight (lb.)
1975	½ Finn	2	132.0	64.8	5.7	87.8
	Ramb.		91.3	66.4	8.7	90.8
1976	½ Finn	3	91.7	66.3	4.9	94.6
	Ramb.		78.2	63.7	8.0	107.7
1977	½ Finn	4	156.3	67.3	4.7	96.9
	Ramb.		93.8	64.7	7.8	114.1
1978	½ Finn	5	135.3	58.4	4.6	109.5
	Ramb.		95.2	62.6	7.5	120.6
1979	½ Finn	6	132.3	69.1	5.5	120.1
	Ramb.		97.2	65.7	8.6	128.3
1980	½ Finn	7	111.1	—	4.1	—
	Ramb.		101.9	—	7.7	—
Av.	½ Finn	—	126.5	65.2	4.9	101.8
	Ramb.		93.0	64.6	8.1	112.3

Figure 1. Lifetime Mean Production Parameters for Rambouillet and Finnish Landrace X Rambouillet Ewes



WEANING TIME EFFECTS ON SUBSEQUENT REBREEDING OF EWES

Phillip Thompson and Maurice Shelton

SUMMARY

A total of 100 aged Rambouillet ewes was used to study the effect of time of weaning on subsequent rebreeding. The data indicated that ewes whose lambs were weaned 20 days prior to breeding performed superior to ewes which had lambs weaned when the rams were put with the ewes. A total of 99 out of the 100 ewes mated, but only 87 percent lambed as a result of matings which occurred in the first 30 days. Eventually 97 percent of the ewes lambed from a 60-day breeding season. Fewer ewes which had their lambs weaned early rebred during their second cycle. These data do not support a suggestion that mating immediately following weaning might be beneficial, but does indicate that improved condition of the ewes at mating should have a beneficial effect on reproduction.

INTRODUCTION

Improved reproductive performance is the most important means of improving productive efficiency in sheep. The success with which a ewe can be rebred after producing a lamb crop is one factor affecting reproductive efficiency. Observations on the behavior of certain other species suggest that the process of cessation of lactation or an abrupt cessation of lactation may stimulate initiation of reproductive activity. At least one study has suggested this might also apply to sheep. This suggests the possible desirability of exposing ewes to rams immediately after weaning of lambs. Alternatively one might consider weaning lambs at least several weeks in advance of initiating rebreeding with a goal of allowing the ewes to improve their condition. The present study was conducted with a view of looking at these alternatives.

EXPERIMENTAL PROCEDURE

Data were collected on 100 aged Rambouillet ewes at the Winter's Wall Ranch at Brady, Texas to study the effect of time of weaning on subsequent rebreeding. The ewes had previously lambed in March and April. Two groups of 50 ewes each were randomly selected from one experimental flock. One had their lambs weaned July 26, 20 days prior to exposure to rams (Group I), whereas the other had their lambs removed at the time of exposure to rams (Group II). Parent-offspring records were not available on the flock from which the experimental ewes were drawn, thus weaning of the lambs was accomplished by removal of 50 ewes to a separate, but comparable, pasture. All animals were individually weighed prior to being joined with the ram. The experimental groups were maintained together in a small pasture for a 30-day breeding period, and mating records were obtained by use of marking pigment on the ram. All ewes were exposed to clean-up rams for a further

30 day post-treatment. The ewes were lambed in confinement to obtain lambing records.

RESULTS AND DISCUSSION

The results are shown in Table 1 and Table 2. Ewes in Group I, which had their lambs weaned prior to breeding, were in better condition for rebreeding (108 lbs. versus 100 lbs.) than were ewes in Group II from which lambs were weaned immediately before breeding. This difference seems somewhat excessive for the short period of time involved, and may in part represent sampling difference or inapparent differences in the pastures to which they were assigned for the short time following weaning of the lambs. Ninety-nine out of the entire 100 ewes mated as determined by breeding marks during the 30-day experimental period with several of the Group II ewes rebreeding during this period of time. The average number of days between being joined with the rams and first mating was greater for the late weaned ewes.

Lambing data for each group are shown in Table 2. There were 12 percent more ewes lambing in Group I than in Group II based on the 30-day mating period. Data are also reported based on the 60-day mating period. Both approaches indicate a markedly superior lamb crop for the ewes which had their lambs weaned earlier. An obvious conclusion is that this study does not support the thesis that rebreeding might be benefited by a stimulating effect of cessation of lactation coincident with attempts at mating. It is also apparent that in this case the improved body weight of the ewes which had their lambs weaned early had a positive effect on reproduction. It is not immediately clear to what extent the observed weight differences are attributable to early weaning of the lambs, but it does appear that the observed difference was beneficial to the ewe.

Table 1. Effect of Date Weaning on Breeding

Group	No. Ewes	Av. Breeding Wt. (lb.)	No. Ewes Bred 30 days	No. Ewes Rebred Within 30 days	Av. No. Days to First Mating
I	50	108.1	48	6	10.5
II	50	99.6	50	10	14.1

Table 2. Effect of Weaning on Lamb Production Based on 30-Day or 60-Day Breeding Season

		30 Day Breeding Season					60 Day Breeding Season		
								Total Lambs	
Group	No. Ewes	No. Ewes Lambing	No. Lambs Born	% Lamb Crop Dropped	No. Lambs Marked	% Lamb Crop Marked	No. Ewes Lambing	Born	Raised
I	50	46	58	116	49	98	49	62	53
II	50	41	48	96	36	72	48	55	42

PR-3701

PARTITIONING THE LOSSES IN REPRODUCTIVE EFFICIENCY IN FALL-BRED RANGE FINEWOOL EWES

Maurice Shelton and Phillip Thompson

SUMMARY

The reproductive potential of mature mixed-age fall-bred finewool ewes was investigated over four years at the Winter's Wall Ranch at Brady. Representative samples were slaughtered for ovulation and conception data. A subsequent sample was lambed in pens to obtain lambing data. The remainder were lambed in the normal way in the pasture. Essentially all the ewes cycled with a mean ovulation rate of approximately 150%. The actual lamb crop raised was only slightly more than 100%, indicating a loss of almost 50 potential lambs per 100 ewes. The greatest part of this loss was with ewes which had twin ovulations, but produced only one lamb. Other areas of loss were in dry ewes and in death loss of the lambs produced. In the latter instance most losses occurred before marking. Losses from marking to weaning were only approximately 1.8 percent.

INTRODUCTION

It is generally conceded that improved lamb production provides a major opportunity to improve income to the sheep industry. The potential reproductive rate with sheep is quite high relative to competing species, such as cattle, and provides one of the opportunities to be exploited in improving the competitive position of sheep. Most flocks of range ewes in Texas have a relatively low rate of lamb production relative to the potential. The percent lamb crop weaned in Texas is generally on the order of 75-80% as a statewide average. One approach to the study of this problem area is to look at the potential for range ewes and identify areas of loss or deviation from this potential.

PROCEDURE

The flock of finewool ewes at the Winter's Wall Ranch at Brady was used in this study. Only fall-bred (September or October) and mature ewes (mixed ages with the exception that no two-year-old ewes were present) were involved. The ewes were exposed to approximately 4% rams consisting of both Rambouillet and Blackface breeding for a six-week period. The data were collected over four breeding (1976-79) and lambing seasons (1977-80). Approximately 20 days after the rams were removed a sample of the ewes (24-28 head) was slaughtered through a commercial abattoir. The reproductive traits were recovered and the ovulation rate and the number of embryos present were recorded. In the case of ewes which did not settle and continued to cycle, the ovulation rate recorded would represent a cycle subsequent to that in which the rams were present. This would be a minor source of error in that only 4.5% of the ewes failed to settle. Prior to lambing, a further sample of approximately 50 ewes (40-60 depending on year) was removed from the flock and lambed in confinement (drylots) to record lambing rate. Actual lamb production, i.e., lambs marked or lambs weaned, was recorded for the remainder of the ewes which lambed under range conditions. The ewes were fed salt-controlled supplements on the range as deemed necessary or as approximated commercial practice for the area.

RESULTS AND DISCUSSION

The results are summarized in Table 1 and Figure 1. These data show that essentially all the ewes ovulated, with only 1 of 102 tracts examined failing to show evidence of an active or functional corpus luteum (ovulation points) on the ovaries. The one ewe had cycled during the fall, but was not cycling at the time of slaughter in December. Actual matings were not recorded. Ovarian activity is not exactly the same as showing estrus, but may be presumed to be almost the same.

At slaughter 95.5% of the ewes were pregnant. Thus between 3 and 4% of the ewes which ovulated failed to settle. A total of 92.3% of the ewes lambed,indicating that 3.2% of the ewes lost their lambs between conception and lambing. It seems possible that this may be an underestimate of ewes lambing in that any lambs which were not recorded would show up as a ewe which failed to lamb. It is known that small varmints sometimes carry away dead lambs. These data seem to suggest that a high percent of range ewes will cycle and settle and that loss from conception to parturition is small. This might very well not be the case if infectious diseases were encountered, which was not known to be the case in this study.

As shown in Figure 1 the major loss which occurred was between ovulation and conception. In this case a potential of 37 lambs was lost between ovulation and conception. Most of this loss occurred with twin ovulating ewes which were carrying only one lamb. For instance 52.4% of the ewes had twin ovulations, whereas only 19.4% of the pregnant ewes had twin lambs. These data do not provide evidence on conception versus implantation. Other studies have suggested that conception tends to be an all-or-none thing. Assuming this is true with these data, the loss is occurring through a failure of implantation. This is an area that should receive attention in future research. The other major area of loss was in death loss of lambs produced. In these data this loss was only on the order of 10% of which approximately 90% occurred prior to marking. For the two years in which these data were available only 1.8% of the lamb crop was lost from marking to weaning. In one season a significant number of lambs were lost from a combination of needle grass, internal parasitism, and poor nutrition for a short period of time in early June, but the sheep in which this loss occurred were number one were not those contributing to these data. This is a relatively low or a conservative loss. These losses could well have been much higher if predation was a factor, which was not known to be the case in this flock. Also weather was relatively favorable at the lambing seasons during the period of years covered by this study.

These data indicate that three approaches might be taken to improve lamb production. These are: (a) increase ovulation rate, (b) reduce loss from ovulation to implantation, (c) reduce death losses. None of these will be easily accomplished, but a loss of the potential as indicated by the ovulation is a major area of loss and should warrant further investigation. Without a clear-cut lead as to methods of reducing this loss, none of the above approaches will be ignored.

Table 1. Partitioning Losses in Reproductive Efficiency in Fall-Bred Finewool Ewes

Year	Breeding Wt./Lbs.	% Ewes Ovulating	Ovulation Rate		Conception Rate		
			% Total Ewes	% Cycling Ewes	% Ewes Pregnant	% Embryo Mated	% Embryo Pregnant
1976-77	107.1	100.0	180.8	180.8	96.2	130.8	136.0
1977-78	115.5	100.0	129.2	129.2	100.0	108.3	108.3
1978-79	124.0	96.4	164.3	170.4	85.7	103.6	120.8
1979-80	112.3	100.0	129.2	129.2	100.0	112.5	112.5
Summary	114.7	99.1	150.9	152.4	95.5	113.8	119.4

Year	Lambing Results			Lambs Marked	Lambs Weaned
	% Ewes Lambing	% Lambs of Ewes Present	% Lambs of Ewes Lambing	% of Ewes Present	% of Ewes Present
1976-77	92.0	118.0	128.3	110.9	109.2
1977-78	92.3	92.3	92.3	99.0	—
1978-79	94.9	133.9	141.1	107.7	105.9
1979-80	89.8	110.2	122.7	98.6	—
Summary	92.3	113.6	121.1	104.1	—

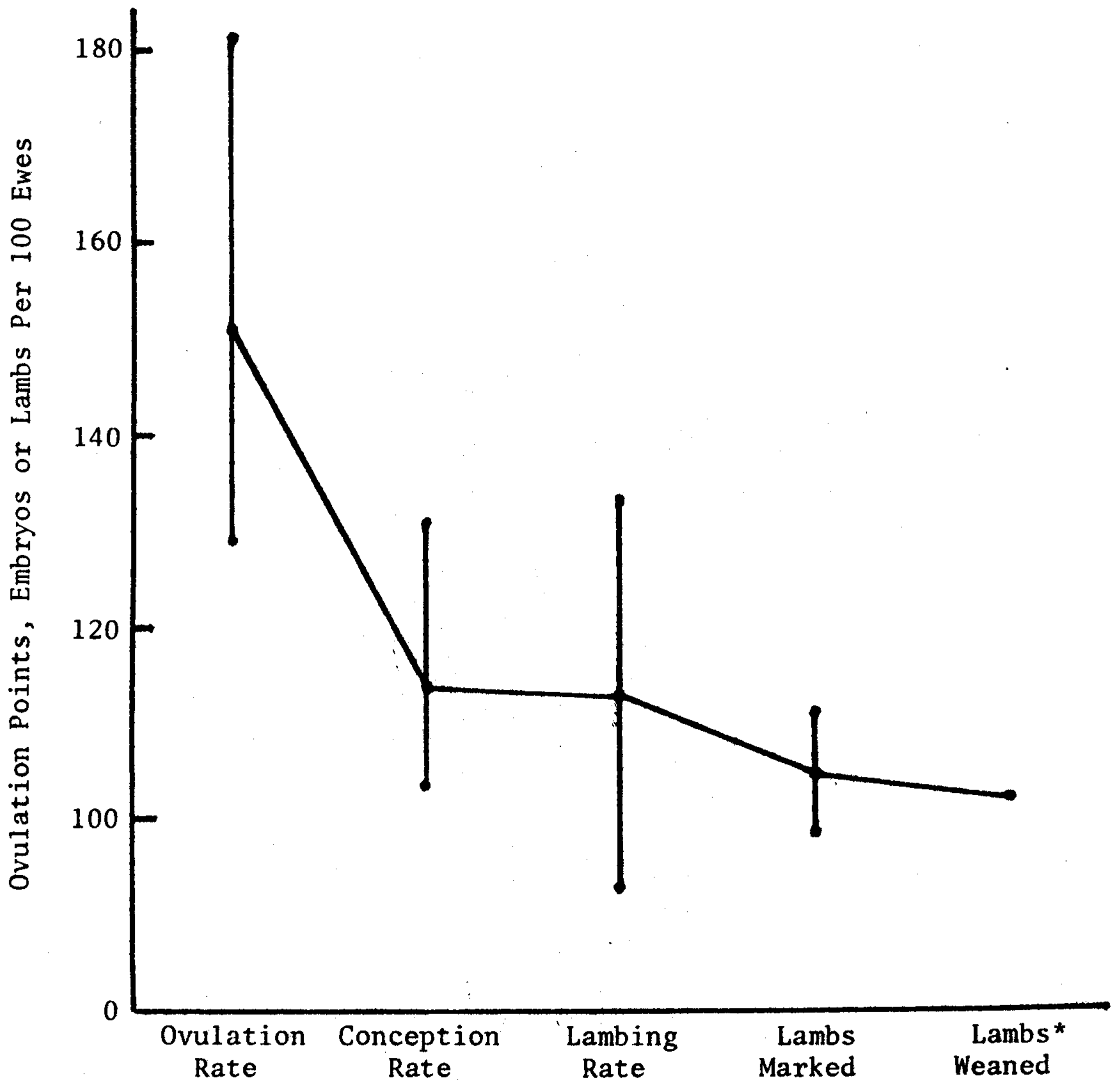


Figure 1. Reproductive potential (ovulation rate) and areas of loss in reproduction in one flock of mature fine-wool ewes. Vertical lines represent variation between years. Lambs weaned data represent data from only two years' data.

PR-3702

ESTRUS AND PREGNANCY RATES FOLLOWING SYNCHRONIZATION WITH CRONOLONE INTRAVAGINAL SPONGE OR NORGESTOMET EAR IMPLANT IN CYCLING EWES

John C. Spitzer and Robert H. Carpenter

SUMMARY

Two experiments were conducted to evaluate the efficacy of a 3 mg ear implant of Norgestomet in conjunction with an injection of 1.5 mg Norgestomet and 0.5 mg estradiol valerate (EV) for controlling a fertile estrus in the ewe. The implant remained *in situ* for 10 days. This treatment regime was compared with the long-accepted treatment of a 2 mg Cronolone impregnated intravaginal sponge left *in situ* for 14 days (Experiment 1) and a modification of the Cronolone sponge treatment to include an injection of 1.5 mg Norgestomet and 0.5 mg EV (Experiment 2). The percentage of ewes synchronized was not significantly affected by progestin treatment (Experiment 1-Cronolone alone, 96% , Norgestomet implant and injection of Norgestomet and EV, 92%; Experiment 2-Cronolone pessary + injection of Norgestomet and EV, 84%; Norgestomet implant + injection of Norgestomet and EV, 96%).

In Experiment 1, the pregnancy rate of 80% for Cronolone-treated ewes was significantly higher than the 59% observed in Norgestomet-treated ewes ($P<.05$). In Experiment 2, no significant differences were observed in pregnancy rate between the two treatment groups (Cronolone, 57%; Norgestomet, 65%).

INTRODUCTION

A progestin treatment regime using intravaginal pessaries impregnated with Cronolone (Syncro-Mate, G. D. Searle and Co.) has been shown to be effective in controlling estrus and ovulation in the cycling ovine (2,3,7). Recently, success has been reported in synchronizing estrus in the bovine with a treatment regime involving an ear implant impregnated with the progestin Norgestomet (Syncro-Mate-B, G. D. Searle and Co.) (5,6). These reports and the cessation of commercial production of the Cronolone impregnated intravaginal pessary have encouraged investigations into the use of the Norgestomet ear implant in synchrony programs in the ovine (1,4).

The present studies were conducted to compare estrus and pregnancy following the widely accepted 14-day treatment involving the Cronolone-impregnated intravaginal sponge with the 10-day Norgestomet-impregnated ear implant treatment regime. Additionally, a regime using the Cronolone-impregnated intravaginal sponge and a parenteral injection of Norgestomet and EV at time of sponge insertion was compared with the 10-day Norgestomet ear implant regime in ability to control a fertile estrus.

EXPERIMENTAL PROCEDURE

One hundred and forty-five mature ewes were utilized for these experiments. Ewes were western range ewes of mixed breeding but, by visual assessment, were predominantly Rambouillet. Studies were conducted during the months of September through November when these ewes would be cyclic. However, to insure that no anestrous ewes were assigned to treatment, only ewes observed in estrus within the 15 days preceding a replicate starting date were selected for experimental animals. The 145 ewes were selected from a larger flock maintained with vasectomized rams equipped with marking harnesses. The flock was monitored at least once a day for marks indicative of estrous behaviour.

Experiment 1

Ninety-six ewes were selected with 24 ewes assigned to each of four replicates. A replicate was started in each of four consecutive weeks. Within each replicate, ewes were randomly allotted to two equal groups. One group received the intravaginal sponge impregnated with 20 mg Cronolone. Sponges were withdrawn 14 days following insertion. Ewes in the second group received the 3 mg Norgestomet ear implant with the implant being removed 10 days following insertion. An injection of 1.5 mg Norgestomet and 0.5 mg estradiol valerate (EV) was administered intramuscularly concurrent with insertion of the implant (4). Initiation of treatments was staggered such that pessaries were withdrawn and implants removed on the same day.

Immediately following implant or pessary removal, ewes from both groups were combined and exposed to two fertile rams wearing marking harnesses. Mating activity was monitored twice daily for five days subsequent to implant removal. Pregnancy was diagnosed either by laparotomy at 30-40 postmating or by radiography at 75-85 days postmating.

