

FEED EFFICIENCY AND CARCASS CHARACTERISTICS OF  
RAM AND EWE LAMBS FED FOR TWO WEIGHT GAIN  
INTERVALS AND SLAUGHTERED AT  
TWO LIVE WEIGHTS

By

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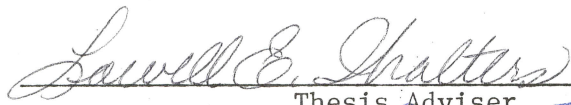
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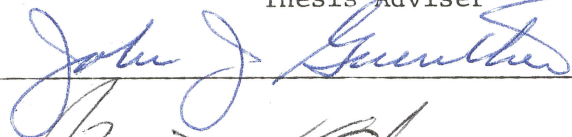
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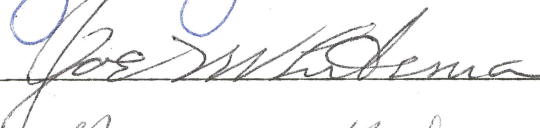
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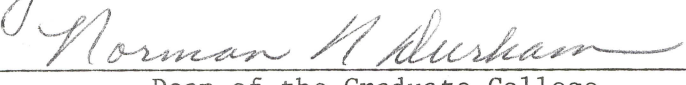
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## CHAPTER I

### INTRODUCTION

A current interest of the sheep industry is to produce a heavier market lamb yielding a larger (yet still desirable) edible portion than the lamb slaughtered at the traditional live weight of 100 pounds. The profitability of producing heavier lambs is highly dependent on the amount of additional feed required and the possible price discrimination against heavier lambs because of their "believed" greater increase in fat content in proportion to their increase in lean content.

Many previous studies on feed efficiency of lambs have shown that efficiency of production of 100 pound market lambs could be improved if male lambs were left intact. These studies conclude that ram lambs gain faster and are more efficient feed convertors than wether or ewe lambs. However, there are relatively few studies reported that have examined feed efficiency of lambs fed to heavier than 100 pound slaughter weights.

There have also been numerous studies that have shown that as slaughter weight of ram and ewe lambs increases above 100 pounds, carcass fat deposition increases, loin eye area increases and yield of edible portion (as a percent of carcass weight) decreases. In general, these studies agree on the direction of the changes that occur in carcass traits as slaughter weight increases. However, there are few

studies that agree on the magnitude of the changes in carcass traits as slaughter weight increases.

This study was initiated to determine a) the pounds of feed required per pound of gain for ram and ewe lambs fed for two weight gain intervals and b) how much change can be expected in some economically important carcass traits of ram and ewe lambs slaughtered at 100 and 125 pounds live weight.



## CHAPTER II

### REVIEW OF LITERATURE

Previous research done in the general areas of a) feed efficiency of lambs in relation to slaughter weight and b) the effects of sex and slaughter weight on lamb carcass characteristics will be of concern in this literature review.

#### Feed Efficiency of Lambs in Relation to Slaughter Weight

The effects of sex on growth performance of market lambs are well-documented. Previous studies have shown that ram lambs grow faster and are more efficient convertors of feedstuffs to animal protein than either wether or ewe lambs when fed to slaughter weights of approximately 100 pounds. However, few studies examining the feed efficiency of lambs in relation to differences in slaughter weight can be found in the literature.

Deweese et al. (1969) reported a study on the performance of rams and wethers slaughtered at different weights. Sixty Hampshire-sired crossbred lambs (30 rams and 30 wethers) were fed a high concentrate pelleted ration in pens of five lambs each. Lambs were assigned to slaughter groups with one-third slaughtered at each of three live weights; 36.2, 45.3 and 54.4 kilograms. Average daily gain and feed consumption were measured for every 9.1 kg increment from 18.1 kg to

slaughter. Both rams and wethers increased in average daily gain during every 9.1 kg increment except between the slaughter weights of 45.3 and 54.4 kilograms. During this interval, rate of gain decreased from .415 to .338 kg/day for the ram lambs and from .352 to .315 kg/day for the wether lambs. Feed required per kilogram of gain increased for every 9.1 kg weight gain from the 18.1 kg weaning weight to the 54.4 kg slaughter weight. The increases in kilograms of feed required per kilogram of gain for each of the three 9.1 kg weight gain intervals were 1.27, 0.69 and 1.9 for ram lambs and 1.5, 0.67 and 1.7 for wether lambs, respectively. Rams consistently gained faster on less feed than did wethers during each weight gain interval.

Orskov et al. (1971) studied the growth performance of lambs fed ad libitum on diets of different protein content and at different live weights. Twenty-five male and 25 female lambs were killed at intervals starting after they had been on the diets for 3 weeks. The last lamb to be slaughtered had reached a live weight of about 55 kilograms. They found that the feed conversion ratio of "kg feed dry matter/kg gain" increased with increasing slaughter weight. The rate of increase did not differ significantly between the six groups by diet and sex; therefore, their combined estimate of the increase in the feed conversion ratio for each kg increase in slaughter weight was  $0.038 \pm 0.008$  kg feed DM/kg gain (thus the overall conversion ratio would increase by 0.38 for each 10 kg live-weight gain). They also found that mean growth rate from the start of the experiment to time of slaughter was not significantly related to final live weight. The mean average daily gains for the ram and ewe lambs on the medium protein diet (15.7% crude protein) were 270 and 225 grams/day, respectively.

Orskov et al. (1973) reported a study designed to provide more data on the effect of weight at slaughter on the overall efficiency of intensive systems of sheep production. Twin lambs from 27 North Country Cheviot ewes mated to Suffolk rams were used for this experiment. The ewes were randomly allocated to have their lambs weaned at either 25, 33 or 41 days of age and the lambs were assigned at random within weaning times to be slaughtered at either 35, 45 or 55 kg live weight. There were 28 ewe and 26 ram lambs slaughtered. The same diet, consisting of 91% rolled barley, 7.5% white fish meal and 1.5% limestone, was used both as creep feed from 14 days of age and for fattening. The feed was pelleted and fed ad libitum. The effect of weight at slaughter on the feed conversion ratio was similar to that found by Orskov et al. (1971). For each kg increase in live weight at slaughter from 35 to 55 kg, the overall quantity of feed dry matter required per kg gain increased by  $0.035 \text{ kg} \pm 0.006$  while in the previous work referred to using a similar genotype, the value was  $0.038 \text{ kg} \pm 0.008$ . Rate of gain was not significantly affected by increased slaughter weights from 35 to 55 kg. The growth rate, in grams per day, was 300, 289 and 316 for the 35, 45 and 55 kg slaughter weight groups, respectively. There was a significant difference observed for growth rate due to sex of lamb. Male lambs gained 327 g/day whereas ewe lambs gained only 280 k/day.

