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EFFECT OF BREED, SEX, AND FINAL WEIGHT ON FEEDLOT PERFORMANCE, CARCASS CHARACTERISTICS, AND MEAT PALATABILITY OF LAMBS

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Summary

Eighty-six lambs were randomly allotted to treatment (heavy vs light slaughter weight) within breed (Targhee vs Suffolk x Targhee) and sex (rams vs wethers). Lambs in the lightweight group were fed to an average weight of approximately 109 lb. and the heavyweight group was fed to an average weight of approximately 136 pounds.

The carcass measurements and estimates made were weight, hindsaddle weight and percent (excluding kidney and pelvic fat), leg conformation score, fat thickness over the rib eye, rib eye area, percent of kidney and pelvic fat and quality grade.

Two 1-inch chops were taken from the loin (rack end) for taste panel evaluation. Uncooked and cooked weights were taken so that percent shrinkage could be determined. Warner-Bratzler shear tests were run on .5-inch cores of cooked sample from the loin chops. The remaining portions were ranked on an eight-point hedonic scale by seven taste panel members for tenderness, juiciness and flavor.

The heavy slaughter weight group had ($P<.05$) higher dressing percents, heavier hindsaddles, more fat over the rib eye, more kidney and pelvic fat, higher leg conformation scores and quality grades, larger rib eye areas, were less tender and had less desirable yield grades compared to the lightweight group.

Rams had ($P<.05$) heavier carcass weights, more desirable yield grades, heavier hindsaddles, lower dressing percents and less fat per lb. of carcass weight than wethers. Also, in all feeding periods measured, the rams had higher average daily gains. There were no significant ($P<.05$) palatability differences between the two sex groups.

The Suffolk x Targhee group had ($P<.05$) higher carcass weights, more external fat, higher leg conformation scores and quality grades and more desirable flavor than straightbred Targhees. The Suffolk x Targhee group also had higher average daily gains for the overall period and from the initial to intermediate periods.

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Introduction

In 1977 Americans consumed 154 lb. per capita of red meat. Of that, only 1.5 lb. was lamb. This may be attributed, in part, to the limited supply and to the relatively small amounts of lean and sometimes large amounts of fat on lamb cuts, especially rib and loin chops. Additionally, and probably most importantly, the flavor of lamb is the most pronounced of any meat species.

An intense "mutton" flavor, thought to be caused by hydrogen sulfide, has been identified in very mature lambs. This mutton flavor has been attributed to other factors in addition to chronological age.

Flavor seems to be more intense in fine wool breeds, possibly due to higher dietary sulfur requirements for wool production, when high concentrations of legumes are fed and when slaughter takes place during warm environmental temperatures. Mutton flavor associated with the saturation of fatty acids in the adipose tissue is somewhat heritable.

There has been an increased interest in marketing heavier lambs in the past few years. Production of heavy market lambs could substantially increase quantity and efficiency of lamb production and reduce the processing cost per pound. Research suggests that the industry must shift to a larger, meatier lamb if the production of lamb in the role of a red meat species is to grow. Therefore, it is up to the producer to identify management systems that produce a larger animal and the meat industry to do their part to make heavier carcasses marketable and acceptable to the retailer and the consumer.

Previous results are not consistent in comparing palatability characteristics of heavy market lambs and traditional market lambs. However, most researchers reported that heavy lamb carcasses were acceptable in palatability. Growthy lambs continued to do well in the feedlot and their carcasses had acceptable yield grades.

Several researchers have compared carcass characteristics and palatability attributes of lambs differing in sex condition. Generally, ram lambs are trimmer and more muscular than wethers. There is not full agreement on the palatability of ram lambs, but they usually have higher Warner-Bratzler shear values, are not as juicy and have a higher incidence of mutton flavor when compared to wethers.

It is widely recognized that meat-type breeds (i.e., Suffolk and Hampshire) are more efficient producers of muscle protein than are wool breeds (i.e., Rambouillet and Targhee). They also have been shown to have less mutton flavor than fine wool breeds of sheep.