Experiment 2

At approximately weekly intervals 49 ewes were treated in eight replicates of 4-10 ewes per replicate. Within each replicate, ewes were randomly allotted to two equal groups. One group received the intravaginal sponge impregnated with 20 mg Cronolone with the sponge withdrawn 10 days following insertion. Additionally, those ewes received 1.5 mg Norgestomet and 0.5 mg EV when the pessary was inserted. The second group received the Norgestomet treatment regime exactly as outlined for Experiment 1. Pessary or implant insertion and pessary or implant removal occurred on the same days, respectively.

Immediately following pessary or implant removal, ewes from both groups were combined and exposed to a single fertile ram equipped with a marking harness. Pregnancy was diagnosed by radiography at 75-85 days postmating.

In both experiments, statistical analysis of differences in data were analyzed by chi-square contingency table.

RESULTS AND DISCUSSION

All 145 ewes receiving either a pessary or implant retained the respective device until planned removal. In contrast to other views (1) the Norgestomet ear implant regime was considered to be much easier and esthetically more desirable to administer and remove than the Cronolone intravaginal pessaries.

In Experiment 1, 96% of the Cronolone-treated ewes and 92% of the Norgestomet-treated ewes were in estrus within five days (synchronized period) of the end of treatment (Table 1). In Experiment 2, 84 and 96%, respectively, of the Cronolone-treated and Norgestomet-treated ewes were in estrus during the synchronized period. These data are in contrast to previous data (1) and are supportive of data (4) indicating a high degree of synchrony for ewes following the Norgestomet ear implant treatment regime.

Pregnancy rates for ewes exhibiting estrus during the 5-day synchronized period were 80% for Cronolone-treated ewes and 50% for Norgestomet-treated ewes in Experiment 1 ($P<.05$). In Experiment 2, the pregnancy rate of 57% for ewes receiving the Cronolone sponge for 10 days and injections of Norgestomet and EV was not significantly different from the 65% for ewes receiving the Norgestomet ear implant.

The reduction in pregnancy rate for ewes receiving the Norgestomet treatment regime in Experiment 1 is difficult to explain since there were no untreated control ewes to evaluate pregnancy rate at an unregulated estrus. An earlier trial (4) reported almost identical pergnancy rates for ewes receiving this treatment regime and non-treated control ewes mated during the same time period. The pregnancy rates of 59 and 65% for Experiments 1 and 2, respectively, agree closely with their reported pregnancy rates. The 80% pregnancy rate observed for Cronolone-treated ewes in Experiment 1 is greater than other pregnancy rates reported following this treatment (2,7).

Results with the 10-day Norgestomet treatment regime are encouraging, and large scale field trials need to be conducted. Additionally, little work has been done on altering the length of time the implant remains *in situ* and the effect on synchronization of estrus and fertility in the ovine. It is concluded that Norgestomet may be a useful progestin and the ear implant a useful delivery device for control of a fertile estrus in the ewe.

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TABLE 1. ESTRUS AND PREGNANCY FOLLOWING PROGESTIN TREATMENTS FOR SYNCHRONIZATION IN CYCLING EWES

Experiment	Treatment group	Ewes No.	Estrus No.	Estrus %	Pregnancy No.	Pregnancy %
1	Cronolone sponge[b] alone	48	46	96	37	80[d]
	Norgestomet implant[c] + 1.5 mg N and 0.5 mg EV	48	44	92	26	59[e]
2	Cronolone sponge[c] + 1.5 mg N and 0.5 mg EV	25	21	84	12	57
	Norgestomet implant[c] + 1.5 mg N and 0.5 mg EV	24	23	96	15	65

[a]Percent pregnant based on number of ewes pregnant of those in estrus.

[b]Fourteen-day treatment regime.

[c]Ten-day treatment regime.

[de]Figures in the same experiment with different superscripts are significantly different ($P<.05$).

PR-3703

COTTON GIN WASTE VALUE IN MAINTENANCE RATIONS FOR SHEEP (AGED FINEWOOL EWES) AND GOATS (AGED ANGORA DOES)

Lee Warren, Maurice Shelton and Gary Snowder

SUMMARY

A study was conducted to investigate the use of cotton gin waste based rations for maintenance or breeding rations for aged finewool ewes and aged Angora does. The rations used contained 52 to 80 percent cotton gin waste. The Angora goats adapted very poorly to these rations and did not perform satisfactorily. Extreme age, senility or debility may have been a partial explanation. The ewes were stronger at the initiation of the study. They performed satisfactorily on both rations indicating a good potential for use of this material with sheep.

INTRODUCTION

Dry lot rations for breeding sheep or goats might be of interest for several reasons including the following:

1. For use in confinement or partial confinement production systems,
2. Emergency feeding during periods of drought,
3. Confinement during lambing or kidding to reduce death losses.

The concentrated portion of these rations tends to be static or constant in that sorghum grain and cottonseed meal (and sometimes urea) are standard ingredients. Texas producers are in a reasonably favorable position relative to other areas in that sorghum and cotton are major crops for the state and prices for these products are usually competitive with other areas. However, local producers are in a difficult position relative to the roughage component and the overall cost of the ration. These problems arise from the difficulty of producing cultivated forages in range areas or the cost of inshipments of bulky feeds. Some of the options include alfalfa hay or pellets, cottonseed hulls, peanut hulls or cotton gin waste. Each presents problems of cost or nutritional value. Producers are generally familiar with alfalfa, cottonseed hulls or peanut hulls, but have less experience with cotton gin waste. The following study was undertaken to provide data on this product. A large volume of this material is available in the state, and presents problems of disposal. Thus, if it could be utilized as a feed, two problems might be solved. Most readers will be aware that throughout much of the state arsenical preparations are used in desiccating for harvest. As a result, gin wastes may contain arsenic as a contaminant. The levels are highly variable. They have not proved toxic in limited use, but are much too high to recommend for widespread use. The cotton gin trash used in these studies was obtained from areas in the northern part of the state where desiccants are not used. The material was purchased in pelleted form and was reground before mixing with other ingredients.

MATERIALS AND METHOD

Fifty aged Rambouillet ewes and seventy aged Angora does were purchased from a local auction or were culled from station flocks in the fall of 1979. Their ages were not known, but existing industry practices suggest that the does were older than the ewes both in actual years and in relative age. This should be kept in mind in evaluating the results. Prior to the experiment, the animals were weighed, drenched for internal parasites, and the sheep were given a condition score based on one to ten with ten being more favorable.

The animals were randomly assigned to rations containing two different levels of gin waste as shown in Table 1. The two rations were fed *ad libitum*.

The test animals were maintained in open lots with no shelter. The does were allowed seven days and the ewes nine days to adjust to the feed rations. Two Angora billies were placed with each pen of does and two rams were added to each pen of ewes. The males were rotated weekly. An oil-base pigment was placed on the chest of the males. Breeding data were obtained by observation of marked females. At the end of the experiment, 27 ewes were slaughtered to obtain carcass data and reproductive performance. Other reproductive data were gained from lambing records. Those ewes allowed to go through term were placed on a diet of alfalfa pellets. The Angora does were carried until pregnancy diagnosis (ultrasonic) could be made. Open does were sold and the pregnant does were used in another experiment.

RESULTS AND DISCUSSION

Performance data are summarized in Table 2. It should be noted that not all test animals survived the experiment. Some of the does adapted slowly to the new environment, with substantial death loss. The main causes of death were diagnosed as old age and starvation. Some ewes which did not cycle were later found to be pregnant due to breeding before onset of the experiment and these are not included in the results. The ewes performed reasonably well on both rations, while the goats did not perform satisfactorily. The primary differences appear to be related to level of feed intake. The goats consumed significantly less of both rations when expressed either on a per-head or per-pound-of-body-weight basis. By contrast the goats likely had a higher nutrient requirement per unit of weight than the sheep. At least in this case it may be stated that goats did not perform satisfactorily on gin trash based rations. This may be ascribed to their reluctance to go on feed on this type material and to extreme age of the does at the outset.

Reproductive data are summarized in Table 3. The feed treatments had no apparent effect on the ability of the ewes to show estrus and to ovulate. Although ovulation was not noticeably affected, the ewes on the lower quality ration did have fewer embryos at slaughter. Based on the number bred, the considerable breeding performance difference between the does was probably nutritionally related. Although the number of does surviving were somewhat comparable between the rations, the breeding performance greatly favored those receiving the superior ration. When studied as individuals, the does losing weight did not show estrus as well as the does gaining weight. Weight gains were poor suggesting little potential for use of this type rations to put weight on Angora does before breeding or slaughter. Both groups of ewes gained weight suggesting that it might be feasible to use gin trash-based rations for sheep. Essentially all of the ewes showed estrus, and the results at slaughter suggest the potential for a reasonably good lamb crop. Approximately ten pounds of feed were required per pound of weight gain on these ewes. Based on weight gains alone this would not be economic in terms of the current price for aged ewes for improved slaughter value, but could very well provide an economic response where a positive margin or increase in market price was realized.

Table 1. Rations Utilized

Ingredient	Ration #1	Ration #2
Cotton gin trash	52.0%	80.0%
Cottonseed meal	10.0%	9.0%
Milo	30.0%	9.0%
Dehydrated alfalfa	6.0%	—
Di-Cal	1.0%	1.0%
Salt	1.0%	1.0%
Calculated protein content %	10.852%	8.817%
Calculated DE M cal/lb.	1.112	.699
ME M cal/lb.	.912	.573

Table 2. Performance Data

	Higher Quality Ration		Lower Quality Ration	
	Goats	Sheep	Goats	Sheep
Days on feed	28	42	28	42
Number of animals at completion of experiment	29	22	28	23
Average initial weight, lbs.	58.9	95.21	61.68	95.7
Final weight, lbs.	61.24	108.04	57.86	106.25
Daily weight change, lbs.	+0.08	+0.30	-0.14	+0.25
Average daily intake, lbs.	1.80	3.54	1.53	2.94
Feed conversion (feed per lb. gain)	22.5	10.41	—	10.14
Carcass yield	—	45.4	—	40.9
Number animals lost during experiment	6	0	7	0

Table 3. Reproductive Data

ANGORA DOES

Treatments	No. In Lot	No. Bred	% Bred	No. Open	No. Pregnant	% Pregnant of Does Surviving
Ration #1	29 hd.	21	72.4	8	21	72.4
Ration #2	28 hd.	13	46.4	15	13	46.4

RAMBOUILLET EWES

Treatments	No. In Lot	No. Bred(%)	No. Pregnant(%)	No. Embryos	Potential Lamb Crop(%)
Ration #1	22 hd.	21(95.5%)	21(95.5%)	28	127.3
Ration #2	23 hd.	23(100%)	22(95.7%)	26	113.0

PR-3704

FEATHER MEAL -- EVALUATION FOR BODY WEIGHT GAIN AND FIBER PRODUCTION IN ANGORA BILLIES

Gary Snowder, Maurice Shelton and J. E. Huston

SUMMARY

Two experiments were conducted with Angora kid goats to determine if hydrolized feather meal could be utilized to stimulate increased mohair production. Cottonseed meal was used for comparison, as well as a sorghum grain-based ration to which no protein supplement was added. Both protein sources appeared to give a response in increased mohair production as compared to the control ration. Hydrolized feather meal not only did not provide a response in fiber production, it did not appear to be utilized as efficiently as cottonseed meal.

INTRODUCTION

Angora goats have been shown to have a high protein requirement, or at least to respond with increased fiber production up to a relatively high ration protein content (3). The result is that Angora goats are normally provided with protein supplements. It has also been shown in sheep that if intact proteins can be made to escape ruminal degradation an increase in fiber production can be expected (1). The latter might theoretically be accomplished by use of protected (encapsulated) proteins or by use of natural proteins of low solubility which may tend to escape ruminal degradation. Hydrolized feather meal is a by-product of the poultry industry (85+% protein) which is available as a livestock feed. Since it is a form of keratinized protein it is generally considered to be low in solubility. Thus, it appeared advisable to investigate the potential of this material to stimulate fiber production. This possibility had been suggested in an earlier study (2).

EXPERIMENTAL PROCEDURE

Two experiments were conducted simultaneously from November 1979 to February 1980. In each experiment 20 Angora billy kids were shorn and assigned to one of four treatments. In Experiment 1 kids were maintained in individual stalls on raised floors and fed controlled amounts daily for 130 days. Kids in Experiment 2 were fed <u>ad libitum</u> in four pens of five animals for 124 days. Experimental treatments consisted of feeding one of four pelleted rations as shown in Table 1. Cottonseed hulls and dehydrated alfalfa were the main roughage components. The protein and energy sources consisted of sorghum grain, cottonseed meal and feather meal. Urea was added to the 7.5-percent feather meal ration to increase nitrogen content. One kid died of urinary calculi while in Experiment 2 on ration 2 even though all rations contained .5 percent ammonium chloride as a preventative measure against urinary calculi formation.

At termination of the feed period and before shearing, staple length and hair character were measured. Character (over-all visual appearance of the fleece) was subjectively scored on a scale of 0 to 5 basis with high values being more desirable. Animals were sheared and grease fleece weight recorded.

RESULTS AND DISCUSSION

Performance data of both experiments are reported in Table 2. In Experiment 1 in which all animals received a controlled amount of one of the four rations, there were no significant differences between gains, but the small differences which did exist favored cottonseed meal ration and the 13-percent feather meal ration. At termination of Experiment 1 all kids were consuming 3.5 pounds of feed daily, but the overall average daily intake was only 2.3 pounds. Even though the low protein sorghum grain-based ration fed lot sheared considerably less mohair, treatment effects were not a significant source of variation in fleece weight. The differences observed favored the rations with more protein. A lack of significance can no doubt be explained by the small numbers involved. Staple length and character score were similar between treatments.

When fed ad libitum the kids in Experiment 2 consumed an average of .5 to .9 pound more per day than those in Experiment 1. Average daily gains were not significantly different though goats fed the sorghum grain ration had noticeably lower gains. The 13-percent feather meal ration appeared to present a palatability problem resulting in reduced intake.

In Experiment 2, grease fleece weights of those kids fed cottonseed meal were significantly heavier than fleece weights of those on the sorghum grain ration and the 13-percent feather meal ration. The response to cottonseed meal ration over the sorghum grain ration was expected due to greater total protein intake. Though fleece weights of the cottonseed meal group were over one and a half pounds heavier than those of the 7.5-percent feather meal group, they were not significantly different. The cottonseed meal group also had a longer staple length and more desirable character score. The sorghum grain treatment and the 13-percent feather meal treatment had shorter staple and significantly lower character score.

The results of these two tests indicate the expected response to providing a protein source over the sorghum grain based ration. No advantages for feather meal supplementation were observed at the levels fed. Angoras fed feather meal did not produce heavier or more desirable fleeces or greater weight gains than those receiving cottonseed meal. The feather meal-based rations did provide a response over the low protein ration indicating that the kids were utilizing the feather meal. However, the ratio of protein intake to fiber produced indicated that feather meal not only did not stimulate increased fiber production but was not utilized as efficiently as cottonseed meal. Thus if feather meal is to be utilized in goat rations, it should sell at a lower price relative to protein content due to lower overall protein utilization. Also an equivalent amount of protein from cottonseed meal would provide a significant amount of energy. Variability in quality of feathermeal may be a partial explanation for the poor results obtained in this study compared to earlier studies (2).

LITERATURE CITED

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Table 1. Composition of Rations, Percent

Feed Ingredients	Sorghum Grain Ration	Cottonseed Meal Ration	Feather Meal 7.5% Ration	Feather Meal 13% Ration
Cottonseed meal	45.0	45.0	45.0	45.0
Dehydrated alfalfa	15.0	15.0	15.0	15.0
Sorghum grain	33.0		24.0	20.0
Cottonseed meal		33.0		
Feather meal			7.5	13.0
Urea			1.5	
Molasses	5.0	5.0	5.0	5.0
Ammonium chloride	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Dicalcium phosphate	1.0	1.0	1.0	1.0
Analyzed crude protein	9.4	17.6	16.6	15.7

Table 2. Performance of Angora Billy Kids on Different Protein Sources

EXPERIMENT 1

	Sorghum Grain	Cottonseed Meal	Feather Meal 7.5%	Feather Meal 13%
Number	5	5	5	5
Weights, shorn basis				
Initial, lb.	33.67	38.20	34.40	33.83
Final, lb.	72.00	82.00	7[illegible] 20	77.20
Weight change, lb.	38.33	43.80	39.80	43.37
Avg. daily gain, lb.	.29	.34	.31	.34
Avg. daily consumption lb./head	2.30	2.30	2.30	2.30
Fleece data, 130-day basis				
Grease weight, lb.	3.50	5.30	5.18	4.50
Staple length, in.	4.14	4.09	4.01	4.42
Character score	3.40	3.40	4.00	2.60

EXPERIMENT 2

	Sorghum Grain	Cottonseed Meal	Feather Meal 7.5%	Feather Meal 13%
Number	5	4	5	5
Weights, shorn basis				
Initial, lb.	43.0	40.2	42.2	40.4
Final, lb.	76.4	86.0	86.6	82.2
Weight change, lb.	33.4	45.8	44.4	41.8
Avg. daily gain, lb.	.23	.36	.36	.31
Avg. daily consumption lb./head	2.80	2.96	3.21	2.78
Fleece data, 124-day basis				
Grease weight, lb.	3.90	6.63	4.94	4.16
Staple length, in.	4.20	4.79	4.53	4.37
Character score	1.80	4.25	2.40	1.40

PR-3705

SUPPLEMENTAL PHOSPHORUS EFFECTS ON GROWTH RATE AND MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS

J.E. Huston

SUMMARY

A study was conducted at the Texas A&M University Research and Extension Center at San Angelo to determine whether dietary phosphorus is a limiting nutrient in growth and development of Angora kids under practical range conditions. The study involved 50 female Angora kids during a 200-day fall and winter period. The results indicate that phosphorus is not a limiting nutrient under the practical conditions of this study.

EXPERIMENTAL PROCEDURE

A 200-day supplemental feeding study was conducted with 50 female Angora kids fed three levels of protein and four, three or two levels of phosphorus. The kids were grazed together in a common pasture and penned and fed individually 6 days each week (TABLE 1). Group 1, control, received no supplemental feed at any time. The levels studied were from 1 to 4 grams of supplemental phosphorus per head per day, Because of the phosphorus content in milo and cottonseed meal, it was not possible to have low phosphorus treatments at the higher protein levels.

RESULTS AND DISCUSSION

Results of the study (TABLE 2) indicate that all supplements improved performance above the control group. Losses of animals from wild dogs and other causes account for the reduced numbers of animals. Mohair production and weight gain tended to increase with increased protein intake, which is consistent with results of the companion report[1]. There appeared to be no consistent response to increased phosphorus intake in either mohair production (TABLE 3) or weight gain (TABLE 4).

No experimental data are vailable on the importance of phosphorus in supplemental feed for Angora kids on rangeland. These data indicate that phosphorus is not a limiting nutrient in kids given an opportunity to select diets from range vegetation.

LITERATURE CITED

1. Huston, J.E. 1980. Supplemental energy and protein effects on growth rate and mohair production in weaned Angora female kids. TAES PR 3706. 5 pp.

TABLE 1. RATIONS AND SUPPLEMENTAL NUTRIENTS FOR WEANED ANGORA FEMALE KIDS

		Ingredients (%)			Approximate Nutrients (g/day)[3]		
Ration	Levels[1]	Milo	CSM	Phosphate[2]	TDN	CP	P
2	Low-Low	89	10	1	150	25	1
3	Low-Med	86	10	4	150	25	2
4	Low-Mod	85	9	6	150	25	3
5	Low-High	82	9	9	150	25	4
6	Med-Med	55	43	2	150	50	2
7	Med-Mod	54	42	4	150	50	3
8	Med-High	52	41	7	150	50	4
9	High-Mod	24	73	3	150	75	3
10	High-High	24	71	5	150	75	4

[1]Refers to levels of protein (CP) and phosphorus (P) supplied in supplemental feed.