The influence of sex and slaughter weight on the performance of slaughter lambs was examined by Shelton and Carpenter (1972). Lambs sired by Hampshire, Suffolk, Hampshire X Suffolk or Columbia rams out of grade Rambouillet ewes were early weaned at approximately 20 kg and placed on feed in drylot. The basic ingredients of the ration fed were

rolled sorghum grain at 71%, ground alfalfa at 10% and cottonseed meal at 8% of the ratio. At the time of weaning, a portion of the lambs was castrated to produce three sex groups of rams, wethers and ewes. One-hundred ninety-six lambs were slaughtered at various live weights ranging from approximately 36 to 64 kilograms. The differences in rate of gain and feed/gain due to sex were found to be highly significant and followed trends to be expected with rams making the fastest gains and requiring the least feed/g gain and with ewes gaining the slowest and requiring the most feed/g gain. Ram lambs in this study gained 292.4 g/day and required 5.8 grams of feed/g of gain; whereas, ewe lambs gained 234.9 g/day and required 6.6 g feed/g gain. Within the weight ranges included in this study, rate of gain was not significantly affected by body weight of the lamb. When rate of gain was regressed on body weight, the regression coefficients obtained were found to be negative and of very low magnitude and did not represent a significant source of variation in rate of gain. The regression coefficients for rams, ewes and wethers were -1.2, -2.6 and -2.5 respectively. Variation in body weight, however, was found to be an important source of variation in the amount of feed required per unit of gain. The regression of feed efficiency on body weight yielded significantly ( $P < .01$ ) higher coefficients for wethers and ewes than for rams (0.075, 0.086 and 0.046 respectively). This meant that as body weight increased, feed required per unit of gain increased at a faster rate for wether and ewe lambs than for ram lambs. They concluded that ram lambs of the type used in this study could be grown to heavier weights much more economically than can wether or ewe lambs.

## Effects of Sex and Slaughter Weight on Lamb Carcass Characteristics

### Sex

Oliver et al. (1967) examined the quantitative characteristics of ram, wether and ewe lamb carcasses. Carcasses were from 337 lambs of either Rambouillet, Hampshire, Columbia and Southdown purebred breeding or of mixed breeding resulting from the crossing of Hampshire, Dorset, Suffolk, Shropshire or Columbia rams with Delaine or Rambouillet ewes. The average live weights for the wether, ram and ewe lambs were 39.2, 42.2 and 39.9 kg, respectively. They found that carcasses from ewe lambs had  $0.58 \text{ cm}^2$  less rib eye area, about 1% more kidney fat, 0.12 cm more fat over the 12th rib and 2.25% less consumer cuts than carcasses from ram lambs. These differences were significant at the  $P < .05$  level. There were no significant differences in muscling and amounts of fat in carcasses from ram and wether lambs.

Cunningham et al. (1967) reported the carcass characteristics of 99 ram, wether and ewe lambs with carcass weights ranging from 29.5 to 54.5 kilograms. They found the carcass characteristics between rams, wethers and ewes to be quite similar with the only significant difference being in fat thickness at the 12th rib. The fat thickness for rams, ewes and wethers were 0.33, 0.46 and 0.43 cm, respectively. They also found advantages in 1. dorsi area, percent retail leg, loin, rack and shoulder and percent retail leg and loin to be in favor of ram carcasses over carcasses from wethers or ewes.

Carpenter et al. (1969) used carcasses from 276 wether, 207 ram and 202 ewe lambs to examine the effects of sex on the quantitative

characteristics of lambs. The mean carcass weights were 21.45, 20.64 and 20.91 kg for wether, ram and ewe carcasses, respectively. They found that ram lamb carcasses had 1.55 cm<sup>2</sup> more rib eye area, 0.92% more retail leg, 1.77% more retail leg, loin, rack and shoulder, 0.92% less kidney fat and were 1.4 mm trimmer over the rib eye but were about one-third of a grade lower in quality grade. There was no significant difference observed in percent loin between the ram and ewe carcasses. The direction of these differences are in agreement with work reported by Oliver et al. (1967); Cunningham et al. (1967) and Garrigus et al. (1962). Ram lambs were generally higher in the yield of preferred cuts than wether lambs and were not significantly different from wether lambs in final grade, fat over the rib eye and conformation grade.

#### Weight

The effect of increasing slaughter weight above the "traditional" 100 pounds has been a topic of major interest to researchers in lamb carcass composition studies. This increase in slaughter weight would be desirable if the weight of fat trimmed from the carcass did not increase at a faster rate in proportion to muscle weight as slaughter weight increases. Callow (1947), working with cattle, found correlations ranging from 0.91 to 0.98 between carcass weight and the weight of separable and/or chemical fat. Barton and Kirton (1958) studied the relationship between carcass weight and the different components of the carcass with particular emphasis on fat content. They used 25 six year old Romney ewes in one part of the study and 33 wether lamb carcasses that ranged in weight from 26 to 50 pounds in another part of the study. They found that in the mature ewe carcasses, separable fat

weight increased at about twice the rate of muscle weight. They also found that in the carcasses of the young lambs, separable fat weight and separable muscle weight increased at about the same rate as carcass weight increased. This would suggest that if an animal is young and growing, it can be carried to a heavier weight and still maintain a desirable fat to muscle ratio.

Lambuth et al. (1970) slaughtered 72 Hampshire cross wether lambs at weights of 36, 45 and 54 kilograms. They found that percent total fat trim increased from 15 percent to 18.92 percent between the 36 and 45 kg slaughter weights and from 18.92 percent to 25.55 percent between the 45 and 54 kg slaughter weights. L. dorsi area increased from 14.02 cm<sup>2</sup> to 15.8 cm<sup>2</sup> and from 15.8 cm<sup>2</sup> to 16.06 cm<sup>2</sup> as slaughter weight increased from 36 to 45 and from 45 to 54 kg, respectively. These increases were significant at the  $P < .01$  level. It was also noted that the leg and shoulder decreased as a percentage of carcass weight and that the loin and rack increased. They also found that as slaughter weight increased from 36 to 45 kg and from 45 to 54 kg, the corresponding increases in percent kidney and pelvic fat, dressing percent and fat over the longissimus were; 0.53% and 0.73%, 1.88% and 1.23% and 2.41 mm and 4.71 mm, respectively. Also percent total bone decreased 1.26% and 1.23% as slaughter weight increased.

Rouse et al. (1970) reported a rather detailed and comprehensive study on the carcass composition of lambs at different stages of development. Thirty Western wether lambs were slaughtered at weights of 32, 46 and 50 kg live weight. They found that bone development, expressed as a percent of carcass weight, occurred at a slower relative rate than other tissues from 32 to 50 kg slaughter weight. From 32 to

50 kg, muscle growth as a percent of carcass weight decreased. However, total grams of lean deposited between 32 and 46 kg indicate that muscle deposition had nearly doubled but only slight increases in lean tissue weight occurred between the 46 and 50 kg slaughter weights. The greatest percent composition change with increased slaughter weight was percent separable fat. These workers noted that nearly three-fourths of the bone development, one-half the lean development and one-third of the fat development had occurred before these lambs weighed 32 kilograms. Further, lean had reached its peak rate of development at 46 kg and a large portion of the gain from 46 to 50 kg was caused by fat deposition.

Thomas (1975) studied the effect of slaughter weight on carcass traits of 60 wether lambs out of various dam breed combinations of Rambouillet, Dorset and Finnsheep breeding and sired by Suffolk or Hampshire rams. One-half of the lambs were slaughtered at approximately 100 pounds and one-half at approximately 125 pounds live weight. He found that as slaughter weight increased by 25 pounds, quality grade increased about one-third of a grade, dressing percent increased 3.21%, yield grade increased from 3.35 to 4.60, percent kidney and pelvic fat increased 1.72% and rib eye area increased 0.35 in<sup>2</sup>. Percent shoulder and leg of carcass weight decreased and percent rack and loin increased as slaughter weight increased. This observation is in agreement with Lambuth et al. (1970). Thomas (1975) also noted that as slaughter weight increased from 100 to 125 pounds, percent trimmed major cuts (trimmed and boned leg and shoulder and trimmed rack and loin) as a percent of carcass weight decreased from 58.07% to 53.92%. However, when this trait was expressed as a percent of live weight, no



significant difference was observed between the two slaughter weight groups. The percent trimmed major cuts as a percent of live weight for the 100 and 125 pound lambs were 27.34% and 27.11%, respectively.