The objective of this project was to study the effect of slaughter weight (heavy vs light), sex (ram vs wether) and breed (Targhee vs Suffolk x Targhee) of lambs on feedlot performance, carcass characteristics and palatability attributes. In addition, year (1975 vs 1976) and type of birth (single vs multiple) were included in the analysis.

Materials and Methods

Lambs for this project were produced in 1975 and 1976 at the Antelope Range Station, Buffalo, South Dakota. In both years, the lambs were weaned on June 2 and transported to Brookings. Eighty-six lambs were randomly allotted to treatment (heavy vs light slaughter weight) within breed (Targhee vs Suffolk x Targhee) and sex (rams vs wethers).

All lambs were fed a 13% protein ration ad libitum. The ration consisted of 20% ground alfalfa hay and 80% concentrate. The concentrate was primarily corn plus the necessary soybean oil meal and other supplements to balance the ration. Lambs in the lightweight group were fed to an average weight of approximately 109 lb. and the heavyweight group was fed to an average weight of approximately 136 pounds. At these weight end points, the lambs were transported to John Morrell and Company in Sioux Falls, South Dakota, and slaughtered.

A trained team collected carcass data and a U.S.D.A. grader determined the quality grade and estimated the percent of kidney and pelvic fat. The carcass measurements and estimates made were carcass weight, hindsaddle weight (excluding kidney and pelvic fat), leg conformation score, fat thickness over the rib eye, rib eye area, estimated percent of kidney and pelvic fat and quality grade. The actual weight (and therefore percent) of kidney and pelvic fat was determined on 58 of the carcasses.

The hindsaddles of the carcasses were purchased by and transported to the South Dakota State University Meat Lab. Two 1-inch chops were taken from the loin for subsequent taste panel evaluation. The chops were closely trimmed, weighed and cooked in a preheated oven at 325 F (163 C) to an internal temperature of 167 F (75 C). The chops were then reweighed to determine the cooking loss. Two .5-inch cores were taken from the rib eye of each carcass for Warner-Bratzler shear tests (two shears per core). The remaining portions of that muscle were given tenderness, juiciness and flavor scores by a seven-member taste panel. The samples were ranked on an eight-point hedonic scale using the descriptive terms extremely, very, moderately and slightly.

Differences in treatment means were analyzed by a F test for appropriate main effects and interactions.

Results and Discussion

The treatment effects on live and carcass traits are given in table 1. In evaluating overall average daily gain, the heavyweight lambs showed a significant ($P<.05$) advantage over lightweight lambs. However, there was no significant difference between weight groups in average daily gain from initial to intermediate weights[1]. This would

[1] Final weight for lightweight group and intermediate weight for heavyweight group.

indicate that there was, in fact, a random assortment of lambs into weight treatment. Furthermore, the relatively short feeding period in relation to the adjustment period for the lightweight slaughter group gave an advantage to the heavyweight group in average daily gain.

When observing the effect of sex on average daily gain, rams were significantly superior gainers from an overall standpoint ($P<.005$), from initial to intermediate weights ($P<.005$) and from the intermediate to final weight period[2] ($P<.01$). The rams appeared to gain better at heavier weights than the wethers.

The Suffolk x Targhee group outgained the Targhee group in an overall comparison ($P<.01$) and from the initial to intermediate weight period ($P<.005$). There was no significant difference ($P>.10$) between breed groups for average daily gain from intermediate to final weights.

In comparing slaughter weight treatment and its effect on carcass traits, the heavyweight group had significantly ($P<.005$) greater dressing percentages, fat measurements, kidney and pelvic fat percentages, rib eye areas and hindsaddle weights. However, fat per 50 lb. of carcass weight did not differ significantly. There was no significant difference in hindsaddle percentages, but the lightweight group had a slight advantage. The heavyweight group had significantly ($P<.01$) higher leg conformation scores which are partial reasons for significantly ($P<.005$) higher quality grades. The lightweight group had significantly ($P<.005$) more desirable yield grades, but the mean yield grade of the heavyweight group was still acceptable (3.7). The lightweight group also had an advantage ($P<.05$) in rib eye area per 50 lb. of carcass weight.