[2]A commercial phosphorus source containing 18% phosphorus.

[3]Refers to Total Digestible Nutrients (TDN), Crude Protein (CP), and Phosphorus (P).

TABLE 2. WEIGHT GAIN AND MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS FED VARIOUS LEVELS OF PROTEIN AND PHOSPHORUS

Supplemental Treatment[1]	Number of Animals	Average Gain (Lbs)	Grease Fleece Wt. (Lbs)
Control	5	0.8	3.3
Low-Low	4	5.8	4.1
Low-Med	4	6.5	3.2
Low-Mod	4	6.8	4.3
Low-High	4	6.0	5.1
Med-Med	3	9.7	5.1
Med-Mod	4	7.2	4.7
Med-High	4	4.8	5.0
High-Mod	5	8.8	5.0
High-High	4	8.5	4.9

[1]The Control Group received no supplemental feed. Treatment description for all other groups refers to levels of supplemental protein and phosphorus, respectively (TABLE 1).

TABLE 3. EFFECTS OF SUPPLEMENTAL PROTEIN AND PHOSPHORUS ON MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS [1]

Supplemental Phosphorus (g/day) \ Supplemental Protein (g/day)	0 (Control)	25 (Low)	50 (Med)	75 (High)
	Mohair Production (g/day)			
0 (Control)	8.8	-	-	-
1 (Low)	-	9.6	-	-
2 (Med)	-	10.0	12.8	-
3 (Mod)	-	10.0	11.2	12.0
4 (High)	-	12.8	12.8	12.0

[1] Data adjusted to an Angora female kid weighing 40 pounds (shorn weight).

TABLE 4. EFFECTS OF SUPPLEMENTAL PROTEIN AND PHOSPHORUS ON MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS[1]

Supplemental Phosphorus (g/day) \ Supplemental Protein (g/day)	0 (Control)	25 (Low)	50 (Med)	75 (High)
	Fleece-free Weight Gain (g/day)			
0 (Control)	4.4	-	-	-
1 (Low)	-	14.8	-	-
2 (Med)	-	10.4	24.8	-
3 (Mod)	-	16.4	17.6	20.4
4 (High)	-	13.6	12.8	22.0

[1]Data adjusted to an Angora female kid weighing 40 pounds (shorn weight).

SUPPLEMENTAL ENERGY AND PROTEIN EFFECTS ON GROWTH RATE AND MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS

J.E. Huston

SUMMARY

A study was conducted during the fall and winter of 1979-80 to determine the effects of various levels of supplemental protein and energy on growth rate and mohair production in female Angora kids. The animals grazed a common pasture during the 200-day study and were penned and fed daily. Treatments included a control (no supplemental feed) and nine levels and ratios of energy and protein. The nine combinations were 75, 150 and 225g T /head/day and either 25, 50 or 75g CP/head/day, respectively. Both mohair production and growth rate were influenced by both energy and protein supplementation. Mohair production reached a maximum at 150g TDN and 50g CP. However, growth rate was increased by higher levels of either or both supplemental nutrients. These results indicate that some adjustment in the supplemental feed formulation can be made to economize on supplemental feed without affecting performance.

INTRODUCTION

A major factor that determines lifetime productivity of Angora females is yearling breeding weight[2]. Underdeveloped yearlings have poor lifetime reproductive rates and fleece weights. Because kids are weaned in the late summer or fall, diet quality from rangeland is low[1], and supplemental feeding is essential for proper development during this critical first year. Taylor and Merrill[3] found cottonseed meal superior to either corn or 20% range cubes as a winter supplement for weaned Angora kids. They attributed the improvement to higher protein content of cottonseed meal in comparison to the other supplements tested. However, since all supplements provide both energy and protein, it is of interest to determine what effect each has on performance and if there is an optimum combination.

EXPERIMENTAL PROCEDURE

Fifty Angora female kids (average shorn weight - 34.1 pounds) were selected at weaning and assigned randomly to ten experimental groups of five kids per group. During the 200-day study beginning September 12, 1980, all kids were grazed in the same pasture at the Texas A&M Research and Extension Center at San Angelo. The kids were gathered 6 days each week and were fed the appropriate treatment rations individually (TABLE 1). Group 1, control, received no feed at any time. At the end of the treatment period, the kids were weighed and shorn. Period weight gains and fleece weights were recorded (TABLE 2).

RESULTS AND DISCUSSION

Some unavoidable problems arose during the study. Eight of the kids were killed during the study period by wild dogs. Fortunately, these losses were almost equally distributed across treatments. It was necessary to include feather meal and urea in ration 4 in order to raise the protein to the desired level. Goats fed ration 4 were slow in adjusting to these ingredients, and the average intake of this supplement was lower than planned and may have caused a slight reduction in weight gain and mohair growth.

Results of the study indicate that both energy and protein supplementation increased weight gain and mohair production (TABLE 2). However, weight gain was much more responsive to increased energy and protein than was mohair production. Whereas, mohair production reached a maximum at the intermediate levels of energy and protein (TABLE 3), weight gains were increased with each increase in either energy or protein (TABLE 4). Moreover, increases in both energy and protein consistently improved gain more than the increase of either nutrient alone.

It is obvious that neither protein nor energy acts alone in promoting weight gain in Angora kids on rangeland and that both nutrients should be given attention. It is also obvious that an increase in either nutrient improved performance within the ranges used in this experiment. Therefore, prices of feed ingredients in relation to value of goat products ultimately determine the optimum feed supplement for Angora kids.

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TABLE 1. RATIONS AND SUPPLEMENTAL NUTRIENTS FOR WEANED ANGORA FEMALE KIDS.

Ration	Levels[1]	Ingredients(%)			Approximate Nutrients (g/day)[3]		
		Milo	C.S.M.	Phosphate[2]	T.D.N.	C.P.	P
2	Low-Low	50	39	11	75	25	3
3	Low-Med	0	92	8	75	50	3
4	Low-High	5	87[4]	[illegible]	75	75	3
5	Med-Low	85	9	6	150	25	3
6	Med-Med	54	42	4	150	50	3
7	Med-High	24	73	3	150	75	3
8	High-Low	96[5]	0	4	225	25	3
9	High-Med	77	20	3	225	50	3
10	High-High	55	43	2	225	75	3

[1]Refers to levels of Energy (TDN) and Protein (C.P.) supplied in supplemental feed.

[2]A commercial Phosphorus source containing 18% Phosphorus.

[3]Refers to Total Digestible Nutrients (T.D.N.), Crude Protein (C.P.) and Phosphorus (P).

[4]Actually consisted of 64.4% Cottonseed Meal (C.S.M.), 18% Feather Meal and 4.6% Urea.

[5]Actually consisted of 78% Milo and 18% Molasses.

TABLE 2. WEIGHT GAIN AND MOHAIR PRODUCTION IN WEANED ANGORA FEMALES FED VARIOUS SUPPLEMENTS.

Supplemental Treatment[1]	Number of Animals	Average Gain (Lbs)	Grease Fleece Weight (Lbs)
Control	5	0.8	3.3
Low-Low	4	3.5	4.4
Low-Med	3	4.7	4.9
Low-High	4	5.5	3.9
Med-Low	4	6.8	4.3
Med-Med	4	7.2	4.7
Med-High	5	8.4	5.0
High-Low	4	6.0	4.5
High-Med	5	10.4	5.4
High-High	4	12.5	4.4

[1]The Control Group received no supplemental feed. The Treatment descriptions for all other groups refer to levels of supplemental energy and protein, respectively (TABLE 1).

TABLE 3. EFFECTS OF SUPPLEMENTAL ENERGY AND PROTEIN ON MOHAIR PRODUCTION IN WEANED ANGORA FEMALE KIDS[1].

Supplemental Protein (g/day) \ Supplemental T.D.N. (g/day)	0 (Control)	75 (Low)	150 (Med)	225 (High)
	Mohair Production (g/day)			
0 (Control)	8.8	-	-	-
25 (Low)	-	10.0	10.4	10.8
50 (Med)	-	11.6	12.4	12.4
75 (High)	-	9.2	12.0	10.4

[1]Data adjusted to an Angora female kid weighing 40 pounds (shorn weight).

TABLE 4. EFFECTS OF SUPPLEMENTAL ENERGY AND PROTEIN ON WEIGHT GAIN IN WEANED ANGORA FEMALE KIDS[1].

Supplemental Protein (g/day) \ Supplemental T.D.N. (g/day)	0 (Control)	75 (Low)	150 (Med)	225 (High)
	Fleece-Free Weight Gain (g/day)			
0 (Control)	4.4	-	-	-
25 (Low)	-	8.8	13.6	15.2
50 (Med)	-	10.8	18.4	25.2
75 (High)	-	13.6	21.2	29.2

[1]Data adjusted to an Angora female kid weighing 40 pounds (shorn weight).

NUTRITIONAL SUPPLEMENTS FOR SHEEP GRAZING FORAGE SORGHUMS

Maurice Shelton, Lee Warren and Phillip Thompson

SUMMARY

Gains on sheep grazing sorghum forage are often below expectations. Research work in Australia has suggested that animals grazing forage sorghums might respond to sulfur supplementation. Nutrient composition data indicate that for growing lambs protein might also be a limiting factor. A series of studies with Blackface crossbred feeder lambs was conducted to determine the value of supplementing forage sorghums with protein and sulfur. Animal gains tended to favor the supplemented group in each of the three years, but was statistically significant only in one year.

INTRODUCTION

Sudan grass or sorghum x sudan grass hybrids are often seeded for use as summer forage crops with grazing livestock. These forage crops are more extensively and better adapted for use with cattle, but sheep do frequently have access to sorghum forage. Weight gains from sheep grazing sorghums are often below expectations. The reasons for this are not always apparent. The protein content of sorghum forage ranges from a high of approximately 16 percent for the young growing plant to a low of 5 to 6 percent at maturity. The digestibility of sorghum forage is not high. As a result, certain age classes of sheep can suffer a protein or energy deficiency when grazing sorghum forages. In addition animals grazing sorghums can suffer from cyanide poisoning. Workers in Australia (2) have shown that sorghum tends to have a low sulfur content, and that sulfur is involved in *in vivo* metabolic pathways required to protect the animal from acute or subacute prussic acid poisoning. Also sulfur (sodium thiosulfate) is used in the therapeutic treatment of acute cyanide poisoning. These same workers have shown improvements in weight gains in sheep as a result of providing sulfur. For these reasons it appeared desirable to investigate the potential for improving gains by providing supplemental protein or sulfur to sheep grazing sorghum forage.

EXPERIMENTAL PROCEDURE

A total of 178 crossbred lambs was used in a series of three experimental trials which were conducted during the summers of 1976, 1978, and 1979. Before initiating the experiment the lambs were weighed and randomly divided into three groups. One group served as a control, one group received sulfur, and an additional lot received sulfur plus protein. Composition of the supplements is shown in Table 1. Salt and dehydrated molasses were used as carriers of the test materials. Group 1 received ration 1 while group 2 received ration 2. The supplements were provided in the form of a lick, and the intended intake of the supplement was .25 lb./day/head, but this level was not always achieved.

The plots used in the test contained approximately 6.67 acres each. During 1976 the three groups remained in separate plots throughout the experiment whereas in 1978 and 1979 the groups were rotated weekly. In 1976 and 1978 the lambs were weighed weekly compared to every two weeks in 1979. In 1976 and 1978, the lambs began grazing the sorghum after it had grown to a height of about 18-20 inches. In 1979, the sorghum had been cut and removed about 27 days before the experiment was initiated. The regrowth was approximately 10-12 inches tall when grazing commenced. Commercial varieties of hybrid forage sorghums were used each year.

RESULTS AND DISCUSSION

Performance data are summarized in Table 2. Except in 1978, higher daily gains were achieved by those animals consuming ration 2. Considered as individual experiments these differences were significant only in 1979; however, if the three experiments were pooled the differences would no doubt be significant. They cannot be considered as true replicates since the ration used in 1979 was different.

These data support the contention that sheep gains on sorghum are not particularly good. In this series of studies the overall average daily gain was 0.283 pound. This is well below the expected gains of healthy lambs grazing good quality forage. However, it should be remembered that sorghum forage is available, and these studies were conducted during midsummer which would adversely affect animal gains. The response to treatments appear to be of economic significance to producers utilizing sorghum forage. The three ingredients in the ration to which a response might be obtained include sulfur, dehydrated molasses (energy) or cottonseed meal. Table 2 reports the added treatment response over the control group as a function of the concentrate intake (salt and sulfur excluded). These data suggest an animal response to the non-energy components as the ratio of feed (concentrates) to gain was 2.8 pounds. Most would consider this below the expected feed to gain ratio if the response was to energy alone.

It is not clear that the actual supplements formulated are the most desirable. In practice a block which contained protein as well as sulfur in the elemented or sulfate form would be indicated.

During this study several lambs (3.9%) died. Most of these losses occurred from miscellaneous causes, killed in weighing or at times when actual cause of death was not determined. Insofar as is known no losses occurred which could be attributed to prussic acid poisoning.

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Table 1. Ration Composition

	Ration 1			Ration 2		
	1976	1978	1979	1976	1978	1979
Sulfur	18%	18%	24.0%	18%	18%	20.0%
Salt	5%	5%	18.5%	5%	5%	18.5%
Dehydrated molasses	77%	77%	57.5%	56%	56%	39.0%
Cottonseed meal	—	—	—	21%	21%	22.5%

Table 2. Performance Data

Test Length	1976 32 Days			1978 42 Days			1979 55 Days		
	Group 1	Control	Group 2	Group 1	Control	Group 2	Group 1	Control	Group 2
No. of animals	26	27	26	25	22	24	9	10	9
No. of animals lost	1	0	1	1	2	2	0	0	0
Av. initial weight (lbs.)	63.46	64.19	58.27	66.44	60.95	60.58	76.88	77.40	76.22
Av. total gain per head (lbs.)	10.42	9.51	11.17	13.80	10.69	11.80	14.23	9.60	16.55
Av. daily gain (lbs.)	.332	.297	.347	.329	.254	.281	.259	.174	.301
Daily av. intake of supplement (lbs.)	.180	—	.180	.198	—	.190	.232	—	.232
Sulfur intake (grams)	14.723	—	14.723	16.188	—	14.988	21.084	—	25.304
Total supplement intake/hd.	5.76	—	5.76	8.32	—	7.98	12.76	—	12.76
Total lbs. concentrate/hd.	4.43	—	4.43	6.40	—	6.14	7.14	—	7.14
Lbs. concentrate per lb. of added grain (above control lots)	3.99	—	2.67	2.06	—	5.53	1.54	—	1.03

PR-3708

CRUDE PROTEIN LEVEL, ROUGHAGE LEVEL AND MONENSIN IN FEEDLOT LAMB RATIONS

M.C. Calhoun and B.C. Baldwin, Jr.*

SUMMARY

Three crude protein levels, 9, 12 and 15%; two roughage levels, 10 and 40% cottonseed hulls; and two monensin levels, 0 and 10 g/ton were fed in a factorial arrangement to 252 wether lambs for 56 days. The diets were based on sorghum grain, cottonseed hulls, and cottonseed meal. Live weight gains (adjusted to a constant dressing percentage) were: .58, .64 and .63 lb/day, respectively, for the 9, 12 and 15% crude protein diets and .65 and .58 lb/day, respectively, for the 10 and 40% cottonseed hull diets. There was no monensin effect on live weight gains. Crude protein level did not affect feed intake. Lambs on the 10% cottonseed hull diets consumed 23.1% less feed than those on the 40% cottonseed hull diets, i.e., 3.37 vs 4.39 lb/day. Monensin decreased feed intake 7.2% when added to the 40% diets but had no effect on feed intake in the 10% cottonseed hull diets. Feed efficiency was maximum at 12% crude protein, with both the 40% and 10% cottonseed hull diets; however, the response was greater with the 40% diets. Likewise, monensin improved efficiency 8.8% with the 40% but only 4.7% with the 10% cottonseed hull diets. Monensin did not have a protein-sparing effect in this experiment.

INTRODUCTION

Dietary monensin [1/] improves performance of growing-finishing lambs (2,4,6,8). Feedlot gains are slightly increased and there is an improvement in feed efficiency, whereas feed intake tends to decrease. These responses are similar to the effects of monensin on performance of feedlot cattle (5,9,10). However, sheep respond to lower levels of monensin than are currently recommended for cattle. The optimum level for feedlot lambs appears to be between 5 and 20 g/ton as compared to 20 to 30 g/ton for cattle. Thirty g/ton is definitely excessive for lambs.

Monensin appears to work better in higher roughage feeds. For example, Calhoun et al. (2) reported a 23.2% improvement in feed efficiency, in a lamb feeding experiment, when monensin was added to a 30% peanut hull diet compared with only a 6.7% improvement with a 10% peanut hull diet. Recent studies with feedlot cattle indicate monensin also has a protein-sparing effect (5,7). Responses to monensin are often greater with diets that are marginal in crude protein content. The objectives of this study were to examine the effects of crude protein levels, roughage levels, and monensin on the feedlot performance of growing-finishing lambs.

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* This research was supported in part by the Natural Fibers and Food Protein Commission of Texas. The assistance of Dr. E.L. Potter (Eli Lilly and Company, Greenfield, Indiana) in obtaining Food and Drug Administration approval to conduct this reserach and in providing monensin is appreciated.

1/ Monensin-sodium, a product of Eli Lilly and Company is an experimental drug and is not approved for use with sheep.

EXPERIMENTAL PROCEDURE

Two-hundred-fifty-nine crossbred, wether, feeder lambs were used in this study. A pre-experimental uniformity period of 21 days was used to adapt the lambs to the feedlot. During this period, lambs were shorn, weighed, administered an anthelmintic2/ and vaccinated3/. A 25% cottonseed hull ration was fed during the uniformity period.

At the beginning of the experimental feeding period, 252 lambs were weighed and switched to their respective dietary treatments. The remaining 7 lambs were slaughtered to obtain an estimate of initial dressing percentage. Treatments consisted of three crude protein levels, 9, 12, and 15% (as-fed basis); two roughage levels, 10 and 40% cottonseed hulls; and two monensin levels, 0 and 10 g/ton which were fed in a factorial arrangement. Three pens (replicates) with seven lambs per pen were fed each treatment combination. The duration of the feeding period was 56 days. The percentage ingredient composition of the experimental diets are given in Table 1.

RESULTS AND DISCUSSION

The chemically determined crude protein percentages (% Nitrogen x 6.25) of the experimental diets (as-fed basis) were consistently higher than anticipated (Table 1). These differences are believed to be due to the difficulty in grinding, mixing and sub-sampling dietary mixtures containing significant amounts of cottonseed hulls. Average monensin-sodium level in the experimental diets, determined colorimetrically (2), was 15.5 ± .58 g/ton.

Fecal samples from 17 sheep were examined to determine coccidial oocyst numbers at the beginning of the experiment. Numbers ranged from 250 to 425,000 oocysts per gram of feces with a median value of 4,800. However, there was no evidence of clinical coccidiosis during the trial. Two lambs were found dead, one on the 18th and the other on the 46th day of the experiment. Cause of death in both cases was diagnosed as enterotoxemia. One additional lamb was losing weight and had a swollen right foot due to a puncture wound. This lamb was removed from the experiment on the 38th day. Pen feed consumption was adjusted for each lamb removed using a formula that considers initial weight of the lamb, weight gain or loss, days on the experiment, energy level of the diet and the National Research Council's recommended energy requirements for maintenance and gain of growing-finishing lambs.