#### Sex and Weight

Field et al. (1967) reported in abstract form a study on the effects of sex and ram weight on carcass composition of lambs. Carcasses from 36 rams averaging 22 kg were compared to 49 ram carcasses averaging 32 kilograms. Both the heavy and light rams were compared to 105 ewe carcasses averaging 22 kilograms. The lambs were from Western type ewes of Rambouillet, Columbia and Corriedale breeding. Significant differences were found between similar weight rams and ewes for all traits studied. Light rams had significantly ( $P < .01$ ) larger l. dorsi areas, higher retail yields and less fat trim than ewes. Traits favoring ewes included higher dressing percentages, higher carcass quality grades and lower Warner-Bratzler shear scores. Heavy ram carcasses yielded a higher percent of retail cuts and had higher dressing percentages, carcass grades and rib eye areas than ewes.

Kemp et al. (1970) evaluated the effect of slaughter weight and castration on carcass characteristics of lambs. They used 30 rams and 30 wethers fed to slaughter weights of 36, 45 or 54 kilograms. The lambs were of Hampshire X crossbred breeding. Heavier carcasses in both sex groups were fatter, had lower yields of retail cuts and edible portion and higher yields of fat trim. The increases in fatness and decreases in retail yield and edible portion were greater in wether than in ram carcasses as carcass weight increased. The difference in dressing percent between the two sex groups increased 0.9% as slaughter

weight increased from 36 to 45 kg but decreased 1.2% as slaughter weight increased from 45 to 54 kilograms. Rib eye area increased from 13.2 cm<sup>2</sup> to 15.0 cm<sup>2</sup> and from 15.0 cm<sup>2</sup> to 16.6 cm<sup>2</sup> as slaughter weight increased from 36 to 45 kg and 45 to 54 kg, respectively. Carcass fat trim, as a percent of carcass weight, ranged from 12.52% in the 36 kg slaughter weight group to 21.47% in the 54 kg slaughter weight group. Edible portion, as a percent of carcass weight, was significantly ( $P < .01$ ) higher in the 36 kg slaughter weight group than in the 45 or 54 kg slaughter weight groups. The percent edible portion of carcass weight for the 36, 45 and 54 kg slaughter weight groups were 68.04%, 65.88% and 62.93%, respectively.

If one converted the percentages of edible portion to a live weight basis by using the dressing percentages presented in this study, the differences in percent edible portion between the slaughter weight groups become smaller. The percentages of edible portion obtained by this procedure would be approximately 32.52%, 32.54% and 31.65% for the 36, 45 and 54 kg slaughter weight groups, respectively.

Jacobs et al. (1972) examined the effects of weight and castration on lamb carcass composition. Forty-three wether lambs weighing 50 kg, 45 wethers weighing 55 kg and 50 rams weighing 68 kg were slaughtered for the study. All lambs slaughtered were of Suffolk X whiteface breeding. Carcasses from light weight wethers were trimmer than carcasses from either heavy wethers or rams and were superior in cutability to both heavy rams and wethers. Heavy ram carcasses had 0.11 kg less kidney fat, 0.71 cm<sup>2</sup> more rib eye area and 0.32 cm less fat over the rib eye than heavy wether carcasses. These differences were significant at the  $P < .05$  level. Light wether carcasses had a

significantly ( $P < .05$ ) higher percent total major cuts as a percent of their carcass weight than either heavy wethers or rams. However, the difference in percent total major cuts was greater between light and heavy wethers than between light wethers and heavy rams.

Shelton and Carpenter (1972) examined the influence of sex and slaughter weight on the carcass traits of slaughter lambs. Fifty-three male, 49 wether and 48 female lambs were slaughtered over a period of approximately one year. The lambs in each group were slaughtered at various live weights ranging from approximately 36 to 64 kilograms. The mean values for carcass traits for the sex groups were adjusted to equivalent carcass weights of 24 kilograms. They found that carcasses from male lambs were 3.6% lower in dressing percent, 1.53% lower in percent hindsaddle and had 2.21% less of their carcass weight in percent kidney fat. Further, ram carcasses had 0.33 cm less fat over the 12th rib, 3.62 kg less fat trim, 1.34 cm<sup>2</sup> more rib eye area and 2.03% more of their carcass weight in boneless cuts than did carcasses from ewe lambs. Regression analyses for the relationship of carcass weight to various carcass traits were included to indicate the rate of change in carcass traits with increases in slaughter or carcass weight. The regression coefficients found for kilograms of fat trim and fat thickness over the 12th rib were 0.1413 and 0.0302 for male lambs and 0.3133 and 0.0352 for ewe lambs, respectively. The workers noted the data indicated that female lambs deposit fat faster and earlier than male lambs and that males could be fed to heavy weights without excessive fat deposition.

### Summary of Literature Review

Available data on feed efficiency and rate of gain in relation to increases in slaughter weight tend to indicate that as slaughter weight increases, feed required per unit of gain increases. However, rate of gain does not seem to be significantly affected by increases in slaughter weight within the weight ranges studied. Data also indicate that intact males grow faster and utilize feedstuffs more efficiently than either wethers or ewes and can be fed to heavier weights more economically than either wethers or ewes.

Research on the effects of sex and weight on lamb carcass composition indicates that ram lamb carcasses are leaner, have larger rib eyes, higher percentages of bone, lower dressing percents and higher percentages of their carcass weights in trimmed retail cuts than wether or ewe lamb carcasses when slaughtered at the same weights. Available data also indicate that ram lambs can be carried to heavier weights and be comparable in retail cut yield to lighter wether and ewe carcasses.

Generally, studies have shown that when lambs from populations that have been selected to finish properly at a given weight are slaughtered at heavier weights, carcass fat yield increases and carcass lean or trimmed major cut yield, as a percent of carcass weight, decreases. However, it has been indicated in a recent study by Thomas (1975), utilizing wethers, that if expressed as a percent of live weight, carcass lean or trimmed major cut yield does not decrease appreciably as slaughter weight increases from 100 to 125 pounds.

## CHAPTER III

### MATERIALS AND METHODS

#### Live Animal Procedure

This study involved the feedlot performance and carcass data of 40 ram lambs and 40 ewe lambs born in October-November, 1975 (Season I) and June-July, 1976 (Season II) at the Southwestern Livestock and Forage Research Station, El Reno, Oklahoma. The lambs were a sample of ram and ewe lambs produced by mating Hampshire, Suffolk, Hampshire X Suffolk and Suffolk X Hampshire rams to a flock of crossbred ewes consisting of various levels of Rambouillet, Dorset and Finnsheep breeding. In each season, feed efficiency data was determined for twenty ram lambs and twenty ewe lambs fed from 70 to 100 pounds. After reaching this 100 pound live weight, one-half of the ram lambs and one-half of the ewe lambs were slaughtered and carcass data obtained. The remaining half of the rams and ewes were fed from 100 pounds live weight to a 125 pound slaughter weight with feed efficiency data determined for this feeding interval and carcass data obtained at this 125 pound slaughter weight. Table I presents the number of ram and ewe lambs slaughtered each season and at each weight.