The superior trimness and muscularity of ram carcasses was evidenced by significantly heavier carcass weights ($P<.005$), less fat per 50 lb. of carcass weight ($P<.01$), higher hindsaddle weights ($P<.005$) and more desirable ($P<.05$) yield grades. There were no significant differences ($P>.10$) in actual fat measurements, leg conformation scores, quality grades, hindsaddle percentages, kidney and pelvic fat percentages, rib eye areas or rib eye areas per 50 lb. of carcass weight. The wether group had higher ($P<.05$) dressing percents. This difference would be lessened if testicle weight was included in the salable weight of ram lamb carcasses. Lamb testicle weight accounts for about .75% of the live weight of a ram.

Breed differences were significant in favor of the Suffolk x Targhee over the Targhee group in carcass weight ($P<.005$), leg conformation score ($P<.01$) and quality grade ($P<.005$). The Targhee group was significantly trimmer ($P<.05$), although the mean fat cover over the rib eye was acceptable for the Suffolk x Targhee group (.22 inch). There was no significant difference ($P>.10$) in yield grade or any other of the carcass characteristics measured.

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[2] Includes only heavyweight group.

When palatability attributes were evaluated, taste panel tenderness was significantly ($P<.005$) more desirable for the lightweight group than for the heavyweight group. However, the mean tenderness rating for the heavyweight group was still acceptable (2.9). In accordance, Warner-Bratzler shear value was significantly ($P<.05$) less for the lightweight group.

There were no significant differences ($P>.05$) in means of palatability traits between rams and wethers.

There was a significant ($P<.01$) flavor advantage for the Suffolk x Targhee group compared to the Targhee group. There were no other significant breed differences.

There were no significant differences ($P>.05$) observed in percent cooking loss under any treatment comparison.

The 1976 lambs had significantly ($P<.005$) superior overall average daily gains and average daily gains from the initial to intermediate weights[3] compared to the 1975 lambs. They also had significantly higher dressing percentages ($P<.05$), higher hindsaddle percentages ($P<.05$) and more desirable taste panel tenderness scores ($P<.005$). The 1975 lambs, however, had significantly higher carcass weights ($P<.05$) and rib eye areas ($P<.05$).

Type of birth (single vs multiple) analyzed as a main effect had no significant effect on any live animal, carcass or palatability attribute.

There was a significant slaughter weight x sex interaction affecting carcass weight ($P<.05$), rib eye area ($P<.05$) and hindsaddle weight ($P<.05$). The difference in the light- and heavyweight rams was consistently greater than that difference between light- and heavyweight wethers.

Significant interactions which affected percent kidney and pelvic fat were slaughter weight x breed ($P<.05$), slaughter weight x breed x birth type ($P<.05$) and breed x sex x birth type ($P<.005$). The difference between light- and heavyweight Targhees was greater than that of light- and heavyweight Suffolk x Targhees. In analyzing the slaughter weight x breed x birth type interaction, lightweight Targhees and lightweight Suffolk x Targhee lambs of single birth only differed .1% in kidney and pelvic fat (3.0 and 2.9%, respectively). There was no difference in heavyweight Targhee vs heavyweight Suffolk x Targhee lambs of single birth (4.8%). However, in comparing lambs of multiple birth, the lightweight Targhee lambs differed from the lightweight Suffolk x Targhee in percent kidney and pelvic fat (1.5 and 4.7%, respectively). The heavyweight Targhee differed from the heavyweight Suffolk x Targhee by 1.3% in kidney and pelvic fat (6.1 and 4.8%, respectively).

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[3] Final weight for lightweight group and intermediate for heavyweight group.

Average daily gain from the intermediate to final weight[4] was significantly ($P<.01$) affected by a breed x sex interaction. The differences between the Targhee and Suffolk x Targhee lightweight lambs and that of the Targhee and Suffolk x Targhee heavyweight lambs were consistently in favor of the Suffolk x Targhee lambs. This difference was not as large in the heavy- as in the lightweight group.

A slaughter weight x breed interaction had a significant ($P<.05$) effect on tenderness. The difference between light- and heavyweight Targhees and light- and heavyweight Suffolk x Targhees is consistently in favor of the heavyweight group.