Lambs fed the 10% diets gained 12.5% faster on 23.1% less feed than those receiving 40% cottonseed hull diets. Consequently feed requirements for gains were 32% less for the lambs on the higher energy feeds (10% cottonseed hulls). Effects of crude protein level and monensin on the 56-day feedlot performance of lambs were dependent on the level of energy (cottonseed hulls) in the diet. Responses were greatest with the low energy diets (40% cottonseed hulls). Because of this, the performance data have been summarized to show the crude protein (Table 2) and monensin (Table 3) responses separately for the 10 and 40% cottonseed hull diets.

2/ Levamisole hydrochloride, American Cyanamid Co., Tramisol [R].
3/ *Clostridium perfringens* Type D Toxoid.

Increasing crude protein from 9 to 12% of the diet increased live weight gains 4.9 and 18.4%, respectively, with the 10 and 40% roughage rations. Raising crude protein from 12 to 15% did not further improve gains regardless of roughage level. Crude protein level was without effect on feed intake. Feed requirements (lb feed/lb adj. gain) were decreased 14.4% when the protein level was increased to 12% in the 40% cottonseed hull diets, whereas there was not a significant reduction in feed requirements when protein levels were raised in the 10% cottonseed hull diets (Table 2).

There were slight improvements in gains when monensin (10 g/ton) was added to both the 10 and 40% cottonseed hull diets, however, these responses were not statistically significant. Monensin decreased feed intake by 7.2% when added to the 40% but did not decrease feed intake when added to the 10% cottonseed hull diets. The addition of monensin decreased feed requirements for gain 4.7% and 8.8%, respectively with the 10 and 40% roughage diets. Comparison of the response to monensin within crude protein levels revealed no additional response at the lower protein level; thus there was no evidence for a protein-sparing effect for monensin in this study.

The results of this study support previous reports on the effects of monensin on the performance of feedlot lambs (2,4,6,8). In previous studies feedlot gains were slightly increased, feed intakes tended to be reduced and there were significant improvements in feed efficiency. Also, the response to monensin was less with high grain rations than with rations having a higher roughage level (2). The greater response to increasing protein level in the higher roughage ration observed in this study is also consistent with a previous report (3), providing additional support for the suggestion that there is an interaction between protein requirements and fiber level in the diet.

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TABLE 1. INGREDIENT COMPOSITION AND CRUDE PROTEIN (%) AND MONENSIN LEVELS (g/ton) OF EXPERIMENTAL DIETS

	10% COTTONSEED HULLS CRUDE PROTEIN, %			40% COTTONSEED HULLS CRUDE PROTEIN, %		
Ingredients, %	9	12	15	9	12	15
Sorghum grain, milo	82.2	72.65	62.2	46.95	36.7	26.5
Cottonseed hulls	10.0	10.0	10.0	40.0	40.0	40.0
Cottonseed meal (41% CP)	0.0	9.2	19.2	5.4	15.2	25.0
Molasses	5.0	5.0	5.0	5.0	5.0	5.0
Calcium Carbonate	1.05	1.4	1.85	0.9	1.35	1.75
Ammonium Chloride (NH_4Cl)	.25	.25	.25	.25	.25	.25
Salt, plain mixing	.50	.50	.50	.50	.50	.50
Mineral and vitamin premix	1.0	1.0	1.0	1.0	1.0	1.0
	100	100	100	100	100	100
CHEMICAL ANALYSIS (as-fed basis)						
Crude protein %	10.0	13.1	16.6	10.4	14.1	18.6
Monensin g/ton	15.2	17.0	13.1	16.5	14.9	16.4

TABLE 2. FEEDLOT PERFORMANCE (56-DAY) OF LAMBS RECEIVING 9, 12 and 15% CRUDE PROTEIN IN 10 AND 40% COTTONSEED HULL DIETS

	10% COTTONSEED HULLS CRUDE PROTEIN %			40% COTTONSEED HULLS CRUDE PROTEIN %		
CRITERION	9	12	15	9	12	15
Lambs, No.	42	42	42	42	42	42
Initial Weight, lb.	82.7	81.8	82.0	80.4	82.0	81.8
Gain, lb/day 1/	.634	.666	.664	.527	.624	.597
Feed Intake, lb/day	3.31	3.35	3.44	4.34	4.43	4.41
Feed/Gain, lb/lb	5.24	5.04	5.21	8.28	7.10	7.39

1/ Live weight gains were adjusted to a constant dressing percentage (51%) to remove the effects of variable gut fill.

TABLE 3. EFFECT OF MONENSIN (10 g/ton) ON FEEDLOT PERFORMANCE (56-DAY) OF LAMBS FED 10 and 40% COTTONSEED HULL DIETS

	10% COTTONSEED HULLS MONENSIN, g/ton		40% COTTONSEED HULLS MONENSIN, g/ton	
CRITERION	0	10	0	10
Lambs, No.	63	63	63	63
Initial Weight, lb.	82.0	82.4	81.3	81.6
Gain, lb/day 1/	.639	.670	.577	.589
Feed Intake, lb/day	3.37	3.37	4.56	4.23
Feed/Gain, lb/lb	5.29	5.04	7.94	7.24

1/ Live weight gains were adjusted to a constant dressing percentage (51%) to remove effects of variable gut fill.

PR-3709

DEVELOPMENT OF A QUADRIVALENT BLUETONGUE VACCINE

C.W. Livingston, Jr., S. McConnell and Betty B. Gauer

SUMMARY

Modified live virus monovalent bluetongue vaccines were prepared to the four serotypes (strains) of bluetongue that occur in the United States. Approximately 1220 yearling ewes were inoculated with this vaccine without adverse effects. Calves and pregnant goats inoculated with these vaccines have remained normal. Bivalent vaccines prepared and administered in the same manner have been effective. Quadrivalent vaccines are being formulated and tested at the present time.

INTRODUCTION

Bluetongue is a viral disease transmitted by a very small night-flying insect (Culicoides sp.). Usually only sheep are clinically affected. Other ruminants may be carriers of the virus without showing any signs of disease. Bulls may become infected with bluetongue virus and transmit the virus in the semen to cows during copulation. Abortions have occured in cows bred to bluetongue-infected bulls. The potential danger of bluetongue virus being present in frozen semen has caused several foreign countries to embargo frozen semen from the United States. Serological evidence support observations that bluetongue infections occur yearly in a few sheep flocks in the Edwards plateau area of Texas. Epizootics of bluetongue occur periodically in Texas sheep flocks at intervals of 3 to 5 years causing severe economic losses to the sheep producers. Four serotypes or strains of bluetongue have been identified in the United States, and our goal is to develop a quadrivalent vaccine effective for these four serotypes of bluetongue.

EXPERIMENTAL PROCEDURES

First in the preparation of this modified live virus vaccine, the four serotypes of bluetongue virus were passed in cell cultures separately until the virulence of each serotype was decreased sufficiently for a vaccine. These monovalent vaccines were tested in the laboratory and then in the field, and have been found to be safe and efficacious. Over 1220 sheep, mostly yearling ewes, were vaccinated experimentally during the summer of 1979. One hundred and fifty of the vaccinated sheep were selected randomly and challenged with the specific serotype of virulent bluetongue virus.

Bivalent vaccines were inoculated in laboratory-housed sheep, and four weeks later the resulting immunity was challenged by the inoculation of virulent bluetongue virus.

A quadrivalent vaccine was formulated and administered to 20 lambs raised in confinement. Four weeks after vaccination the immunity of each lamb was challenged with each single serotype of virulent bluetongue virus.

RESULTS AND DISCUSSION

Less than 5% of the yearling ewes vaccinated with the monovalent bluetongue virus showed a mild febrile response when challenged with the specific virulent bluetongue virus. No clinical signs of lameness, coronitis, or dental ulcers were observed as a result of the challenge. The monovalent vaccines appeared to be safe and efficacious under these testing-conditions.

Only a single sheep vaccinated with bivalent bluetongue vaccine showed a febrile reaction when challenged with the specific virulent bluetongue virus. This was a very mild febrile reaction, and no other signs of bluetongue infection were observed in this group of sheep. The bivalent vaccine appeared to be safe and efficacious.

The quadrivalent vaccine failed to protect completely against one component of the vaccine. Four weeks after vaccination, challenges with serotype 10 bluetongue virus showed that only a partial immunity was obtained to this serotype. Seven of twenty sheep challenged showed a temperature rise. The other three serotypes were protective completely in 18 of 20 sheep with only two showing a mild febrile reaction. A subsequent virus titration of the quadrivalent vaccine showed that the virus titer of the serotype 10 component was much lower than the other serotypes and might explain the failure of this compound to protect completely against the serotype 10 challenge virus.

A repeat of the quadrivalent vaccine experiment using an improved formulation is in progress presently, and if successful, a field trial evaluation of the vaccine will be conducted during the summer of 1980. We intend to vaccinate approximately 1200 yearling ewes and select 10% for challenge with virulent virus.

Additional safety tests of the monovalent and bivalent vaccines have been performed. Pregnant Spanish goats, pregnant Angora goats and calves have been vaccinated with no adverse reactions observed to date. The reproductive rates in these vaccinates appear to be within normal ranges for animals under these environmental conditions. If no major problem arises extensive field testing of a modified live virus vaccine under ranching conditions can be undertaken in the fall of 1980.

PR-3710

INCIDENCE OF UREAPLASMAS AND MYCOPLASMAS IN TEXAS SHEEP FLOCKS

C.W. Livingston, Jr., and Betty B. Gauer

SUMMARY

Mycoplasmas and ureaplasmas have been identified in every flock examined in the San Angelo area with but one exception. In this instance, ureaplasmas were not recovered in several attempts. In other flocks, infection ranges from 1.7 to 80 percent. Mycoplasmas and ureaplasmas appear to be common inhabitants of the reproductive tracts in sheep and goats and may be involved in reproductive problems.

INTRODUCTION

Mycoplasmas and ureaplasmas have been identified in Texas sheep and goat flocks. Ureaplasmas appear to be confined to the genitourinary tract of sheep and goats. Mycoplasmas have been isolated from the respiratory tract, lacrimal secretions, as well as the genitourinary tract. With but one exception, we have isolated mycoplasmas and ureaplasmas from every flock examined. Isolation of mycoplasmas from specimens collected from 1970-79 ranged from 9.0 to 97.2%. The isolation rate for ureaplasmas during the same period of time was 10.0% to 64%. Mycoplasmas are associated with respiratory infections, infectious keratoconjunctivitis (pink eye) and fertility problems. Ureaplasmas, particularly a specific serotype, are associated with infertility, abortions, and vaginitis in sheep and goats. With the exception of pink eye, the pathogenecity of ureaplasmas and mycoplasmas found in Texas had not been completely established. In man, ureaplasmas have been proven to be a cause of nongonococcal urethritis. This report is to show the incidence of mycoplasmal and ureaplasmal infections in selected flocks of sheep of different age groups.

EXPERIMENT PROCEDURE

Cervical swabs, vaginal swabs, and preputial swabs were obtained from sheep located in the Edwards Plateau region of Texas. Lambs, yearling ewes, and aged ewes were included in this survey. The methods employed in this laboratory were described by Livingston and Gauer (1).

RESULTS AND DISCUSSION

The results are arranged in Tables I, II, and III.

TABLE I
LAMBS (CERVICAL, VAGINAL OR PREPUTIAL SWABS)

Flock	Number of Specimens Cultured	Number of Mycoplasmas Isolated	% Mycoplasma	Number of Ureaplasmas Isolated	% Ureaplasma
D	56	1	1.7	17	30.3
E	6	1	16.1	5	83.3

TABLE II
YEARLING EWES (CERVICAL AND VAGINAL SWABS)

Flock	Number of Specimens Cultured	Number of Mycoplasmas Isolated	% Mycoplasma	Number of Ureaplasmas Isolated	% Ureaplasma
A Brady	113	0	0	23	20.3
B Sonora	107	3	2.7	25	23.3
C Closed	151	0	0	0	0

TABLE III
AGED EWES (CERVICAL AND VAGINAL SWABS)

Flock	Number of Specimens Cultured	Number of Mycoplasmas Isolated	% Mycoplasma	Number of Ureaplasmas Isolated	% Ureaplasma
F	60	37	61.6	48	80.0

Only one flock (C) was found that was negative when cultured for ureaplasmas. The owner has attempted to maintain this flock as a "closed flock" for several years by never introducing ewes or rams from outside his flock. Only the yearling ewes were examined in flock C. Sheep from the other flocks were found to be infected with ureaplasmas and mycoplasmas. All age groups appeared infected,with the aged ewes having the highest incidence of infections. The aged ewes were obtained from several sources including the sales auction, and were bred for a reproductive study. These ewes were cultured after being bred, and it is possible that copulation may have been instrumental in the high incidence of infection. Venereal transmission does not explain the high incidence in the lambs, however. From this study, we can conclude that ureaplasmal and mycoplasmal infections of the reproductive tract of young and old sheep commonly occur in flocks in the Edwards Plateau area of Texas.

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PR-3711

THE STRATEGIC USE OF ANTHELMINTICS IN EWES GRAZING IN THE EDWARDS PLATEAU

T. M. Craig, R. R. Bell, L. B. Merrill,
C. A. Taylor and T. Brooks

SUMMARY

Worms create serious internal parasite problems in sheep. Ewes treated with anthelmintics at the time the lambs were docked showed a diminished increase in production of worm eggs throughout the grazing season. This reduced contamination of pastures by the ewes resulted in fewer numbers of parasites being acquired by their lambs as compared to lambs from ewes which were treated following weather conditions favorable for worm transmission or from control ewes. Strategic treatment (treatment timed to break the parasite life cycle) proved to be successful in these experiments.

INTRODUCTION

Transmission of the common stomach worm of sheep, Haemonchus contortus, occurs during the warmer parts of the year with most outbreaks of disease caused by this worm occurring in midsummer to late summer. The age, genetics, lactation, and nutritional status of the sheep are important in determining whether or not they will succumb to disease caused by this parasite. In general, sheep less than six months of age, lactating sheep or sheep under nutritional stress are the ones in which disease will be seen. Large numbers of parasites are required to significantly damage the sheep. If the numbers of parasites can be kept low, no disease will occur. Early lactation is a period when the natural resistance of the ewe is reduced. By worming at this time, the parasite levels do not escalate in the usual manner, thus disease is avoided. Comparisons of strategic treatment (at the optimum time to break the parasite's yearly cycle), tactical treatment (when levels of parasites are beginning to significantly increase) and salvage treatment (when the sheep are showing clinical signs of disease) were carried out at the Edwards Plateau Experiment Station.

EXPERIMENTAL PROCEDURE

Experimental ewes were randomly divided into three groups in each year of the experiment (three years). One group was designated as the strategic treatment group, one as the tactical treatment group and a third as the salvage treatment group. The tactical treatment group was evaluated in different ways each year. The first year this group was kept on clean pasture wherein the pasture utilized during the study had been grazed by sheep which had been wormed once a month during the preceeding five months before the initiation of the trial. The second year the ewes were treated at the time of shearing in early May. The third year the ewes were treated when sufficient rainfall and egg counts indicated problems might occur if not treated (early June). Each year the ewes were re-selected and placed in one of three contiguous pastures with their lambs. Most of the lambing occurred during March. Fecal samples were taken monthly from late February until early September.

Fecal samples were taken from the lambs each month from June to September. Feces were examined for levels of helminth eggs and blood was examined for packed cell volume, a gage of anemia. Helminth eggs in the feces were enumerated and the packed cell volume of the blood was determined as a measure of anemia.

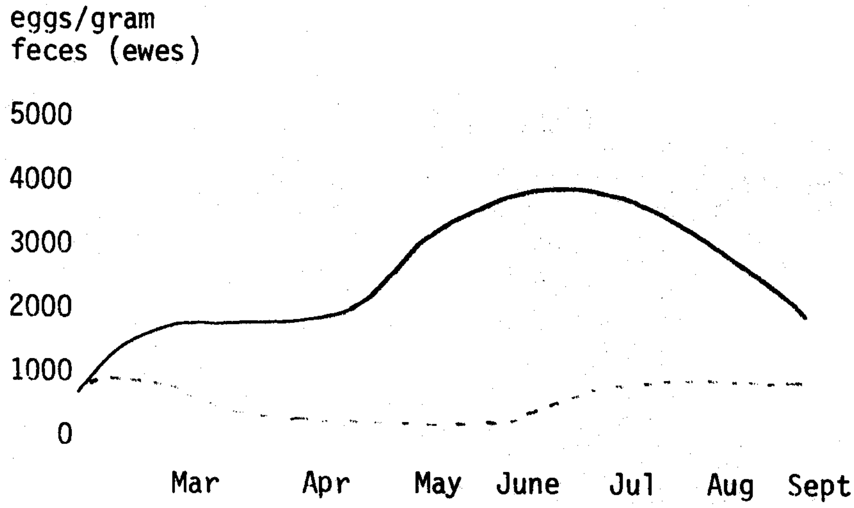
RESULTS AND DISCUSSION

Composite results of three years' observation are presented in Figures 1 through 4. These figures compare ewes or lambs in the strategic treatment group v.s. the control group. Because of the time interval of treatment in the tactical treatment group, the results could not be realistically presented in the graphs. The results indicated that no particular advantage was gained by moving ewes and lambs to clean pastures when the ewes were treated at the time the lambs were docked. Although groups of ewes treated in May or June had a temporary reduction in egg counts, the counts rose again within two months to higher levels than those of the strategically treated ewes. In all cases, the parasite load of the lambs was a reflection of the parasite load of the ewes. No differences in ewe wool yield and quality or surviving lamb weight gain could be detected. In the third year of the test, two of twenty-one lambs died of what was probably severe parasitism, although no confirmatory postmortem examination was made.

In low rainfall areas, strategic treatment of ewes at the time the lambs are docked appears to be a management practice which could be recommended. Depending upon the season, further treatment may or may not be necessary to prevent disease caused by gastrointestinal parasites.