The handling of the lambs from birth to selection for this study was not unlike that described by Thomas (1975). The lambs were born in small pastures of a large, enclosed lambing barn. They were weighed,

identified with a metal ear tag and placed in an individual pen along with their dams shortly after birth. Docking was done at approximately three days of age. At about five days of age, the lambs were released from the individual pens and allowed access to a large paddock with other lambs and dams. After reaching two weeks of age, the lambs were moved with their dams to a feeding barn that allowed access to winter wheat pasture for the lambs born in the October-November, 1975 lambing season and to an alfalfa pasture for the lambs born in the June-July, 1976 lambing season. The "starter" creep ration was fed in ground form and was composed of 50 percent milo, 35 percent alfalfa, 10 percent soybean oil meal and 5 percent molasses.

TABLE I  
DISTRIBUTION OF LAMBS BY SEASON,  
SEX AND SLAUGHTER WEIGHT

Season		I <sup>a</sup>		II <sup>b</sup>		
Slaughter Wt. (lb.)		100	125	100	125	Combined
Sex	Ram	10	10	10	10	40
	Ewe	10	10	10	10	40
Combined		20	20	20	20	80

<sup>a</sup>October-November, 1975 lambing season.

<sup>b</sup>June-July, 1976 lambing season.

Prior to the oldest lambs reaching 66 days of age, all lambs were placed on a bi-weekly weighing schedule. Lambs were weighed full. Any lamb 63 days of age or older at the time of weighing was weaned regardless of his weight or condition. The lambs were weaned by removing the dams to a distant pasture and leaving the lambs in the feeding barn and lot. This is a common management practice for the experimental flock at the Ft. Reno experiment station which places minimum stress on the newly weaned lambs by leaving them in familiar surroundings. When all lambs were weaned, they were placed in drylot and fed a ration similar to the creep ration but with the soybean oil meal deleted and the alfalfa increased by 10 percent.

When 10 ram lambs or 10 ewe lambs were found such that the average weight of the group of ten lambs was approximately 70 pounds (each individual weight being as close to 70 pounds as possible), the ten lambs were transferred to a nearby feeding barn and placed in one of four feeding pens. The range in ages of the lambs in each pen was kept as narrow as possible. Table II presents the average age (in days) of the lambs at the beginning of the feeding period for each season and each pen of 10 lambs. Table III presents the means for the actual slaughter weights of the rams and ewes in each season and for each slaughter weight group.

Two pens of 10 ram lambs per pen and two pens of 10 ewe lambs per pen were selected in each of the two seasons. All lambs, over the two seasons, were fed a ration (ad libitum) of approximately 50 percent milo, 45 percent alfalfa and 5 percent molasses. The ration was fed in ground form. The feed added to the lamb feeder in each pen was weighed and recorded during the feeding period. At the end of the

TABLE II  
AGE MEANS AND STANDARD DEVIATIONS  
OF THE LAMBS AT SELECTION  
BY SEASON, PEN AND SEX

Season		I <sup>a</sup>		II <sup>b</sup>		Pooled S.D.
Pen		1	2	1	2	
Sex	Rams	80.3	82.2	84.8	86.5	7.37
	Ewes	86.2	95.2	83.7	97.7	9.46

<sup>a</sup>October-November, 1975 lambing season

<sup>b</sup>June-July, 1976 lambing season



TABLE III

MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES FOR  
 ACTUAL SLAUGHTER WEIGHT OF THE RAM AND EWE LAMBS  
 SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	Season II		$\bar{d} \pm S_{\bar{d}}$
		Approx. Live Wt.			Approx. Live Wt.		
		100 lbs.	125 lbs.		100 lbs.	125 lbs.	
Actual Slaughter Weight (lbs.)	Rams	101.8	126.1	24.3 $\pm$ 1.41	99.3	123.5	24.2 $\pm$ 1.41
	Ewes	100.6	128.0	27.4 $\pm$ 1.41	101.2	126.6	25.4 $\pm$ 1.41

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

period, the feed remaining in the feeder was re-weighed. The pounds of feed consumed by the lambs in a pen during a feeding period was equal to the total pounds of feed added minus the pounds of feed re-weighed at the end of the period.

During the early part of the feeding period, individual weights were obtained weekly. When the average weight of the ten lambs neared 100 pounds, individual weights were obtained twice weekly so that an average weight as close to 100 pounds as possible could be attained. Lambs were weighed on the same day(s) of the week and at approximately the same time of the early morning to "catch" the lambs at about the same fill each weigh day. When the 100 pound average weight was reached, all lambs in the pen were shorn and their fleeces weighed. The lambs were shorn for two reasons: 1) a more hygienic job of slaughter could be accomplished with shorn lambs and 2) it was thought that the lambs fed to 125 pounds would tend to gain better during hot weather if they were shorn.

After shearing, a stratified sample of 5 lambs from the pen was selected for slaughter at the 100 pound live weight. These five lambs were then trucked to the O.S.U. Meat Laboratory at Stillwater (a distance of about 97 miles), held overnight without feed or water and slaughtered the next day.

After the sample of five lambs was taken from the pen, the remaining five lambs were put back in the pen and fed in the same manner as before. When the average of their individual weights (plus the pounds of wool that each individual produced when shorn at 100 pounds) reached 125 pounds, they too were shipped to the O.S.U. Meat Laboratory for slaughter.

Since individual lamb feed efficiencies were not measured, the pounds of feed required per pound of live weight gain was determined from the total pounds of feed consumed by the lambs in a pen. This procedure, carried out over two seasons, generated 4 feed efficiency values for ram lambs fed from 70 to 100 pounds, 4 for ram lambs fed from 100 to 125 pounds, 4 for ewe lambs fed from 70 to 100 pounds and 4 for ewe lambs fed from 100 to 125 pounds.

#### Slaughter and Carcass Procedure

All lambs were slaughtered at the O.S.U. Meats Laboratory approximately 24 hours after being "weighed off" at the Ft. Reno Livestock Research Station. Slaughter and carcass cutting procedures were very similar to those described by Munson (1966) and Thomas (1975). At the time of slaughter the thymus glands, right and left crura of the diaphragm (hanging tenderloin) and the spleen were removed. The sternum was split and pork carcass flank spreaders were inserted to hold the ventral midline cut open. In order to insure that all kidney fat remained with the hindsaddle, it was pinned posterior to the 13th rib using beef shroud pins. Pelt and hot carcass weights were recorded and the carcass was shrouded with a double layer of cheese cloth.

The carcass was allowed to chill for 24 hours in a 34 to 38 degree Fahrenheit cooler, after which time the cheese cloth was removed and the carcass was quality graded. Maturity, conformation, rib feathering, flank streaking and flank fullness and firmness were visually estimated and a final quality grade estimated to the nearest one-third of a U.S.D.A. grade. Leg conformation scores were also estimated to the nearest one-third of a U.S.D.A. grade. The grades were expressed on

the following numerical scale to facilitate statistical analysis:

high prime	15	average choice	11
average prime	14	low choice	10
low prime	13	high good	9
high choice	12	average good	8

After visual estimates were made, the carcasses were wrapped in a double layer of beef shrouds to reduce dehydration of the carcass before it was cut.