Taste panel tenderness, flavor, juiciness and Warner-Bratzler shear values were correlated to quality grade. The correlation coefficients were $r = .13$, $-.11$, $-.03$ and $.26$, respectively. These were not significant at the 5% level. Taste panel tenderness and Warner-Bratzler shear values were moderately correlated ($r = .68$, $P<.05$). Yield grade was correlated ($P<.05$) to rib eye area, percent hindsaddle, weight of hindsaddle and dressing percent. The correlation coefficients were $r = .22$, $-.32$, $.49$ and $.53$, respectively. Final weight was correlated ($P<.05$) to dressing percent ($r = .25$), but the coefficient of determination ($r^2 = .0625$) gives question to the economic significance of the relationship between the two. Final weight was also correlated ($r = .72$, $P<.05$) to rib eye area. This indicates that heavier carcasses would yield larger, more consumer preferable loin and rib chops. However, live animal production must be such that the heavier carcasses do not have excess fat or the benefit of larger rib eye areas is negated.

Feed consumption was measured on all lambs by pen up until the lightweight groups went to slaughter and for the remaining heavyweight groups by pen after the lightweight lambs were removed. The lb. of feed per lb. of gain was then calculated for these two periods.

The average feed efficiency for all the lambs was 6.4 lb. per lb. gain. If lb. feed per lb. gain is calculated after the adjustment period (from shipping, shearing, worming, etc.) of about 9 days, that efficiency improves to 5.0 lb. feed per lb. gain. The feed efficiency of the heavyweight group (after the lightweight group went to slaughter) was 5.8 lb. feed per lb. gain. The Targhee wethers had the poorest efficiency of any breed-sex group. In 1975 and 1976, 6.1 lb. and 5.5 lb. of feed were required per lb. of gain, respectively (beginning weight taken after adjustment period).

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[4] Includes only heavyweight group.

Table 1. Least Squares Means for Live and Carcass Traits of Lambs by Treatment

	Slaughter weight		Sex		Breed	
	Light	Heavy	Wethers	Rams	Targhee	Suffolk x Targhee
Average daily gain, lb.						
Total period	.51	.58*	.49	.61***	.51	.58**
Initial to intermediate[a]	.51	.55	.47	.59***	.49	.57***
Intermediate to final	--	--	.52	.70**	.58	.64
Carcass wt., lb.	58.3	77.6***	64.0	71.8***	64.8	71.0***
Dressing percent	53.1	56.8***	56.1	53.8*	54.4	55.5
Actual fat, in.	.15	.23***	.21	.17	.17	.22*
Fat per 50 lb. carcass wt., in.	.13	.15	.16	.12**	.13	.15
Leg conformation score[b]	12.4	13.5**	13.0	12.9	12.5	13.4**
Yield grade[b]	2.4	3.7***	3.3	2.9*	3.0	3.2
Quality grade[b]	11.0	12.6***	11.8	11.7	11.4	12.2***
Wt. hindsaddle, lb.[c]	22.0	27.9***	23.6	26.2***	24.3	25.5
Percent hindsaddle[c]	38.23	36.37	37.67	36.93	38.13	36.47
Actual percent kidney and pelvic fat	3.02	5.12***	4.07	4.07	3.85	4.29
Rib eye area, sq. in.	2.32	2.76***	2.44	2.64	2.44	2.64
Rib eye area per 50-lb. carcass wt., sq. in.	2.00	1.81*	1.95	1.86	1.93	1.87
Cooking loss	15.49	16.75	16.88	15.36	16.42	15.82
Shear force[d]	2.17	2.66*	2.55	2.28	2.46	2.38
Tenderness[e]	1.90	2.90***	2.38	2.42	2.48	2.32
Flavor[e]	2.48	2.55	2.57	2.70	2.77	2.26**
Juiciness[e]	2.79	2.97	2.46	3.06	2.86	2.89

* P<.05.
** P<.01.
*** P<.005.
[a] Intermediate weight is final weight for lightweight group.
[b] High prime = 15, high choice = 12, etc.
[c] Without kidney and pelvic fat.
[d] Measured in lb. of force required to cut through a .5-inch core of cooked sample.
[e] Measured on a hedonic scale of 1 = extremely tender; 8 = extremely tough.