Figure 1

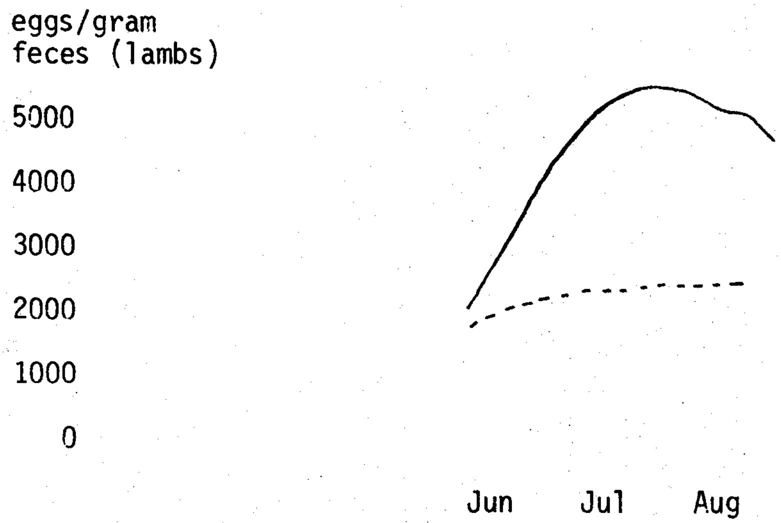
Fecal egg counts per gram of feces in ewes at
The Edwards Plateau Experiment Station



____ control; ---- strategic treatment of ewes

Figure 2

Fecal egg counts per gram of feces of lambs
whose dams were either treated at the time
of docking (strategic) or controls



____ control; ---- strategic treatment of ewes

Figure 3
Packed cell volumes (PCV) of ewes either
strategically treated or untreated at the time of lamb docking

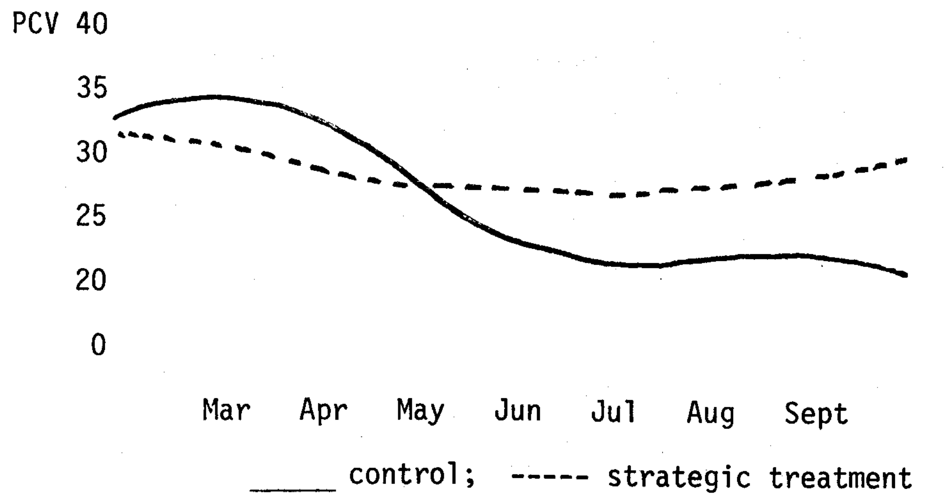
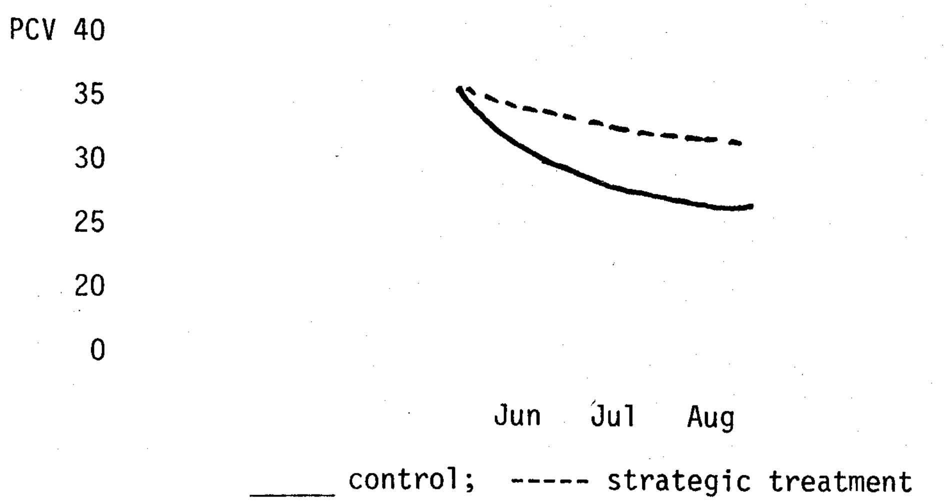


Figure 4
PCV's of lambs born to ewes either
strategically treated or untreated at the time of lamb docking



PR-3712

MONENSIN AS A COCCIDIOSTAT AND ITS EFFECT ON THE DEVELOPMENT OF RESISTANCE TO COCCIDIA BY ANGORA GOATS

M. L. Hinkle and T. M. Craig

SUMMARY

Monensin (Rumensin^{R}) administered in the feed of Angora kids prevented clinical coccidiosis and was associated with reduced fecal oocyst output during the period of medication. Treatment did not interfere with the ability of the goats to develop resistance to coccidiosis. Although treated goats consumed less feed, their weight gains were comparable to untreated goats.

INTRODUCTION

Coccidiosis is one of the most economically important disease problems of the Angora goat. The methods of management of goats in the Hill Country of Texas are such that when kids are weaned they are extremely susceptible to disease caused by coccidia. Over the years, resistance of the coccidia to the presently used coccidiostats has resulted in serious losses to the industry. Monensin, a polyether antibiotic, enhances feed efficacy of ruminants and acts as an efficient coccidiostat. A trial was run to determine if this coccidiostat activity would interfere with the ability of kids to develop resistance to infection once the drug was removed.

EXPERIMENTAL PROCEDURE

Thirty male Angora kids were divided into four groups based on weight at the beginning of the trial. Each resulting group had a similar mean body weight. One group was medicated with monensin at 20 mg/ton of feed and inoculated with 50,000 oocysts over a period of 10 days. A second group was given the medicated feed but no oocysts. The third group was given similar non-medicated feed but inoculated with 50,000 oocysts over a 10-day period and the fourth group was given non-medicated feed and no inoculation. Treatment continued for 27 days. Five days later all goats were challenged with 100,000 oocysts. Body weights, feed efficacy and oocyst counts per gram of feces were determined.

RESULTS AND DISCUSSION

Both inoculated and uninoculated goats had greater numbers of oocysts passed in the feces if they consumed unmedicated feed (Fig. 1). There were no significant differences in weight gains among the various groups although the medicated uninoculated group showed the most constant weight gain throughout the experiment (Fig. 2). It was apparent from oocyst counts that all of the goats were exposed to coccidia prior to the commencement of the experiment and that some transmission occurred during the trial. All goats resisted challenge, which indicated that monensin did not block the immune response. Feed efficacy was reduced and feed intake was increased when monensin was removed from the diet (Table 1). This trial confirmed previous findings that the use of monensin increased feed efficiency and helped prevent disease losses while the medicated feed was used and did not interfere with the immune response.

Table I : Mean weight gains and feed consumption during treatment with monensin and after treatment was discontinued.

	Mean Gain (Kg)/Goat Days 1-27	Feed Cons. (Kg)/Goat Days 1-27	Kg Feed/Kg Gain Days 1-27	Mean Gain (Kg)/Goat Days 28-49	Feed Cons. (Kg)/Goat Days 28-49	Kg Feed/Kg Gain Days 28-49
Medicated Inoculated	2.6	16.6	6.4	5.2	20.1	3.9
Medicated Uninoculated	4.3	18.2	4.2	2.8	20.9	7.5
Nonmedicated Inoculated	2.7	21.8	8.1	4.8	20.5	7.32
Nonmedicated Uninoculated	2.3	21.7	9.4	3.1	19.6	6.32

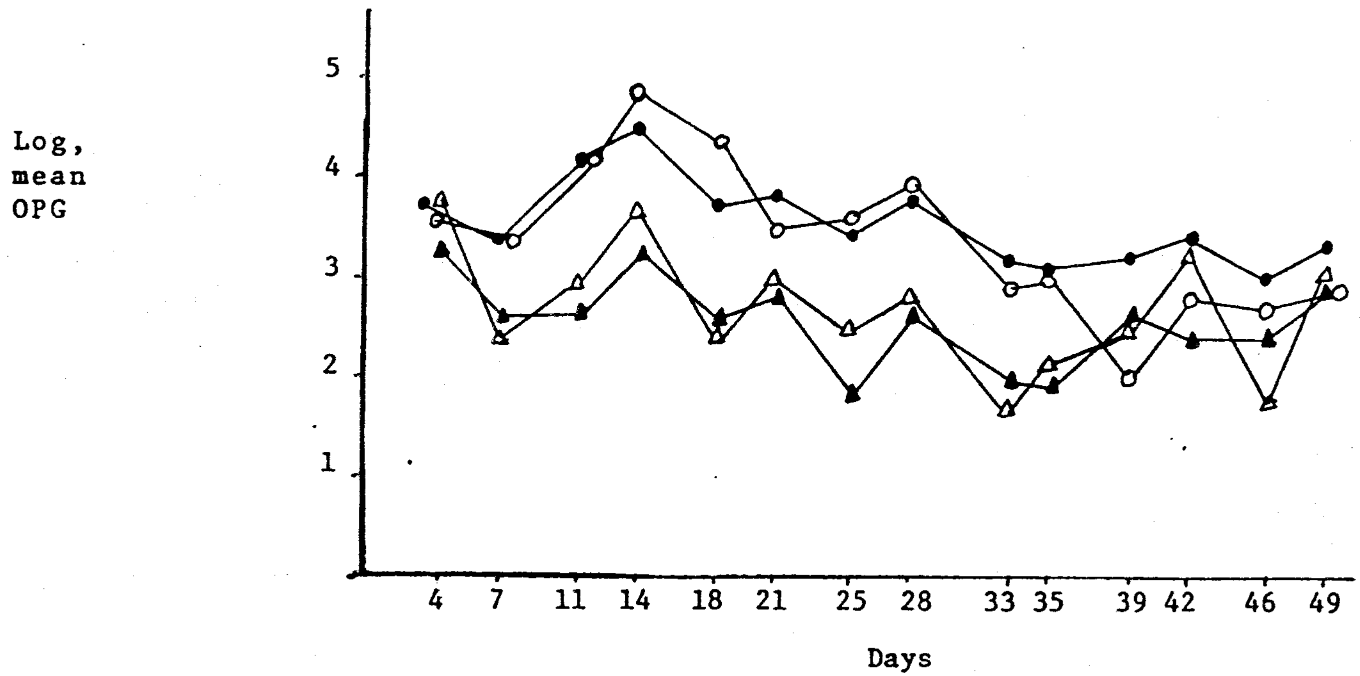


Fig. 1: Mean oocyst counts per gram (OPG). Logs of actual numbers.

Legend: ▲ - medicated, inoculated
△ - medicated, uninoculated
● - nonmedicated, inoculated
○ - nonmedicated, uninoculated

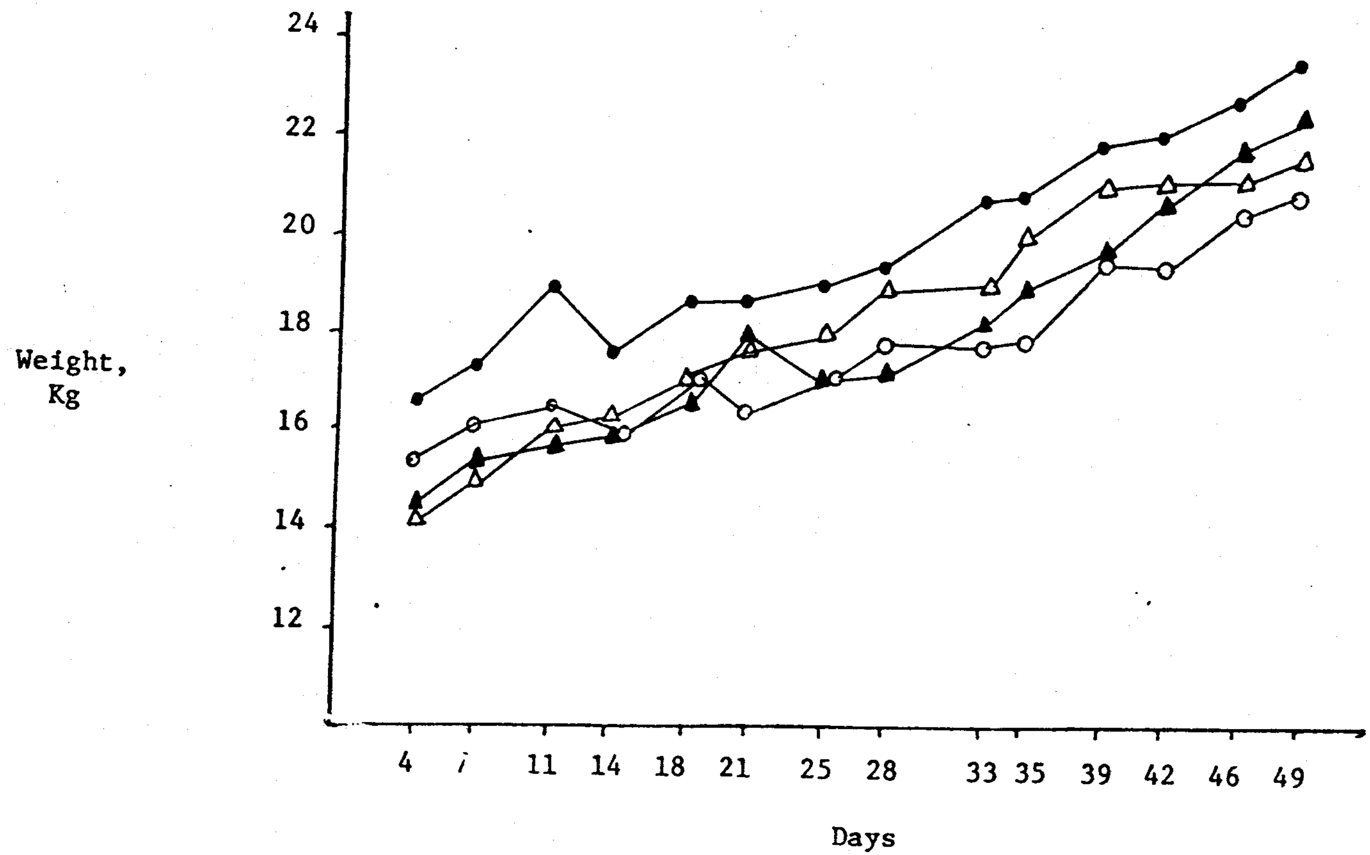


Fig. 2: Mean body weights per group, (Kg).

Legend:
▲ - medicated, inoculated
△ - medicated, uninoculated
● - nonmedicated, inoculated
○ - nonmedicated, uninoculated

PR-3713

EFFICACY OF VARIOUS ANTHELMINTICS ON THIABENDAZOLE RESISTANT HAEMONCHUS CONTORTUS AND THE FRINGED TAPEWORM THYSANOSOMA ACTINIOIDES

T. M. Craig and E. Shepherd

SUMMARY

Lambs given doses of 7.5 mg or 3.8 mg albendazole/kg, 40 mg/kg thiabendazole, 7.5 mg/kg levamisole were compared with untreated controls. Reductions of *Haemonchus contortus* were 99%, 85%, 42% and 98%, respectively. Reductions in numbers of the fringed tapeworm were 98%, 45%, 18% and 0%, respectively, as compared to untreated controls.

INTRODUCTION

In recent years considerable interest has been engendered by the resistance of various worms to anthelmintics. Many of the *Haemonchus contortus*, the barber pole worm of sheep and goats in the Edwards Plateau region of Texas, have such a resistance to thiabendazole. Because of the limited number of anthelmintics which are currently approved for use in sheep and goats, an experiment using albendazole, a compound related to thiabenzole, thiabendazole and levamisole, were evaluated in a controlled anthelmintic trial.

EXPERIMENTAL PROCEDURE

Lambs were acquired from the San Angelo sale and were evaluated for the presence of parasites by fecal examination and administered 10,000 *Haemonchus contortus* larvae. Approximately one month later they were randomly selected into 10 replicates of 5 lambs each. They were drenched by one of the following treatments: 7.5 mg/kg albendazole (Valbenzin, Smith Kline), 3.8 mg/kg albendazole, 40 mg/kg thiabendazole (Omnizole, Merck), 7.5mg/kg levamisole (Tramisole, Cyanimid), or a placebo. One week later the lambs were slaughtered and the gastrointestinal contents and bile ducts were examined for the presence of parasites.

RESULTS AND DISCUSSION

The numbers of fringed tapeworms *Thysanosoma actinioides* and *Haemonchus contortus* recovered from each lamb are indicated in Table I. As can be seen, significant reduction of the numbers of fringed tapeworm occurred in lambs treated with 7.5 mg/kg albendazole and significant reduction of *Haemonchus contortus* with both albendazole and levamisole at 7.5 mg/kg. At the present time levamisole is approved for general use in sheep. Albendazole is only provisionally approved for use against liver flukes in sheep, but as can be seen, at this level, 7.5 mg/kg, it is also effective against fringed tapeworm and Haemonchus. However, the efficacy that albendazole demonstrated at 3.8 mg/kg indicated that it is likely that resistance to this drug by Haemonchus will occur unless used at very high levels. This selection for worms resistant to closely related compounds such as albendazole and thiabendazole has been amply described in the literature and will no doubt occur in this case.

Table 1
Evaluation of Albendazole Efficacy Against Thiabendazole Resistant
<u>Haemonchus contortus</u> from the Edwards Plateau

1. Albendazole 7.5 mg/kg

Lamb	Thysanosoma actinioides	Haemonchus contortus
20	0	0
22	0	0
30	0	0
32	0	0
35	0	25
41	0	25
42	0	0
43	1	0
46	0	325
48	0	25
Mean	.1	40
% Reduction	98	99

2. Albendazole 3.8 mg/kg

Lamb	Thysanosoma actinioides	Haemonchus contortus
5	1	200
9	5	0
13	0	400
17	11	250
18	0	1850
19	0	325
29	2	475
31	1	500
33	3	250
45	0	225
Mean	2.3	447.5
% Reduction	54	85

3. Thiabendazole 40 mg/kg

Lamb	Thysanosoma actinioides	Haemonchus contortus
7	14	800
8	6	600
23	4	2500
24	2	2000
25	11	2525
27	0	1350
34	0	1250
37	0	2400
39	0	1675
49	4	1550
Mean	4.1	1665
% Reduction	18	42

4. Levamisole 7/5 mg/kg

Lamb	Thysanosoma actinioides	Haemonchus contortus
3	0	0
4	0	0
6	7	0
10	5	75
12	1	0
15	4	50
16	3	25
28	5	0
38	15	500
50	6	25
Mean	4.6	67.5
% Reduction	10	98

5. Placebo

Lamb	Thysanosoma actinioides	Haemonchus contortus
1	2	2800
2	0	4275
11	12	1250
14	3	4650
21	3	1625
26	0	4575
36	8	3975
40	4	2050
44	3	1200
47	15	2525
Mean	5	2893

PR-3714

FIBER PRODUCTION IN INTACT, CASTRATE AND TREATED CASTRATE ANGORA MALE GOATS

Gary Snowder, Maurice Shelton and Phillip Thompson

SUMMARY

This study examines the effects of testosterone and zeranol (Ralgro) on body weight and fiber production in Angora wethers compared with untreated wethers and intact billies. Wethers implanted with either testosterone and zeranol showed an increase in body weight but not over that of intact billies. Grease fleece weights were slightly heavier among implanted wethers than untreated wethers and intact billies. Seasonal effects on mohair production between groups were observed.

INTRODUCTION

Castration of male goats is a common practice among Angora producers, allowing castrated male goats (muttons or wethers) to be kept to advanced age for fiber production. Angora wethers are usually smaller in size than intact males, and have markedly smaller horn growth. This decrease in body weight or size and horn growth in castrated males is attributed to the lack of testicular production of the male steriod hormone, testosterone. For these reasons many producers leave kid goats as males until their second year to obtain body size and horn growth. The emphasis on horns provides some protection against predation. The influence of castration on mohair production of goats with advancing age has apparently not been reported. The use of testosterone in the prevention or treatment of sheath-rot has been used with castrated sheep in some countries (2), and Angora wethers have been shown to be susceptible to this problem (3). Also castrated goats have been shown to have an increasing frequency of adrenal tumors with advancing age(1). Testosterone implants have been shown to stimulate fiber production and body weight with sheep.

Zeranol is a widely used implant among cattle and sheep producers to increase rate of weight gain and improve feed conversion. Thus it appeared to be of interest to determine the effect of testosterone and zeranol on weight gain and fiber production in the Angora wethers.