The depth of fat over the second sacral vertebra (rump fat depth) was estimated by probing directly over the dorsal vertebral process, approximately three inches anterior to the base of the tail. This probing was done with a steel swine backfat probe on the intact carcass.

The chilled carcasses were weighed to the nearest five hundredths of a pound. A slight knife cut (scoring) was made on the right side of the carcass from the point of the patella to the junction of the humerus and radius. This scoring facilitated the removal of the flank, breast and fore shank at a later time. The carcasses were divided into fore- and hind-saddles between the 12th and 13th ribs by making a cut perpendicular to the line of the back with a rotating band saw and therefore across the ventral tips of the 11th and 12th ribs. Depth of fat over the bodywall was measured at the cut surface of the 11th rib approximately two inches ventral to the lateral edge of the rib eye.

The foresaddle was separated between the 5th and 6th ribs by making a cut perpendicular to the line of the back with a rotating band saw. This resulted in a "rach section" and a "shoulder section" of the foresaddle. The area of the right half of the exposed sixth

rib surface of the "rack section" was traced onto transparent acetate paper. All bone surfaces and muscle systems exposed were outlined on the acetate paper. The area of exposed bone and muscle were measured by using a compensating polar planimeter. The fat area in this surface was determined by subtracting the combined areas of bone and muscle from the total area of the right half of the sixth rib section.

The area of the longissimus dorsi muscle and fat cover over the 1. dorsi were traced onto transparent acetate paper. Fat thickness over the 1. dorsi was the average of three fat measurements taken over each 1. dorsi muscle. The area of the 1. dorsi was measured by using a compensating polar planimeter and averaging the values obtained for the left and right sides of the carcass.

The neck was removed from the shoulder by cutting along a line parallel to the angle of the scapula and was split into a left and right half using a rotating band saw. All kidney and pelvic fat including the kidneys was removed and weighed. Both the fore- and hind-saddles were split into right and left sides with a rotating band saw. The fore (metacarpel) and rear (metatarsal) cannon bones of the right side were removed, trimmed of soft tissue and weighed on a gram balance.

After the whole carcass was split into a left and right half, all trimming, boning and compositional weighing was done on the right half. Each half of the carcass was weighed and recorded. The remaining parts of the left side were left untouched for future processing and sales.

The flank from the right side was removed from the hind-saddle by a cut which started in the crotch and proceeded out to and along the scored line previously mentioned. The fore shank and posterior and

anterior halves of the breast were removed from the foresaddle along the scored line. Separation of the shank from the breast was at the natural seam. The rack and shoulder had previously been separated between the 5th and 6th ribs. This produced a seven rib rack. The cutting procedure used in this study produced a slightly larger loin and rack than the customary cutting procedure described by Kemp (1952) that has been used by most researchers in lamb carcass composition. A riblet from the rack and a flank portion from the loin were removed to produce a rack and loin more comparable in size to those produced by the customary procedure. The method used for determining the point of separation of the riblet from the rack and the flank portion from the loin is very similar to the method described by Orts (1962) for separating the plate from the wholesale rib in beef. In this study, 55 percent of the distance from a point just ventral to the posterior rib facet on the body of the 12th thoracic vertebra, to the dorsal edge of the visible costal cartilage was used as a standard for determining the point of separation of the riblet from the rack. After this distance was determined, a slight knife cut (score) was made on the inner circumference of the rack running parallel to the length of the spinal cord. The riblet was then separated from the rack by cutting along this "scored" line with a rotating band saw.

The same distance determined for the point of separation of the riblet from the rack was used for separating the flank portion from the loin. This distance was marked on the inner circumference of the loin with a knife cut. The flank portion was then removed by cutting along a line from the knife cut to the point of the patella.

The leg was separated from the loin between the second and third sacral vertebrae with the cut being made perpendicular to the line of the back. As a result, the sirloin area was included with the loin.

The combined weight of the rack plus riblet was recorded as the "full rack" weight whereas the weight of the rack minus the riblet was recorded as the "retail rack" weight. The weights of the loin and flank portion of the loin were recorded in the same manner.

The flank, shank, breast and neck of the right side were handled similarly. The flank was dissected into separable lean and fat and the shank, breast and neck were dissected into separable lean, fat and bone.

The major cuts of the right side (shoulder, full rack, retail rack, full loin, retail loin and leg) were trimmed in such a manner that an average of approximately 0.2 inches of subcutaneous fat remained on each cut. The cuts were then weighed and the weight of each cut was recorded as the "retail trimmed weight". Following the "retail" trim, the major cuts were trimmed of all subcutaneous fat and the weight of each cut was recorded as the "closely trimmed weight." The shoulder and leg were then dissected into separable lean, fat and bone and the weight of the lean trim was recorded as the "closely trimmed and boned weight".

Percent major cuts of carcass weight is equal to the total weight of the four major cuts (shoulder, full rack, full loin and leg) of the right side divided by the right half carcass weight.

Percent rough cuts of carcass weight is equal to the total weight of the four rough cuts (fore shank, breast, flank and neck) of the right side divided by the right half carcass weight.

Percent closely trimmed major cuts of carcass weight is equal to the total weight of the closely trimmed and boned leg and shoulder plus the closely trimmed full rack and full loin of the right side divided by the right half carcass weight.

Percent rough cut lean of carcass weight is equal to the total weight of the separable lean from the fore shank, breast, flank and neck of the right side divided by the right half carcass weight.

Percent major cuts of live weight is equal to twice the total weight of the four major cuts from the right side divided by the actual slaughter weight which was the final live weight recorded at the Ft. Reno station.

Percent rough cuts of live weight is equal to twice the total weight of the four rough cuts divided by the actual slaughter weight.

Percent closely trimmed major cuts of live weight is equal to twice the total weight of the closely trimmed and boned leg and shoulder plus the closely trimmed full rack and full loin divided by the actual slaughter weight.

Percent rough cut lean of live weight is equal to twice the total weight of the separable lean from the four rough cuts divided by the actual slaughter weight.

Percent major cut fat of carcass weight is equal to the total weight of the fat trimmed from the closely trimmed and boned leg and shoulder and the closely trimmed full rack and full loin from the right side divided by the right half carcass weight.

Percent rough cut fat of carcass weight is equal to the total weight of the separable fat from the four rough cuts of the right side divided by the right half carcass weight.



Percent shoulder bone of carcass weight is equal to the total weight of the bone from the right shoulder divided by the right half carcass weight.

Percent leg bone of carcass weight is equal to the total weight of the bone from the right leg divided by the right half carcass weight.

#### Statistical Analysis

Feed efficiency data were analyzed by the paired comparison method described by Steel and Torrie (1960) section 5.6. Carcass data were arranged in a split-plot design as described in Steel and Torrie (1960) sections 12.2 and 12.3. Means, standard errors and analyses of variance of all carcass data were computed using the computer program entitled Statistical Analysis System (SAS '72) developed by Barr and Goodnight (1972). The general Analysis of Variance table used for each trait studied along with the associated degrees of freedom is given in Table IV.

One ewe lamb from the first season, second pen and the 125 pound slaughter weight group prolapsed and was eliminated from the study. In order for the data to be balanced and complete, all values for this missing lamb were estimated by using the mean value of the remaining four lambs in that particular season, pen and slaughter weight group. The estimated values were treated as normal data. However, the total degrees of freedom and lambs within season, sex, pen and slaughter weight degrees of freedom were reduced by one.

TABLE IV  
ANALYSIS OF VARIANCE FOR CARCASS DATA

Source	d.f.
Season	1
Sex	1
Season x Sex	1
Pen (in Season and Sex) <sup>a</sup>	4
Slaughter Weight	1
Season x Sl. Wt.	1
Season x Sex x Sl. Wt.	1
Pen x Sl. Wt. (in Season and Sex) <sup>b</sup>	4
Lambs (in Season, Sex, Pen and Sl. Wt.)	63
Total	78

<sup>a</sup>Error (a)

<sup>b</sup>Error (b)

## CHAPTER IV

### RESULTS AND DISCUSSION

This chapter is divided into two main sections: 1) Feed efficiency of ram and ewe lambs fed for two weight gain intervals and 2) Carcass characteristics of ram and ewe lambs slaughtered at two live weights.

#### Feed Efficiency of Ram and Ewe Lambs Fed For Two Weight Gain Intervals

The literature review has cited several studies that have shown that as slaughter weight increases above 100 pounds, feed required per unit of gain increases. The purpose of this section is to determine how much more feed per pound of gain is required by ram and ewe lambs fed from 100 to 125 pounds live weight than is required by ram and ewe lambs fed from 70 to 100 pounds live weight. The results discussed in this section apply to lambs sired by blackfaced sires and raised under similar conditions.

Table V presents the mean values for average daily gain, daily feed intake and feed/gain ratios for the ram and ewe lambs in each weight gain interval and averaged over the two seasons.

Orskov et al. (1971), Orskov et al. (1973) and Shelton and Carpenter (1972) observed that as live weight increased, average daily gain was not significantly affected. However, in this study average

TABLE V  
MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES  
FOR AVERAGE DAILY GAIN, DAILY FEED INTAKE  
AND FEED/GAIN OF RAM AND EWE LAMBS FED  
FOR TWO WEIGHT GAIN INTERVALS<sup>ab</sup>

Growth Trait	Sex	Weight Gain Interval (lbs)		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		70-100	100-125		
Average Daily Gain (lbs)	Rams	0.82	0.73	0.09 $\pm$ 0.044	P < .050
	Ewes	0.61	0.49	0.12 $\pm$ 0.026	P < .005
Daily Feed Intake (lbs)	Rams	4.35	5.31	0.96 $\pm$ 0.190	P < .005
	Ewes	3.93	4.20	0.27 $\pm$ 0.098	P < .025
Feed/Gain	Rams	5.35	7.29	1.94 $\pm$ 0.256	P < .001
	Ewes	6.47	8.67	2.20 $\pm$ 0.477	P < .005

<sup>a</sup>n=4 pens per sex at each weight gain interval.

<sup>b</sup>Data from Seasons I and II combined.

daily gain decreased significantly for both ram and ewe lambs fed from 100 to 125 pounds as compared to ram and ewe lambs fed from 70 to 100 pounds. Heavier ram lambs gained  $0.09 \pm 0.044$  ( $P < .05$ ) pounds per day less than rams fed from 70 to 100 pounds. Heavier ewe lambs gained  $0.12 \pm 0.026$  ( $P < .005$ ) pounds per day less than lighter ewe lambs. The rams and ewes in this study did not differ significantly ( $P > .3$ ) in their decreases in average daily gain as live weight increased above 100 pounds. This finding is similar to those of Orskov et al. (1971) and Orskov et al. (1973) who also found that as live weight increased from 35 to 55 kg, ram and ewe lambs did not differ significantly in their rate of decrease in average daily gain.

Daily feed intake by the ram lambs fed from 100 to 125 pounds was  $0.96 \pm 0.19$  ( $P < .005$ ) pounds greater than that of the rams fed from 70 to 100 pounds. This increase in daily feed intake by the heavier ram lambs was over three times greater than the increase of  $0.27 \pm 0.098$  ( $P < .025$ ) pounds achieved by the heavier ewe lambs.

Since the heavier rams and ewes had lower average daily gains and greater daily feed intakes, it would be expected that the feed/gain values, or pounds of feed required per pound of gain, would be greater than those for the lighter rams and ewes. This was in fact the case and was similar to the findings of Orskov et al. (1971), Orskov et al. (1973) and Shelton and Carpenter (1972). The ram lambs fed from 100 to 125 pounds required  $1.94 \pm 0.256$  ( $P < .001$ ) pounds more feed per pound of gain than rams fed from 70 to 100 pounds; whereas, the heavier ewe lambs required  $2.20 \pm 0.477$  ( $P < .005$ ) pounds more feed per pound of gain than the lighter ewes. The feed/gain data in Table IV also indicates that the heavier ram and ewe lambs in this study did not differ

significantly in their respective increases in pounds of feed required per pound of gain. This finding is similar to those of Orskov et al. (1971) and Orskov et al. (1973) and agrees with the direction of the difference in rate of increase in feed required per unit of gain between rams and ewes found in a study by Shelton and Carpenter (1972).

The data presented in Table V indicate that ram lambs can be fed to heavier than 100 pound weights without an appreciable decrease in rate of gain or feed efficiency and that ram lambs of this type can be fed to heavier weights faster and more efficiently than ewe lambs of a similar type. The data also suggest that after reaching 100 pounds live weight, one of the major limiting factors in the gaining ability of the ewe lambs in this study was feed intake.

#### Carcass Traits of Ram and Ewe Lambs

##### Slaughtered at Two Live Weights

The purpose of this section is to report how much difference can be expected in some economically important carcass traits of blackface sired ram and ewe lambs slaughtered at 100 and 125 pounds live weight. The literature review has cited a number of studies that have shown that as slaughter weight increases above 100 pounds, loin eye areas increase, yield of trimmed major cuts (edible portion) as a percent of the carcass decreases, carcass fat deposition increases and percent carcass bone decreases. However, few if any of these studies report an expected level of increase or decrease in these carcass traits.

Table VI presents the means, differences and standard errors of differences for some carcass lean characteristics as a percent of carcass weight of the light and heavy rams and ewes. Rib eye areas of

TABLE VI  
MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES FOR  
SOME CARCASS LEAN CHARACTERISTICS AS A PERCENT  
OF CARCASS WEIGHT OF RAM AND EWE LAMBS  
SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