EXPERIMENTAL PROCEDURE

This continuing study was started with the fall shearing in August 1977 at which time the goats were one and one-half years of age. One hundred and ninety-six Angora males were divided into four groups. Three groups were castrated (by knife) in advance of the start of the experiment. A fourth group was left as intact billies. One or both horns were tipped to maintain group identity among the three groups of wethers. At the onset of this study and on each shearing date thereafter, wethers in one group were implanted with a 12 mg. pellet of zeranol in the ear and those in another group were implanted with 47 mg. of testosterone in pellet form in the ear. This material was obtained from an Australian source. All animals were grazed together on a native pasture at the leased Winter's Ranch, Brady, Texas. A salt limiting range supplement was available to all animals during the winters of 1978 and 1979. Body weights and fleece measures were collected at biannual shearings in March and August. Clipped side samples were sent to Texas A&M Wool Laboratory for fiber diameter determination, but these analyses are not completed.

RESULTS AND DISCUSSION

Several animals have been lost during the study. The greatest single cause of loss was from chilling following the March shearing in 1978. Other losses have occurred in the pasture in which the actual causes were unknown.

Body weight changes are reported in Table 1. Intact billies were significantly heavier and had greater weight gains than all groups of wethers. Zeranol tended to slightly increase body weight when compared with untreated wethers. The body weight gains of the zeranol-treated wethers showed no effect of season whereas the three remaining groups were lighter at spring shearings than previous fall shearings. Wethers implanted with testosterone were not as heavy as intact billies.

Grease fleece weights between treatments appear to be affected by season (Table 2). At each fall shearing intact billies sheared heavier fleeces than other groups. However, at spring shearings intact billies sheared lighter than all other groups suggesting a probable seasonal or cyclic hormonal effect (see Figure 1). Wethers implanted with zeranol sheared the heaviest fleeces at each March shearing. Average lock length between intact billies, untreated wethers and testosterone implanted wethers were similar.

The use of intact males would not be recommended as a result of this study. The additional shearing costs alone would more than offset the slight increase in fleece weight over castrate animals. In addition other problems such as odor or interference with breeding programs, if does were present on the ranch, would be involved. The tendency of the intact males to shear lighter in the spring can likely be attributed to rutting during the fall and winter.

According to this study testosterone or zeranol implants in Angora wethers will increase body weight but not over that of intact billies. Grease fleece weight was slightly increased by use of zeranol or testosterone when compared with both untreated wethers and intact billies. At present mohair and meat prices it would appear that either testosterone or zeranol implants would provide a marginal economic response. The use of testosterone may have added advantages in that it reduces incidence of sheath-rot and formation of adrenal glandular tumors in castrated goats, but neither of those are considered to be serious problems with Angora wethers under the conditions which they are managed. Although both materials are routinely used with other animals, neither carries FDA approval for use with goats. In addition the testosterone would not be generally available in this country, but could be obtained from Australia.

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2. Osborne, W. B. and F. A. Widdows. 1961. Sheath-rot and testosterone - its effects and side effects on health and production. Wool Technology and Sheep Breeding 8:99.

3. Shelton, J. M. and C. W. Livingston. 1975. Posthitis in Angora wethers. Journal of the American Veterinary Medical Association, 167:154.

Table 1. Weight Change in Intact, Castrate and Treated Castrate Angora Male Goats During a Thirty-Month Study Comparing Effects of Zeranol and Testosterone

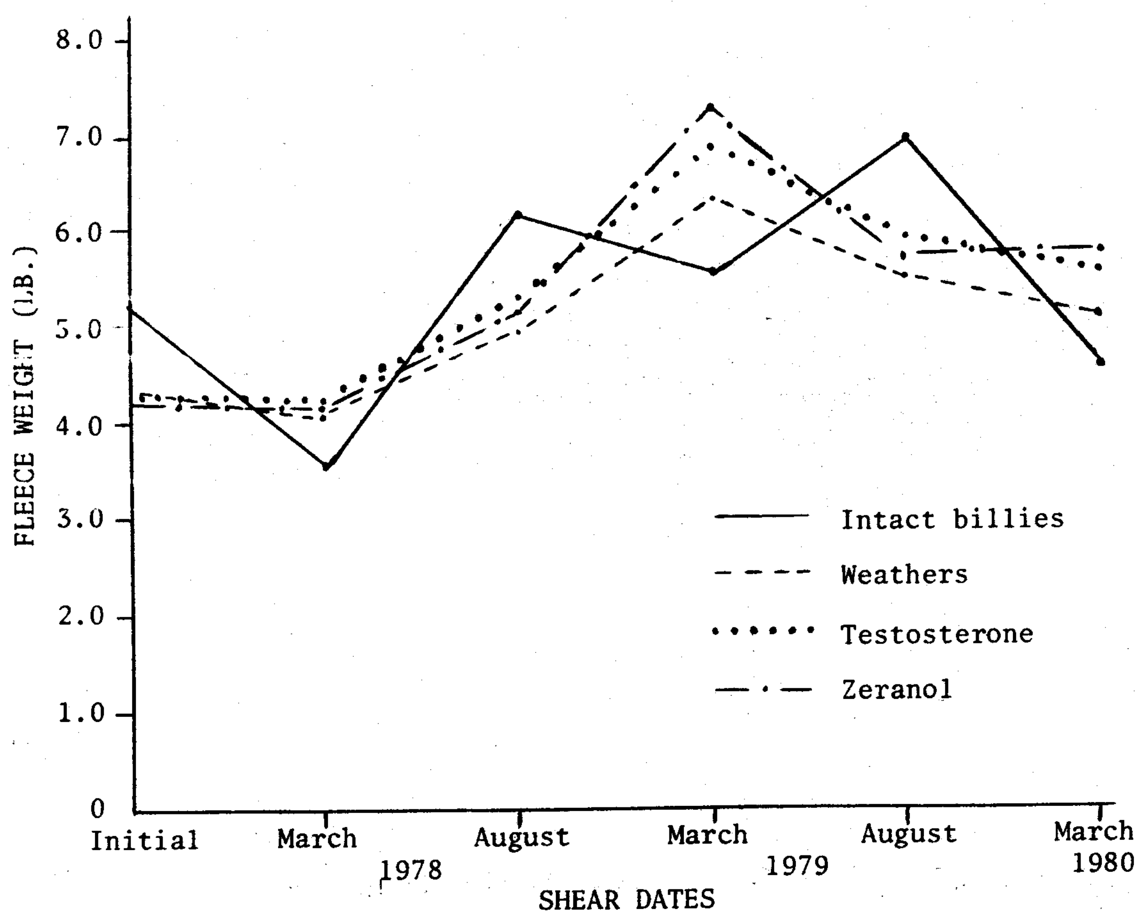
Group	Initial (August 1977)		Final (March 1980)		Weight Change (lb.)
	Number	Weight (lb.)	Number	Weight (lb.)	
Intact billies	50	55.04	39	82.40	27.36
Castrate muttons	47	53.40	35	74.30	20.90
Testosterone	49	52.51	34	76.50	23.99
Zeranol	49	52.92	35	77.50	24.58

Table 2. Fiber Production From Intact, Castrate and Treated Castrate Angora Male Goats

Group	Initial, August 1977			March 1978			August 1978			March 1979		
	No.	Grease (lb.)	Length (in.)	No.	Grease (lb.)	Length (in.)	No.	Grease (lb.)	Length (in.)	No.	Grease (lb.)	Length (in.)
Intact billies	50	5.07	—	46	3.57	4.24	44	6.07	4.95	44	5.58	5.62
Castrate muttons	47	4.29	—	43	4.04	4.32	43	4.95	4.90	42	6.25	5.54
Testosterone	49	4.26	—	40	4.16	4.29	36	5.32	4.89	36	6.81	5.68
Zeranol	49	4.34	—	47	4.27	4.41	43	5.08	4.92	39	7.23	6.19

Group	August 1979			March 1980			Overall Average		Average Total/Head	
	No.	Grease (lb.)	Length (in.)	No.	Grease (lb.)	Length (in.)	Grease (lb.)	Length (in.)	Grease (lb.)	Length (in.)
Intact Billies	39	6.83	4.94	39	4.58	5.66	5.33	5.08	26.63	25.41
Castrate muttons	36	5.48	5.14	35	5.08	5.55	5.16	5.09	25.80	25.45
Testosterone	34	5.83	5.03	34	5.44	5.69	5.51	5.12	27.56	26.38
Zeranol	39	5.68	5.01	35	5.77	5.89	5.61	5.28	28.03	26.42

Figure 1. Effect of Season on Mohair Production in Angora Billies, Wethers, and Treated Wethers



PR-3715

THE RELATIVE IMPORTANCE OF MEAT AND WOOL AS A SOURCE OF INCOME TO TEXAS SHEEP PRODUCERS

Maurice Shelton and Robert Kensing

Sheep may be produced for a number of purposes or products including meat, fiber, milk, leather, fertilizer or for sporting purposes (fighting or hunting). On a world basis the values obtained from meat, milk and fiber are near equal with others of relatively minor importance. However, in certain areas of highly intense agriculture, sheep are valued for the manure they produce, and in some cases they are produced largely for sport (Indonesian fighting rams or Mouflon-Barbado rams in Texas for hunting).

In the U.S. and more especially in Texas sheep are a dual-purpose animal with lambs and wool as the important products. It should be of interest to look at the relative income from these sources as a guide to where emphasis should be placed in improvement programs. In the earlier years the Texas sheep industry existed largely based on a wool economy, but this has gradually changed.

It is more important to speculate where the income will come from in the future, as it is only in the future that man can have an influence. Attempts to predict the future are based on intuitive guesses or on a study of historical trends. In this connection the relative income from meat (sheep and lambs) and wool since 1940 are shown in Table 1. A wool incentive program has been in effect since 1955 and income to the industry from this source is also shown in Table 1. It is in the period 1940-1945 that production of lamb and wool in Texas was at its maximum. The trend since this period of time has been steadily downward except for a possible turnaround in 1979-80. The trends in income from variable sources are shown in Figure 1 and Figure 2.

The total income is shown as being erratic from year to year, but in terms of real value, when discounted for inflation, the income to the sheep industry has decreased. The data presented attempt to present producer income and do not include the value added in feed lots or the overall benefit to the economy. These data suggest that producers may have had some good years in the period 1972-78. The author was unable to locate data on actual payments from the incentive program in Texas, and the values reported were calculated by multiplying the payment rates to production data obtained from the Statistical Reporting Service. These data show that for most of the years of its existence the incentive payments have been a relatively small part of the total income. However, this might be looked on as the icing on the cake and possibly a necessary part of the industry. Even with this program numbers have tended to decrease, and no doubt would have decreased further without this program. The continuation of this program may be a necessary ingredient to maintain or increase this industry.

The most significant part of these data is the shift in the relative amount of income from lamb and wool in the period since 1965. If the present situation or trend is to continue in the future, it should indicate some changes in breeding and management practices. Throughout the country as a whole the income picture is even more tilted toward meat production. This is due to the fact that the state of Texas is below the average in lamb production, but does a somewhat better job of wool production. The more important question is, what does the future hold? The energy crisis bodes well for wool prices, due to increased cost of some competitive products such as artificial fibers. However, in this writer's opinion this influence will likely be small, and the importance of lamb production will continue. The primary opportunity for a substantially improved position for the sheep industry is to be found in doing a better job of lamb production.

Management and selection practices should reflect this. The primary means to increase lamb income is to produce more and larger lambs. Immediate gains in both will come only from improved management practices. Genetics or selection offer the potential for important long term gains. Selection for increased fertility is a relatively new concept, but it has been shown to be effective. Selection for lamb growth rates is more easily accomplished. However, this is generally associated with increased mature size, and there does appear to be some limitations on the optimum size for ewes adapted to Texas ranges.

Table 1. Time Trends in Production and Income to Texas Sheep Industry

Year	Sheep Shorn 1,000 head	Wool Value $1,000	% Total	Incentive Payments: Wool $1,000	Incentive Payments: Unshorn Lambs $1,000	Incentive Payments: Total Incentive	% Total	Sheep & Lamb Income $1,000	% Total	Total Income $1,000
1940	10,218	23,171	63.9					13,075	36.1	36,246
1941	10,468	29,692	69.1					13,252	30.9	42,944
1942	10,474	30,748	59.9					20,630	40.2	51,378
1943	10,607	34,707	59.2					23,941	40.8	58,648
1944	10,301	33,836	58.2					24,271	41.8	58,107
1945	9,639	31,423	51.0					30,190	49.0	61,613
1946	9,153	30,643	48.2					32,925	51.8	63,568
1947	8,013	26,637	43.5					34,536	56.5	61,173
1948	7,219	30,053	47.5					33,212	52.5	63,265
1949	6,406	28,211	53.8					24,259	46.2	52,470
1950	6,728	35,006	54.3					29,519	45.8	64,525
1951	6,698	48,225	54.0					41,148	46.0	89,373
1952	5,973	26,841	53.2					23,632	46.8	50,473
1953	5,576	27,400	58.6					19,357	41.4	46,757
1954	5,651	25,883	54.9					21,243	45.1	47,126
1955	5,677	20,333	38.4	9,130	1,036	10,166	19.2	22,461	42.4	52,960
1956	5,534	20,443	38.2	8,177	1,012	9,189	17.2	23,886	44.6	53,518
1957	5,075	23,425	52.7	3,631	380	4,011	9.0	17,028	38.3	44,464
1958	5,214	15,788	31.3	11,099	1,540	12,639	25.0	22,051	43.7	50,478
1959	5,766	21,222	40.0	9,168	1,292	10,460	19.7	21,384	40.3	53,066
1960	6,358	21,832	40.0	10,392	1,464	11,856	21.7	20,843	38.2	54,531

Table 1. (contd.) Time Trends in Production and Income to Texas Sheep Industry

Year	Sheep Shorn 1,000 head	Wool Value $1,000	% Total	Incentive Payments: Wool $1,000	Incentive Payments: Unshorn Lambs $1,000	Incentive Payments: Total Incentive	% Total	Sheep & Lamb Income $1,000	% Total	Total Income $1,000
1961	6,431	23,501	41.0	10,458	1,410	11,868	20.7	21,928	38.3	57,297
1962	6,344	23,881	44.2	7,164	908	8,072	14.9	22,061	40.8	54,014
1963	5,947	24,285	44.3	6,751	809	7,564	13.8	22,925	41.9	54,774
1964	5,476	21,473	41.2	3,543	589	4,132	7.9	26,527	50.9	52,132
1965	5,169	18,499	38.4	5,846	918	6,746	14.0	22,944	47.6	48,189
1966	5,031	19,001	36.5	4,712	832	5,535	10.6	27,481	52.8	52,017
1967	4,993	15,169	25.5	9,981	1,562	11,543	19.4	32,811	55.1	59,523
1968	4,419	15,347	25.4	10,037	1,638	11,675	19.4	33,292	55.2	60,314
1969	4,029	14,561	22.2	9,479	1,607	11,086	16.9	39,803	60.8	65,450
1970	4,048	11,082	17.1	11,392	2,428	13,820	21.3	40,058	61.7	64,960
1971	4,164	4,864	7.5	13,181	3,677	16,858	25.9	43,424	66.7	65,146
1972	4,145	14,126	16.4	14,931	2,496	17,427	20.3	54,333	63.3	85,886
1973	3,785	23,190	31.0					51,700	69.0	74,890
1974	3,390	15,535	23.7	3,387	575	3,962	6.0	46,167	70.3	65,664
1975	3,090	14,868	18.0	9,159	1,620	10,779	13.1	56,843	68.9	82,490
1976	2,950	15,879	22.4	1,524	274	1,798	2.5	53,216	75.1	70,893
1977	2,930	17,220	21.7	6,458	1,266	7,724	9.7	54,537	68.6	79,481
1978	2,700	15,355	17.7	6,910	1,423	8,333	9.6	62,890	72.6	86,578

Figure 1. Percent of Total Cash Receipts to Texas Sheep Producers From Wool and From Sale of Sheep and Lambs With and Without Incentive Payments Included.