Carcass Traits	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level	Season II		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		Approx. Live Wt.				Approx. Live Wt.			
		100 lbs.	125 lbs.			100 lbs.	125 lbs.		
Rib Eye Area (in <sup>2</sup> ) <sup>b</sup>	Rams	2.03	2.54	0.51 $\pm$ 0.04	P < .001	2.20	2.43	0.23 $\pm$ 0.04	P < .010
	Ewes	2.20	2.39	0.19 $\pm$ 0.04	P < .010	2.10	2.52	0.42 $\pm$ 0.04	P < .001
% Major Cuts	Rams	77.29	78.48	1.19 $\pm$ 0.56	P > .100	79.16	79.99	0.83 $\pm$ 0.56	P > .200
	Ewes	79.33	79.61	0.28 $\pm$ 0.56	P > .500	79.55	80.34	0.79 $\pm$ 0.56	P > .200
% Closely Tr. Major Cuts	Rams	56.11	54.38	1.73 $\pm$ 1.12	P > .100	55.55	52.74	2.81 $\pm$ 1.12	P < .100
	Ewes	53.01	49.22	3.79 $\pm$ 1.12	P < .050	50.72	50.16	0.56 $\pm$ 1.12	P > .500
% Rough Cuts	Rams	21.16	20.68	0.48 $\pm$ 0.40	P > .200	20.48	19.74	0.74 $\pm$ 0.40	P > .100
	Ewes	20.27	20.50	0.23 $\pm$ 0.40	P > .500	19.02	18.64	0.36 $\pm$ 0.40	P > .400
% Rough Cut Lean	Rams	9.74	8.99	0.75 $\pm$ 0.68	P > .300	9.57	8.34	1.23 $\pm$ 0.68	P > .100
	Ewes	8.69	7.97	0.72 $\pm$ 0.68	P > .300	7.57	7.25	0.32 $\pm$ 0.68	P > .500

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

<sup>b</sup>P < .05 for season by sex by slaughter weight interaction.

both the ram and ewe carcasses increased as live weight increased in both seasons. Heavy ram carcasses had  $0.51 \pm 0.04$  ( $P < .001$ ) square inches of rib eye more than light ram carcasses in Season I but only  $0.23 \pm 0.04$  ( $P < .01$ ) square inches more in Season II. Heavy ewe carcasses had  $0.19 \pm 0.04$  ( $P < .01$ ) square inches of rib eye more than light ewe carcasses in Season I; whereas, in Season II, the heavy ewe carcasses had  $0.42 \pm 0.04$  ( $P < .001$ ) square inches more rib eye. The analysis of variance for the variable rib eye area indicated a significant ( $P < .05$ ) season by sex by slaughter weight interaction. The mean difference in rib eye area between the light and heavy ram lambs was greater than the mean difference between the light and heavy ewe lambs in Season I. However, in Season II, the results were reversed. The mean difference in rib eye area between the light and heavy ram lambs was less than the mean difference between the light and heavy ewe lambs. The inconsistencies here were probably due to sample differences between the two seasons and thus chance variation. Although the magnitude of the difference in rib eye area between light and heavy ram and ewe carcasses is not clear, the data here indicate that a significant and rather large increase in rib eye area can be obtained in lambs of this type merely by increasing live weight by 25 pounds. Increasing rib eye areas in lambs is of economic importance to the sheep industry to gain increased consumer acceptance of the higher priced loin and rib chops.

Percent major cuts of carcass weight of the ram and ewe carcasses tended to increase as slaughter weight increased, although not significantly. Heavy ram carcasses had  $1.19 \pm 0.56$  percent and  $0.86 \pm 0.56$  percent more weight of their carcasses in major cuts than the light



ram carcasses in Seasons I and II, respectively. Heavy ewe carcasses in Season I had  $0.28 \pm 0.56$  percent more weight in major cuts than the lighter ewe carcasses and in Season II, the heavier ewe carcasses had  $0.79 \pm 0.56$  percent more weight in major cuts than lighter ewe carcasses. These increases were generally very small and disagree with previous studies which found that as live weight increased, percent major cuts decreased. This disagreement may be due in part to the fact that the cutting procedure used in this study produced a slightly larger rack and loin than the procedure described by Kemp (1952) used in other studies.

Percent closely trimmed major cuts of carcass weight decreased as live weight increased. Heavy ram carcasses had  $1.73 \pm 1.12$  ( $P > .1$ ) percent and  $2.81 \pm 1.12$  ( $P < .1$ ) percent less weight in closely trimmed major cuts than lighter ram carcasses in Seasons I and II, respectively. Heavy ewe carcasses in Season I had  $3.79 \pm 1.12$  ( $P < .05$ ) percent less weight in closely trimmed major cuts; whereas, in Season II heavy ewe carcasses had only  $0.56 \pm 1.12$  ( $P > .5$ ) percent less weight in closely trimmed major cuts. This difference of  $0.56 \pm 1.12$  percent in percent closely trimmed major cuts between the light and heavy ewe carcasses in Season II is not what would be expected for ewe lambs of this type. This disagrees greatly with previous studies on the compositional changes of ewe carcasses as live weight increases which have found that percent closely trimmed major cuts decreases significantly in ewe carcasses as live weight increases. This disagreement may be due to inconsistency in trimming the cuts or the light ewe carcasses in Season II were abnormally fat or the heavy ewe carcasses in Season II were abnormally lean and thus resulting in a bad sample. Discussion of

the remaining data in this study may indicate which of these is most probable.

Percent rough cuts decreased slightly in the heavy ram carcasses in both seasons and in the heavy ewe carcasses in Season II but increased in the heavy ewe carcasses in Season I. However, none of the increases or decreases in percent rough cuts were significant. Percent rough cut lean of carcass weight also tended to decrease as live weight of the rams and ewes increased. The heavy ram carcasses had  $0.75 \pm 0.68$  ( $P > .3$ ) and  $1.23 \pm 0.68$  ( $P > .1$ ) percent less weight in rough cut lean than lighter ram carcasses in Seasons I and II, respectively. The heavy ewe carcasses had  $0.72 \pm 0.68$  ( $P > .3$ ) and  $0.32 \pm 0.68$  ( $P > .5$ ) percent less weight in rough cut lean than lighter ewe carcasses in Seasons I and II, respectively.

It has been indirectly indicated in the literature review and in Table VI that at heavier weights a larger portion of the increase in carcass weight is fatty tissue rather than muscle tissue or bone. Therefore, heavier lambs may have a lower yield of closely trimmed major cuts as a percent of carcass weight (Table VI) and as a result are sometimes discounted in price paid per pound of live weight. However, a study by Thomas (1975), utilizing wethers, indicates that heavy and light lambs sired by blackfaced sires yielded similar proportions of their live weights in closely trimmed major cuts and that payment of lower prices by packers for lambs in excess of 100 pounds live weight is not always warranted. This finding was based on carcasses from 100 and 125 pound live weight wether lambs. It should be of economic interest to lamb producers to know if this same conclusion can be applied to light and heavy ram and ewe lambs. Table VII

presents the means and standard errors of differences for some carcass lean characteristics as a percent of live weight of the light and heavy ram and ewe lambs.

Heavy ram lambs had  $2.24 \pm 0.68$  ( $P < .05$ ) and  $1.55 \pm 0.68$  ( $P < .1$ ) percent more of their live weights in major cuts than did the lighter ram lambs in both Seasons I and II, respectively. Heavy ewe lambs were  $0.75 \pm 0.68$  ( $P > .3$ ) and  $2.10 \pm 0.68$  ( $P < .05$ ) percent greater in percent major cuts of live weight in Seasons I and II, respectively. Percent closely trimmed major cuts of live weight was  $0.42 \pm 0.59$  ( $P > .5$ ) percent greater in the heavy ram lambs of Season I but was  $0.46 \pm 0.59$  ( $P > .4$ ) percent lower in the heavy ram lambs of Season II. Heavy ewe lambs in Season I had  $1.46 \pm 0.59$  ( $P < .1$ ) percent less closely trimmed major cuts as a percent of live weight than the lighter ewe lambs; whereas, the heavy ewe lambs in Season II had  $0.86 \pm 0.59$  ( $P > .2$ ) percent more closely trimmed major cuts than the lighter ewe lambs. The data in Table VII suggests strongly that there is little or no difference in percent rough cuts or rough cut lean, as a percent of live weight, between the light and heavy ram and ewe lambs.