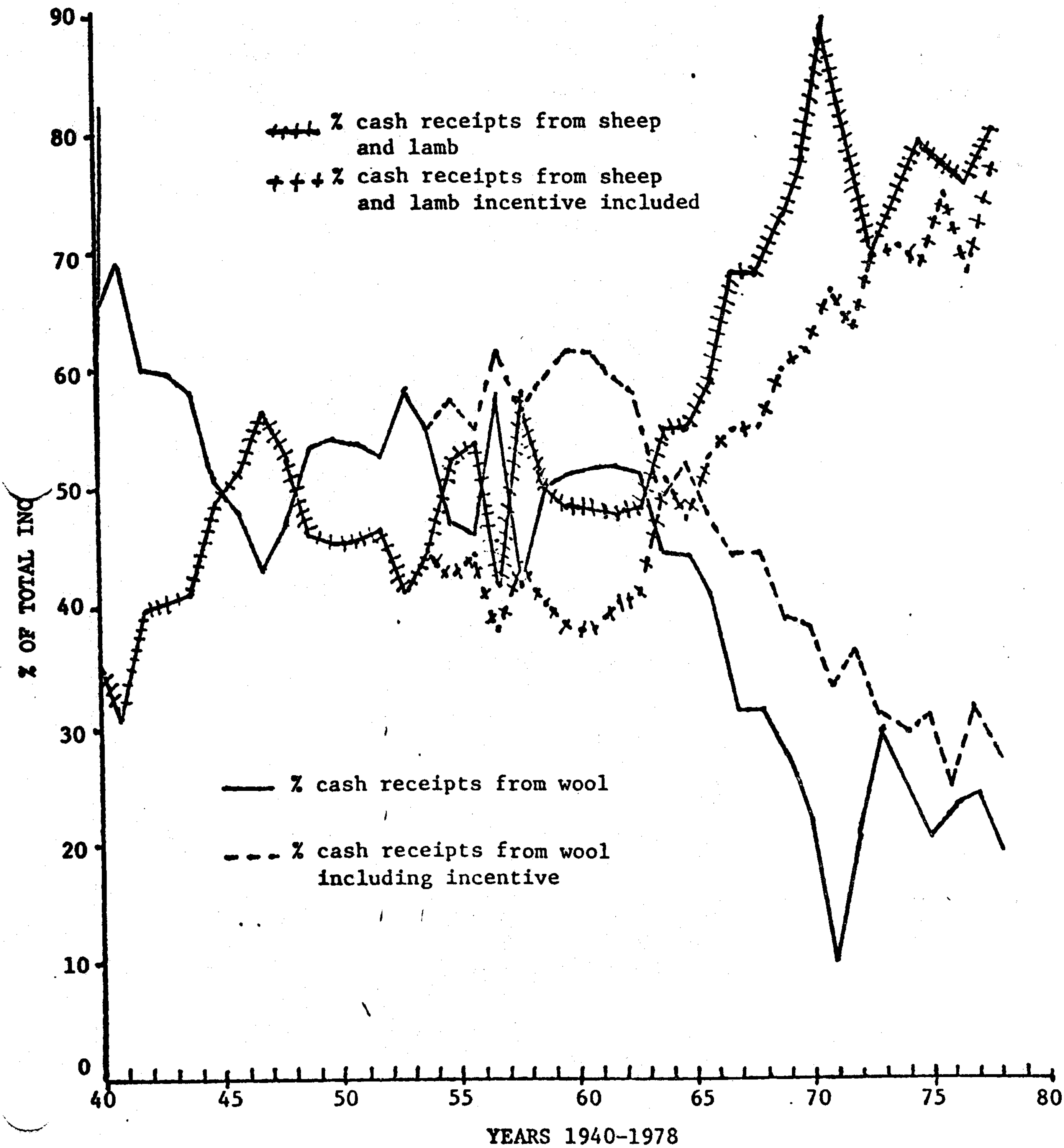
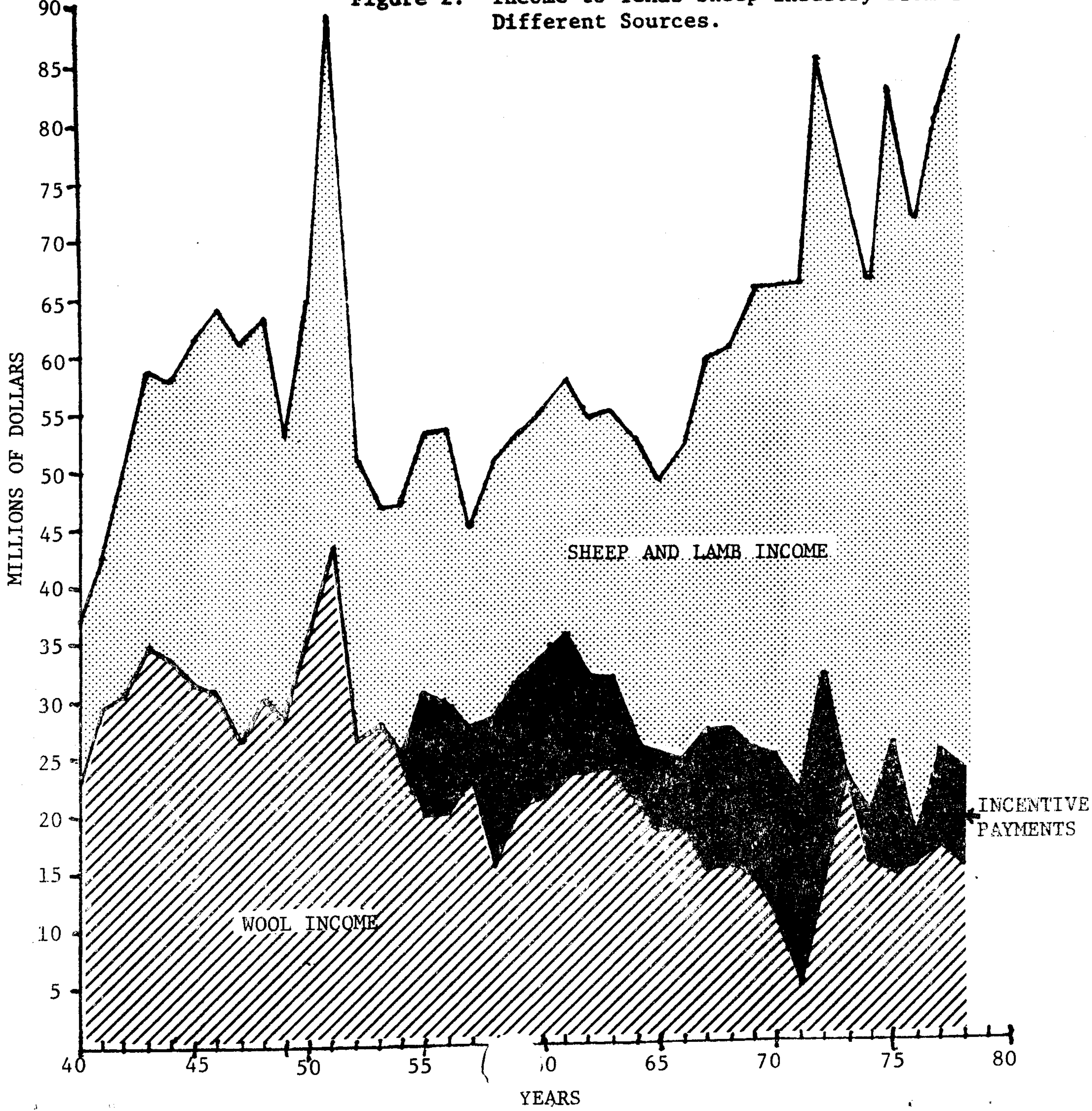


Figure 2. Income to Texas Sheep Industry From Three Different Sources.



PR-3716

NUTRITIONAL QUALITY OF TOBOSAGRASS FOR SHEEP AS AFFECTED BY SEQUENTIAL BURNING

J.E. Huston and D.N. Ueckert

SUMMARY

Prescribed burning in early March to early April increased crude protein content of sheep diets from 14.3% to 17.1% and increased digestible organic matter from 56.4% to 61.3% during spring and early summer on tobosagrass rangeland in the northern Edwards Plateau. Forage quality was similar in sheep diet samples and hand-plucked samples on burned rangeland but higher in sheep diet samples than in hand-plucked samples on unburned rangeland, indicating the ability of sheep to select the more nutritious portions of available forage plants. Burning at 2-week intervals beginning March 8 generally increased the period of high quality forage by delaying initiation of spring growth, and hence delaying maturation of tobosagrass, but the differences among treatments were relatively small by late May.

INTRODUCTION

Prescribed burning removes excessive mulch in tobosagrass communities, increases palatability of tobosagrass for cattle, and increases production during years of adequate precipitation (9). Studies in Kansas (6,8), North Carolina (2), South Texas (5), and the Edwards Plateau (4) have demonstrated increased forage quality and/or livestock production on burned rangeland compared to adjacent unburned rangeland. Grazing animals seek out burned areas to graze (7), apparently because of the higher nutritional quality or increased palatability of forage regrowth. However, the improvement in forage quality after burning is usually temporary (3 to 6 months) (4,5). Sequential burning of rangeland has increased the period of high quality forage in some areas by staggering the initiation of spring growth, thus delaying forage maturity on rangeland burned later in the season (1,3). This study was initiated to determine the effect of sequential burning of tobosagrass rangeland on the protein and energy contents of sheep diets.

EXPERIMENTAL PROCEDURE

Single plots (1 acre) in a honey mesquite-tobosagrass community on the Texas A&M University Research and Extension Center at San Angelo, Texas were burned on March 8, March 23 or April 5, 1979. An adjacent unburned area was maintained as a control. The entire study area was fenced to exclude all livestock other than the study animals. Conditions during the burns were:

	Range
Air temperature (^{o}F)	56-83
Relative humidity (%)	11-35
Wind speed (mile/hr)	8-12
Fine fuel (lb/acre)	2,644-4,358
Fine fuel moisture (%)	11.1-21.9
Soil water content (%)	21.4-27.2
Soil temperature (1 in.) (^{o}F)	60-68
Soil temperature (6 in.) (^{o}F)	50-59

Tobosagrass was dormant until the April 5 date, at which time there was 1 inch of new growth. Associated herbaceous plants were minimal.

Diet samples were collected by hand-plucking and grazing with esophageally fistulated ewes at 2-week intervals from April 19 through June 29, 1979. Plucked samples were taken randomly from each plot to simulate grazing. Esophageal fistula samples were collected using three ewes which were tethered to steel stakes for approximately 15-minute grazing periods in each of the four plots. Collections began at 8:00 a.m. and were completed within 2 hrs. The samples, both plucked and grazed, were placed in separate plastic bags and taken to the laboratory and frozen. The frozen samples were freeze-dried, ground and analyzed for crude protein (CP) and digestible organic matter (DOM). The procedure for estimating digestible organic matter included fermentation of the sample in buffered rumen fluid followed by extraction of all soluble material in a neutral detergent solution. This estimated DOM is similar to total digestible nutrients (TDN) which is commonly used as a measure of digestible energy.

RESULTS AND DISCUSSION

Crude protein contents of hand-plucked and grazed tobosagrass were similar on burned rangeland, but hand-plucked samples from unburned plots were significantly lower in crude protein than those from burned plots (Table 1). Since crude protein values of hand-plucked and grazed tobosagrass from burned plots were similar, they were averaged for comparison with crude protein values of grazed samples from unburned rangeland. At the beginning of the grazing period (April 19) crude protein content of tobosagrass was very high (20.8%) in samples from burned rangeland, but crude protein values dropped to 9.0% (plucked samples) or 13.8% (grazed samples) by May 31. A second peak in crude protein occurred in mid-June on burned and unburned rangeland as a result of new growth of tobosagrass after 3.4 inches of precipitation on June 5 (Table 1). Crude protein content of tobosagrass increased 5.95% on unburned rangeland and 3.7% on burned rangeland from May 31 to June 15 (averaged for plucked and grazed samples).

Crude protein content of hand-plucked tobosagrass samples was consistently lower on unburned rangeland than on burned rangeland (Table 1). On April 19, crude protein content of hand-plucked samples from the unburned plot averaged 7.4%; these values remained stable or declined until late May, increased to 11.6% in mid-June, then decreased to 8.0% by late June. Crude protein content of hand-plucked tobosagrass on burned plots averaged 20.8% on April 19 and was at 11.0% in late June. The plucked samples from burned plots contained new growth exclusively, and crude protein contents tended to decrease as new growth matured. Plucked samples from unburned plots contained both new and old growth, and the periodic increases in crude protein values reflected the increased proportion of new growth in the samples.

Crude protein in grazed samples of tobosagrass from burned rangeland tended to be higher in crude protein on most sampling dates than grazed samples from unburned plots and plucked samples from burned plots (Table 1). These differences between crude protein content in plucked and grazed samples reflect selective grazing. In general, sheep and other grazers select diets that are higher in nutrients than the average available vegetation.

Digestible organic matter contents of grazed tobosagrass samples from burned and unburned rangeland were also more similar than those of hand-plucked samples (Fig. 1 & 2). Moreover, DOM content of diet samples from burned plots varied less and decreased less during the grazing period compared to unburned plots. Differences in DOM of diet samples among the burned plots were relatively small, but there was a trend toward higher DOM in sheep diets as date of burning was delayed (Fig. 1). Average DOM in sheep diets on unburned rangeland (56.4%) was significantly lower than in sheep diets on burned rangeland (59.6% to 62.7%). Average DOM in sheep diets on the plot burned April 5 (62.7%) was significantly higher than that on the plots burned March 8 (59.6%).

Burning in late winter or early spring significantly increased the nutritive value of tobosagrass, especially during April and May. The effects of date of burning were small, and although delaying burning of tobosagrass until early April tended to extend the period of nutritious tobosagrass forage later into the growing season compared to burning in early March, this advantage might be offset by the delay in early spring availability of regrowth for grazing. Also, production of nutritious cool-season forbs, which are very important in sheep and cattle diets, is usually greatly decreased during the spring and early summer after burning tobosagrass communities. However, burning portions of tobosagrass pastures or different tobosagrass pastures sequentially from late winter through early spring may slightly extend the high quality forage period into the summer while greatly increasing production and utilization of tobosagrass.

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TABLE 1. CRUDE PROTEIN CONTENT (% AIR-DRY BASIS) OF GRAZED AND HAND-PLUCKED TOBOSAGRASS ON BURNED AND UNBURNED RANGELAND

	DATES						
	4/19	5/4	5/17	5/31	6/15	6/29	Average
Plucked samples							
Unburned	7.4	8.8	7.7	7.1	11.6	8.0	8.4
Burned 1/	20.8	16.8	11.6	9.0	13.2	11.0	13.7
Grazed samples							
Unburned	15.3	15.8	11.8	11.7	19.1	12.0	14.3
Burned 1/	20.7	19.7	15.8	13.8	17.0	15.5	17.1

1/ Averaged over all burning dates

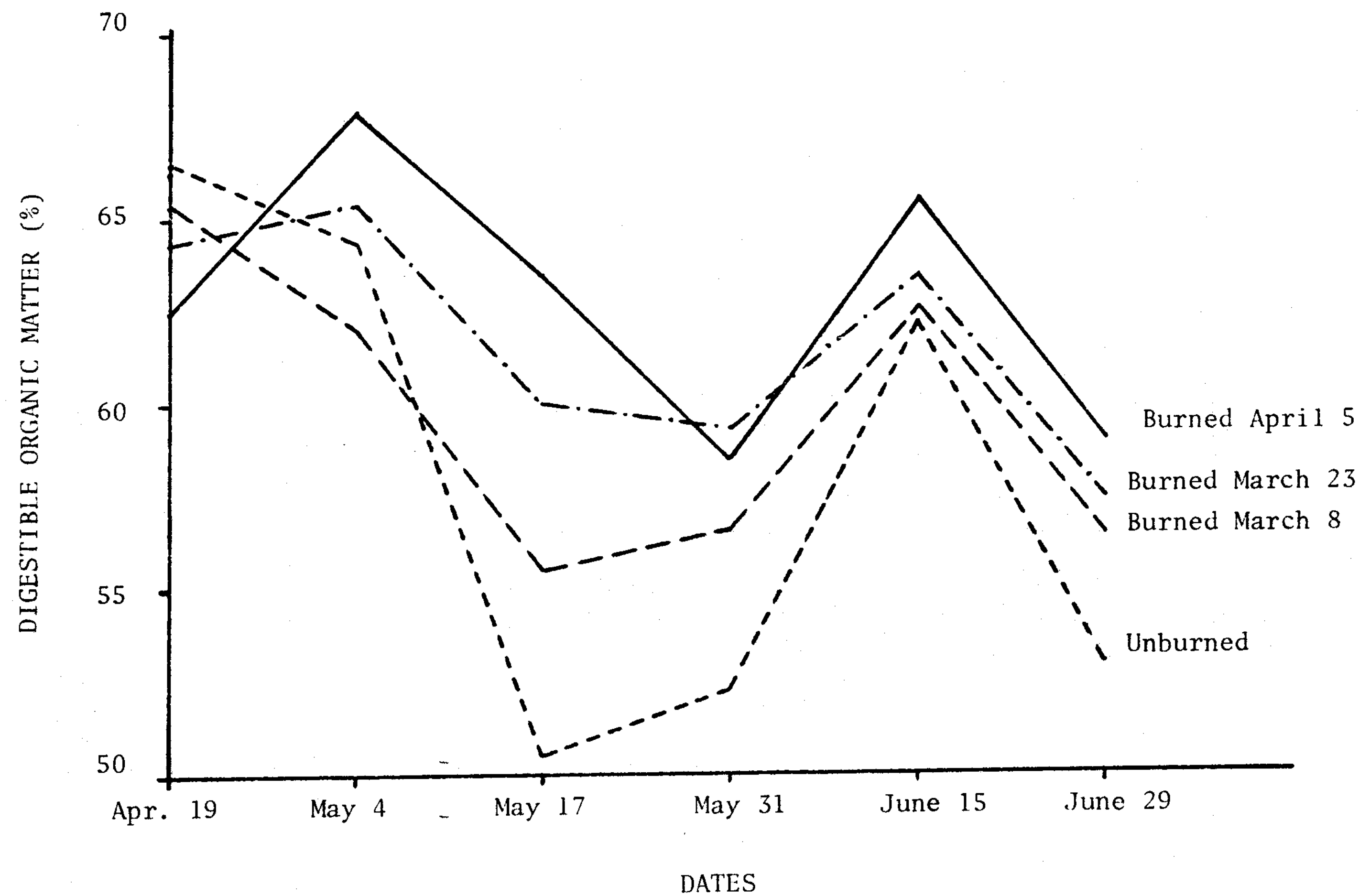

FIGURE 1. DIGESTIBLE ORGANIC MATTER CONTENT OF GRAZED TOBOSAGRASS AT 2-WEEK INTERVALS FOLLOWING SEQUENTIAL BURNING AND ON UNBURNED RANGELAND.

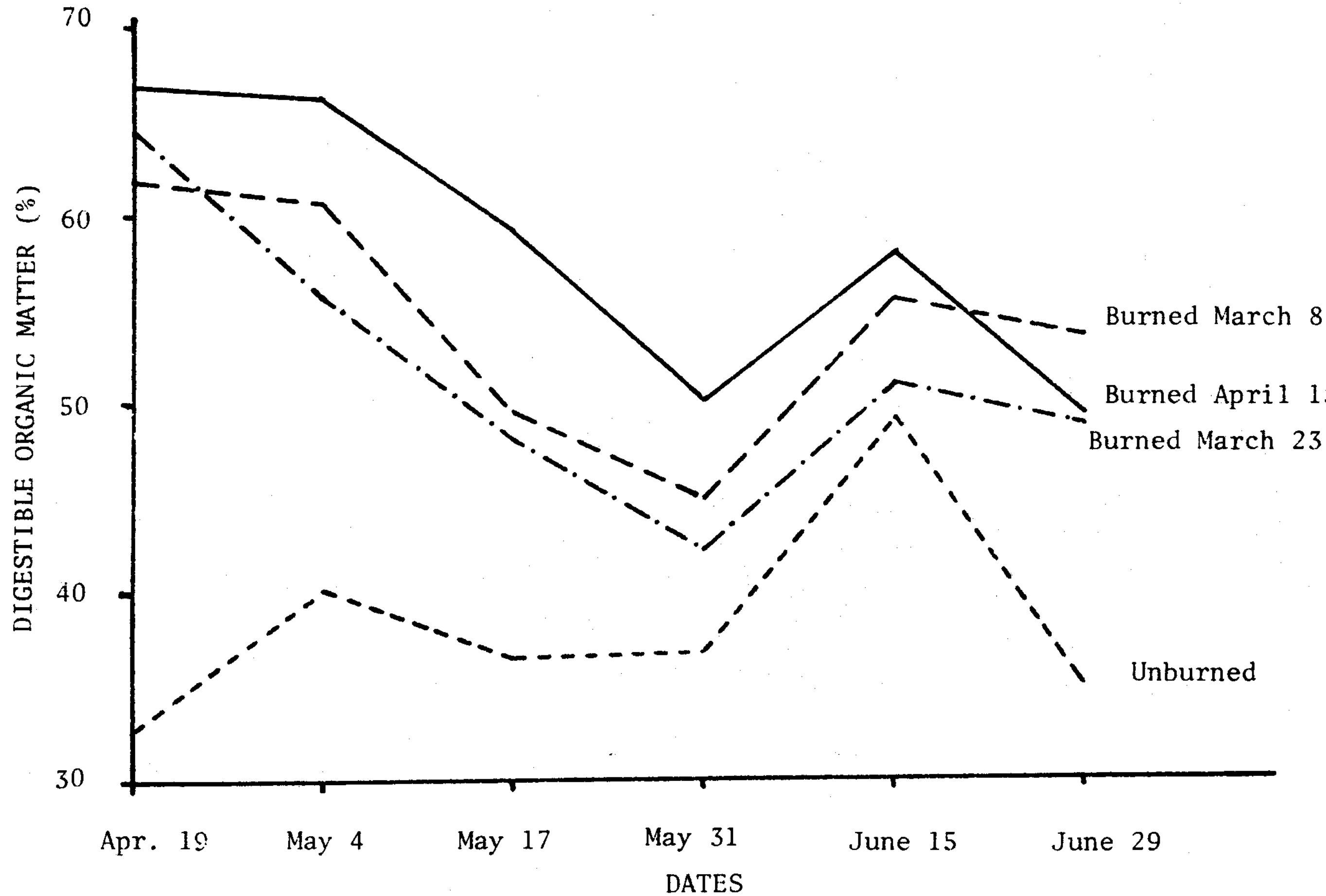

FIGURE 2. DIGESTIBLE ORGANIC MATTER CONTENT OF HAND-PLUCKED TOBOSAGRASS AT 2-WEEK INTERVALS FOLLOWING SEQUENTIAL BURNING AND ON UNBURNED RANGELAND.

PR-3717

ELECTRICAL STIMULATION EFFECT ON APPEARANCE AND PALATABILITY OF RAM LAMBS

R.R. Riley, J. W. Savell, G. C. Smith and Maurice Shelton

INTRODUCTION

Production of wether lambs for meat production is traditional; however, there has been increased interest in meat production from ram lambs. Ram lambs have greater feed efficiency and daily gains (3,9) and produce carcasses that are trimmer and more muscular than wethers (1), but there is some question concerning the palatability of meat from rams of heavy live weights (5). Since purchase of lamb at retail is dependent upon both appearance and palatability of the product, effective means to improve these characteristics are needed. The present study was conducted to investigate the effects of electrical stimulation on some of the quality-indicating characteristics and palatability attributes of meat from ram lambs and the appearance of loin chops from electrically stimulated ram lambs, untreated ram lambs, and untreated wether lambs during retail display.

EXPERIMENTAL

Ram lambs (n=36) and wether lambs (n=12) of the same breed, from the same environment and subjected to the same feeding regimen were dressed, split longitudinally, and the left side of each ram lamb carcass was electrically stimulated within 30 min postmortem. Electrical stimulation (ES) was applied by an experimental "Lectro-Tender" unit manufactured by the LeFiell Company, San Francisco, California. The ES sides received 17 impulses of 550 volts (AC), 5 amps and 1.8 sec duration with 1.8 sec intervals between impulses.

At approximately 24 hr postmortem, quality and yield grade factors and ribeye muscle color were evaluated.

On the fifth day postmortem, the ribeye muscle chops were cut from the loin; two chops were used for shear force determinations, one chop was used for sensory panel determinations, and two chops were cut, using strict sanitation procedures, and used for retail display studies.

Boneless loin chops from some of the carcasses were displayed in a retail display case for four days. A nine-member trained panel evaluated the chops at 24 hr intervals for muscle color (9=very light cherry red, 1=very dark purple), surface discoloration (7=no surface discoloration, 1=total discoloration), and overall appearance (8=extremely desirable, 1=extremely undesirable).

Boneless loin chops from all of the carcasses were cooked to 70 C internally in a 190 C gas oven. Cores were removed from some chops for shear force determinations by use of the Warner-Bratzler shear machine. The loin chops for sensory evaluation were cooked and evaluated, by an eight-member trained sensory panel, for juiciness, muscle fiber tenderness, overall tenderness, flavor, panel-detectable connective tissue and overall palatability using 8-point descriptive rating scales.

Data were analyzed using analysis of variance, and mean separation analyses were performed. For some statistical analyses, ram lamb carcasses were divided into three groups using liveweight (light=115-126 lb; medium=128-138 lb; and heavy=140-150 lb).

RESULTS

Presented in Table 1 are comparisons of quality, palatability and cooking characteristics for sides and loin chops from electrically stimulated and untreated (not ES) ram lamb carcasses stratified according to live weight. Electrical stimulation improved (P<.05) ribeye muscle color for light-weight rams in comparison to their untreated (not ES) paired sides and in comparison to untreated (not ES) sides of medium-weight ram lambs; ES improved (P<.05) lean color of flank and intercostal muscles for light-weight rams in comparison to their untreated (not ES) paired sides and for heavy-weight rams in comparison to their untreated (not ES) paired sides. Previous research (6) has indicated that lean color of ribeye and body cavity muscles in wethers is improved by the use of electrical stimulation. Sensory panel ratings (muscle fiber tenderness, overall tenderness, flavor, juiciness, connective tissue amount and overall palatability) were higher (P<.05) for electrically stimulated sides of light-weight ram lambs than for their untreated (not ES) paired sides; comparisons between ES and not-ES sides of medium-weight and heavy-weight ram lambs did not reveal significant improvements in palatability traits associated with use of electrical stimulation. Use of ES decreased (P<.05) shear force values for loin chops from medium-weight ram lambs. The increase in tenderness of lamb achieved by electrical stimulation has been reported previously (2,6,8). Electrical stimulation has been shown to improve the flavor of goat meat (4).

While not always significant, chops from electrically stimulated sides in each weight group of ram lambs had higher numerical sensory panel ratings (with the exception of juiciness) and lower numerical shear force values than did chops from the untreated (not ES) sides. In addition, electrically stimulated sides from light-weight rams and the highest ratings for each palatability trait whereas chops from untreated (not ES) sides from light-weight rams had the lowest ratings for each palatability trait.

Comparisons of quality, palatability and cooking characteristics for sides and loin chops from electrically stimulated ram lamb and untreated (not ES) wether carcasses are presented in Table 2. Color of the ribeye muscle of electrically stimulated light-weight rams was significantly more youthful (P<.05) than that of the ribeye muscles of untreated (not ES) wethers and of treated (ES) medium-weight ram lambs. Chops from electrically stimulated sides of light-, medium- and heavy-weight rams had (P<.05) higher flavor and overall palatability ratings than did chops from untreated (not ES) wethers. Shear force values of loin chops from electrically stimulated ram lambs in all three weight groups were significantly lower ($P<.05$) than those of loin chops from untreated (not ES) wether carcasses; this is a significant finding since one of the major present deterrents to production of ram, rather than wether, lambs is inadequate tenderness of meat from ram lambs.

Comparisons of appearance and shrink loss of loin chops from electrically stimulated and untreated (not ES) ram lambs and from untreated (not ES) wethers during retail display are presented in Table 3. There were no significant differences among the three groups of chops in muscle color for any day of retail display. Surface discoloration and overall appearance ratings of loin chops from electrically stimulated ram lambs were not different from those for loin chops from untreated (not ES) sides of ram lambs based on the paired-t analysis (Table 3). After one day of retail display, surface discoloration was more extensive ($P<.05$) and overall appearance was less desirable ($P<.05$) for loin chops from ram lambs, irrespective of treatment (ES or not ES), than for loin chops from untreated (not ES) wethers.

Previous research involving evaluations of retail appearance characteristics of lamb chops has shown substantial improvement in muscle color, less surface discoloration and more desirable overall appearance when chops from ES lambs were compared to chops from untreated (not ES) lambs (7). No explanation can be made for the apparent lack of improvement in retail appearance of ram lamb chops in response to electrical stimulation in the present study, but these data suggest that chops from ram lambs are not interchangeable with chops from wethers in terms of retail appearance.

Electrical stimulation can improve the palatability of meat from carcasses produced by ram lambs; when compared to untreated (not ES) wethers, chops from electrically stimulated ram lambs were more tender, more flavorful and had higher overall palatability scores. However, loin chops from ram lambs (irrespective of ES treatment) were decidedly inferior to those from untreated (not ES) wethers in appearance during retail display--electrical stimulation did not lessen this problem.

ACKNOWLEDGMENT

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TABLE 1. COMPARISONS OF QUALITY, PALATABILITY AND COOKING CHARACTERISTICS FOR SIDES AND LOIN CHOPS FROM ELECTRICALLY STIMULATED AND UNTREATED (NOT ES) RAM LAMB CARCASSES STRATIFIED ACCORDING TO LIVE WEIGHT

Trait	Light-weight ram (n=12)[c] x=122.0 lb		Medium-weight ram (n=12) x=132.8 lb		Heavy-weight ram (n=12) x=143.5 lb	
	ES	Not ES	ES	Not ES	ES	Not ES
Ribeye muscle color[d]	A^{53a}	A^{61ab}	A^{63ab}	A^{76b}	A^{60ab}	A^{64ab}
Primary and secondary flank and intercostal muscle color[d]	A^{53a}	A^{63a}	A^{63a}	A^{63a}	A^{56a}	A^{67a}
Juiciness[e]	6.1^{a}	5.5^{a}	5.6^{a}	5.8^{a}	5.8^{a}	5.6^{a}
Muscle fiber tenderness[e]	6.7^{a}	5.6^{b}	6.5^{a}	6.0^{ab}	6.6^{a}	6.1^{ab}
Connective tissue amount[f]	7.0^{a}	6.4^{a}	6.8^{a}	6.7^{a}	6.9^{a}	6.7^{a}
Overall tenderness[e]	6.7^{a}	5.7^{b}	6.5^{ab}	6.1^{ab}	6.5^{ab}	6.2^{ab}
Flavor[e]	6.6^{a}	6.0^{b}	6.4^{ab}	6.3^{ab}	6.4^{ab}	6.3^{ab}
Overall palatability[e]	6.6^{a}	5.5^{b}	6.3^{a}	6.0^{ab}	6.4^{a}	6.0^{ab}
Warner-Bratzler shear force, (kg)	3.1^{ab}	3.8^{b}	2.5^{a}	3.4^{b}	2.9^{ab}	3.4^{b}
Thawing loss, (%)	1.1^{a}	2.2^{a}	1.9^{a}	2.4^{a}	2.3^{a}	1.7^{a}
Cooking loss, (%)	23.4^{a}	24.0^{a}	23.1^{a}	22.8^{a}	24.5^{a}	24.2^{a}

[ab] Means in the same row with a common superscript letter are not different (P>.05).

[c] Means within a weight group underscored by a common line are not significantly different (P>.05).

[d] Lambs slaughtered at chronological ages of 3 to 8 months generally produce carcass with physiological maturity indicators described as A^{00} to A^{100}, respectively, in USDA grade standards (10) for lamb carcasses.

[e] Means based on 8-point descriptive scales (8=extremely juicy, tender or desirable; 1=extremely dry, tough or undesirable).

[f] Means based on an 8-point rating scale (8=none; 1=abundant).

TABLE 2. COMPARISONS OF QUALITY, PALATABILITY AND COOKING CHARACTERISTICS FOR SIDES AND LOIN CHOPS FROM ELECTRICALLY STIMULATED AND UNTREATED (NOT ES) RAM LAMB AND WETHER CARCASSES

Trait	Light-weight ram (n=12) x=122.0 lb ES	Medium-weight ram (n=12) x=132.8 lb ES	Heavy-weight ram (n=12) x=143.5 lb ES	Wether (n=12) x=92.6 lb Not ES
Ribeye muscle color[c]	A^{53a}	A^{63b}	A^{60ab}	A^{70b}
Primary and secondary flank and intercostal muscle color[c]	A^{53a}	A^{63a}	A^{56a}	A^{67a}
Juiciness[d]	6.1^a	5.6^a	5.8^a	5.6^a
Muscle fiber tenderness[d]	6.7^a	6.5^a	6.6^a	6.1^a
Connective tissue amount[e]	7.0^a	6.8^a	6.9^a	6.6^a
Overall tenderness[d]	6.7^a	6.5^a	6.5^a	6.2^a
Flavor[d]	6.6^a	6.4^a	6.4^a	5.1^b
Overall palatability[d]	6.6^a	6.3^a	6.4^a	5.3^b
Warner-Bratzler shear force, (kg)	3.1^a	2.5^a	2.9^a	4.5^b
Thawing loss, (%)	1.1^a	1.9^a	2.3^a	1.3^a
Cooking loss, (%)	23.5^a	23.1^a	24.5^a	24.6^a

[ab]Means in the same row with a common superscript letter are not different (P>.05).

[c]Lambs slaughtered at chronological ages of 3 to 8 months generally produce carcasses with physiological maturity indicators described as A^{00} to A^{100}, respectively, in USDA grade standards (10) for lamb carcasses.

[d]Means based on 8-point descriptive scales (8=extremely juicy, tender or desirable; 1=extremely dry, tough or undesirable).

[e]Means based on an 8-point rating scale (8=none; 1=abundant).

TABLE 3. COMPARISONS OF APPEARANCE AND SHRINK LOSS OF LOIN CHOPS FROM ELECTRICALLY STIMULATED AND UNTREATED (NOT ES) RAM LAMBS AND FROM UNTREATED (NOT ES) WETHERS DURING RETAIL DISPLAY

Trait	Day of retail display	Ram lamb (n=12)[c]		Wether (n=12)
		ES	Not ES	Not ES
Muscle color[d]	0	5.3[a]	5.1[a]	5.0[a]
	1	5.2[a]	5.1[a]	4.9[a]
	2	4.9[a]	5.0[a]	4.9[a]
	3	4.1[a]	4.2[a]	4.5[a]
	4	3.5[a]	3.7[a]	4.1[a]
Surface discoloration[e]	0	7.0[a]	6.9[a]	7.0[a]
	1	4.4[b]	4.1[b]	6.4[a]
	2	3.2[b]	3.0[b]	5.7[a]
	3	2.8[b]	3.0[b]	5.5[a]
	4	2.2[b]	2.4[b]	4.8[a]
Overall appearance[f]	0	6.2[ab]	5.9[b]	6.7[a]
	1	4.6[b]	4.2[b]	5.6[a]
	2	3.6[b]	3.5[b]	4.8[a]
	3	3.3[b]	3.4[b]	4.5[a]
	4	2.3[b]	2.4[b]	3.9[a]
Shrink loss, %	4	3.7[a]	2.9[a]	3.5[a]

[ab]Means in the same row with a common superscript letter are not different (P>.05).
[c]Means within a group underscored by a common line are not significantly different (P>.05).
[d]9=very light cherry red; 1=very dark purple.
[e]7=no surface discoloration; 1=total surface discoloration.
[f]8=extremely desirable; 1=extremely undesirable.

PR-3718

PREDICTING CARCASS CUTABILITY OF RAMBOUILLET RAMS USING LIVE MEASURES

Gary Snowder, Maurice Shelton and Charles Long

SUMMARY

There is a need among producers and researchers to accurately select breeding rams which have desirable meat characteristics. The purpose of this study was to derive prediction equations estimating carcass cutability in terms of weight of the major primal cuts utilizing data which can be obtained on live animals. Sixteen variables representing live measurements and scores were studied. Weights of primal cuts can be predicted with reasonable accuracy by a multiple regression equation. However, size or live animal weight is the major factor contributing to the predicting equation. Removing the influence of size as measured by weight by statistically adjusting individual live and carcass weights to a constant weight for all rams greatly reduced the ability to predict weight of primal cuts and thus the utility of the resulting equations.

INTRODUCTION

Rate of improvement in selection for improved carcass traits in sheep depends to an important degree on the accuracy with which it is possible to discriminate between potential breeding rams without sacrificing the animal. Progeny testing is the most accurate means of selection for carcass merit, but this method is time consuming and places constraints on selection on a large-scale basis. The objective of this study was to develop multiple regression equations to predict carcass cutability of Rambouillet rams using live animal traits. Such an effort would attempt to identify live traits for which selection might be effective at an early age and which could be incorporated into a selection index for use in ram testing programs. Numerous studies have been conducted to predict cutability of live animals (1,2,3); however, identification of live traits which are highly related to carcass traits has not been entirely successful, and until this is accomplished these efforts should receive a high research priority.

MATERIALS AND METHODS

Data for this study were collected from separate Rambouillet ram lamb feedlot performance trials conducted in 1977 and 1978 at the Texas A&M University Research and Extension Center in San Angelo. Data for the two years were pooled. Following termination of each feed trial rams were shorn, weighed and live animal measurements taken. The location and methods of taking live body measures included use of a tape and calliphers to obtain dimensions of body length, heart girth, chest width, chest depth, loin length, loin width, rump length and hip height. All the measurements, excluding hip height, are described by previous authors (3).Hip height measurements were collected in 1978 and limited to 33 rams. Hip height was determined by reading the distance from the ground to the highest point of the hip as measured by a calibrated rod with a smaller sliding bar extending at a right angle. Front and rear live weights were obtained by recording the weight placed on the front or hind legs while a metal plate prevented hind or front feet from reaching the scales. Ultrasonic measures were taken with the scanogram instrument for fat thickness and ribeye area. Visual scores were recorded for muscling and finish on a 10-point scale. Smooth, thick lambs with wide loins, deep full legs and well muscled throughout were scored ideally as 10. Rate of gain in the feedlot was also included in calculations. A total of 107 Rambouillet rams were slaughtered and carcasses fabricated to obtain weights of trimmed retail cuts.

Correlation coefficients were computed among live and carcass measurements and scores to determine their relationships. Live animal variables were used in multiple regression equations to predict weight of total consumer cuts and weight of major primals. A computerized step-wise procedure of selecting live animal variables to derive a maximum R-square value (the amount of variation in the weight of carcass cuts accounted for by the live animal variables in the equation) was utilized. A second set of correlations and regression equations was calculated with live and carcass variables adjusted by regression to a constant body or carcass weight respectively. Statistical adjustment of variables to a constant weight removed the obvious relationship of size of the animal to weight of the cuts.

RESULTS AND DISCUSSION

Only a small number of the live animal measures showed a strong relationship or correlation with the weight of the retail major primal cuts and retail consumer cuts (see Table 1). The weights of the major primals were most highly related to the live slaughter weight (r=.84), hip height (r=.59), live front weight (r=.58), body length (r=.56) and visual finish score (r=.56). Total consumer cuts were also correlated with slaughter weight (r=.79), hip height (r-.55) and live front weight (r=.50).

The equation selected as the most desirable with the largest R-square value (.81) to predict weight of primal cuts was found to be:

$$\hat{y} = -6.13 + .23x_1 = .11x_2 + .29x_3$$

where

$\hat{y}$ = estimated weight of primal cuts in kilograms
x_1= live slaughter weight in kilograms
x_2= body length in centimeters
x_3= loin width in centimeters

In situations such as performance test programs where it is necessary to compare individual cutability, it will be necessary to convert the estimated weight of primal cuts to a percent of live body weight by dividing the estimated value, $\hat{y}$, by live body weight.

After adjusting all live and carcass weights to a constant live and carcass weight, respectively, it was observed that the relationships of the live measures to carcass cuts were generally not significant. Primal cuts were slightly correlated to body length (r=.34), hip height (r=.34), visual finish score (r=.23) and average daily gain (r=.22). This indicates that body size as reflected in weight biases the value of prediction based on live animal measures i.e., a larger animal would logically have a larger heart girth, wider loin etc., but the corollary of selecting for small animals does not seem desirable.

The best equation to predict primal cuts at a constant live and carcass weight is:

$$\hat{y} = 15.27 = .06x_1 = .41x_2 - 2.53x_3$$

where

$\hat{y}$ = estimated weight of primal cuts in kilograms
x_1= body length in centimeters
x_2= ultrasonic measure of ribeye area (cm^2)
x_3= ultrasonic measure of fat thickness (cm)

The R-square value of this equation was only .18, denoting a small amount of variation in the weight of the primal cuts accounted for by the adjusted live variables.

This study indicates the fair amount of accuracy of predicting weight of primal cuts in the individual ram. Several variables reported are highly correlated to the weight primal cuts. However, when live and carcass weight were held to a constant weight for all rams the correlations or relationships between the live and carcass measures were decreased, and the resulting equations do not appear to be of real value in ram selections.

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Table 1. Correlation Coefficients[a] Among Live and Carcass Measures in Rambouillet Rams

	Actual		Adjusted[b]	
	Major Primal Cuts	Consumer Cuts	Major Primal Cuts	Consumer Cuts
Slaughter weight	.84	.79	.07	.04
Front weight	.58	.50	-.01	-.11
Rear weight	.42	.42	-.01	.06
Body length	.56	.35	.34	.13
Heart girth	.59	.55	-.07	-.06
Chest width	.48	.44	.08	.01
Chest depth	.48	.40	.07	-.07
Loin width	.42	.46	-.14	.03
Loin length	.18	.18	.05	.07
Rump length	.15	.17	.11	.15
Hip height	.05	-.04	-.34	-.34
Average daily gain	.39	.21	.22	-.14
Ultrasonic fat thickness	-.01	.07	-.14	.06
Ultrasonic ribeye area	.26	.34	.03	.24
Conformation score	.22	.32	-.08	.16
Finish score	.56	.35	.23	-.20

[a] Correlation coefficients greater than .195 are significant ($P<.05$) for all variables except hip height where coefficients greater than .33 are significant ($P<.05$).

[b] Live measures adjusted to slaughter weight and carcass measures adjusted to carcass weight. Subjective scores are not adjusted.

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