The data in Table VII indicate that blackface sired ram lambs slaughtered at approximately 100 and 125 pounds live weight will yield similar proportions of their respective live weights in closely trimmed major cuts and rough cut lean. It is unclear from the data in Table VII as to whether this same conclusions can be applied to blackface sired ewe lambs since in Season I, the heavy ewe lambs yielded a much lower ( $1.46 \pm 0.59$ ) percentage of closely trimmed major cuts than did the lighter ewe lambs; whereas, in Season II, the heavy ewes yielded  $0.86 \pm 0.59$  percent more weight in closely trimmed major cuts. This

TABLE VII

MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES  
FOR SOME CARCASS LEAN CHARACTERISTICS AS A PERCENT  
OF LIVE WEIGHT OF RAM AND EWE LAMBS  
SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

Carcass Trait	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level	Season II		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		Approx. Live Wt.				Approx. Live Wt.			
		100 lbs.	125 lbs.			100 lbs.	125 lbs.		
% Major Cuts	Rams	33.90	36.14	2.24 $\pm$ 0.68	P < .050	35.16	36.71	1.55 $\pm$ 0.68	P < .100
	Ewes	37.86	38.61	0.75 $\pm$ 0.68	P > .300	37.80	39.90	2.10 $\pm$ 0.68	P < .050
% Closely Tr. <del>Major Cuts</del> <sup>b</sup>	Rams	24.61	25.03	0.42 $\pm$ 0.59	P > .500	24.67	24.21	0.46 $\pm$ 0.59	P > .400
	Ewes	25.29	23.83	1.46 $\pm$ 0.59	P < .100	24.10	24.96	0.86 $\pm$ 0.59	P > .200
% Rough Cuts	Rams	9.26	9.53	0.27 $\pm$ 0.30	P > .400	9.10	9.05	0.05 $\pm$ 0.30	P > .500
	Ewes	9.67	0.04	0.27 $\pm$ 0.30	P > .400	9.04	9.27	0.23 $\pm$ 0.30	P > .400
% Rough Cut Lean	Rams	4.26	4.13	0.13 $\pm$ 0.33	P > .500	4.26	3.83	0.43 $\pm$ 0.33	P > .200
	Ewes	4.14	3.86	0.38 $\pm$ 0.33	P > .400	3.59	3.60	0.01 $\pm$ 0.33	P > .500

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

<sup>b</sup>P < .10 for season by sex by slaughter weight interaction.

finding, in the case of the ram lambs, agrees closely with that of Thomas (1975) who found that blackface sired wether lambs slaughtered at approximately 100 and 125 pounds live weight yielded similar proportions of their respective live weights in closely trimmed major cuts.

This finding should be of economic interest to some of the nation's larger lamb packers who have begun to break lamb carcasses and trim and vacuum package the major cuts in their own plants. But even more importantly, it should be of economic and managerial importance to the nation's lamb producers who have frequently been discounted in price payments for producing lambs heavier than 100 pounds. If packers determine what they can pay for live lambs by multiplying the price they can get for carcasses by an expected dressing percentage, then with the knowledge that heavier lambs generally have higher dressing percentages and that heavy ram lambs of this type yield a similar proportion of their live weights in closely trimmed major cuts as lighter ram lambs, payment of lower prices for these heavier lambs may not be warranted.

Table VIII presents the means, differences and standard errors of differences for some carcass fat characteristics of the light and heavy ram and ewe lambs. The mean values for all traits listed in Table VIII indicate trends that were expected in that as live weight increased from 100 to 125 pounds live weight, carcass fat indices also increased.

Mean quality grades were  $0.40 \pm 0.38$  ( $P > .3$ ) and  $0.70 \pm 0.38$  ( $P > .1$ ) higher in the heavier ram lambs in Seasons I and II, respectively. Heavy ewe lambs in Season I were one-third of a grade ( $P < .1$ ) higher in quality grade than the lighter ewe lambs and in Season II, the heavier ewe lambs were one-half of a quality grade ( $P < .02$ ) higher

TABLE VIII  
MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES FOR  
SOME CARCASS FAT CHARACTERISTICS OF RAM AND EWE LAMBS  
SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

Carcass Trait	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level	Season II		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		Approx. Live Wt.				Approx. Live Wt.			
		100 lbs.	125 lbs.			100 lbs.	125 lbs.		
Quality Grade <sup>b</sup>	Rams	11.40	11.80	0.40 $\pm$ 0.38	P >.300	11.50	12.20	0.70 $\pm$ 0.38	P >.100
	Ewes	12.40	13.40	1.00 $\pm$ 0.38	P <.100	11.90	13.40	1.50 $\pm$ 0.38	P <.020
% Kidney and Pelvic Fat	Rams	2.73	3.35	0.62 $\pm$ 0.54	P >.300	3.12	4.30	1.18 $\pm$ 0.54	P <.100
	Ewes	3.92	5.31	1.39 $\pm$ 0.54	P <.100	4.95	5.93	0.98 $\pm$ 0.54	P >.100
12th Rib Fat <sup>c</sup> Thickness (in.)	Rams	0.15	0.24	0.09 $\pm$ 0.01	P <.001	0.19	0.26	0.07 $\pm$ 0.01	P <.010
	Ewes	0.31	0.49	0.18 $\pm$ 0.01	P <.001	0.32	0.38	0.06 $\pm$ 0.01	P <.010
Yield Grade <sup>c</sup>	Rams	2.79	3.53	0.74 $\pm$ 0.16	P <.010	3.16	3.84	0.68 $\pm$ 0.16	P <.020
	Ewes	4.11	5.63	1.52 $\pm$ 0.16	P <.001	4.48	5.05	0.57 $\pm$ 0.16	P <.050
Dressing Percent	Rams	47.80	51.06	3.26 $\pm$ 0.94	P <.050	49.29	52.81	3.52 $\pm$ 0.94	P <.050
	Ewes	52.29	53.76	1.47 $\pm$ 0.94	P >.100	54.40	55.30	0.90 $\pm$ 0.94	P >.300

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

<sup>b</sup>11=Avg. Choice, 12=High Choice, 13=Low Prime.

<sup>c</sup>P <.10 for season by sex by slaughter weight interaction.

than the lighter ewe lambs. However, all the carcasses were graded either Choice or Prime, so the higher grade of the heavier carcasses was of no economic advantage. Percent kidney and pelvic fat increased  $0.62 \pm 0.54$  ( $P > .3$ ) and  $1.18 \pm 0.54$  ( $P < .1$ ) percent in the ram carcasses as slaughter weight increased from 100 to 125 pounds live weight in Seasons I and II, respectively. Heavier ewe lambs in Season I had  $1.39 \pm 0.54$  ( $P < .1$ ) percent more weight in kidney and pelvic fat; whereas, in Season II, the heavier ewe lambs had  $0.98 \pm 0.54$  ( $P > .1$ ) percent more weight in kidney and pelvic fat.

The analysis of variance for 12th rib fat thickness and yield grade indicated a significant ( $P < .10$ ) season by sex by slaughter weight interaction. In Season I, 12th rib fat measurements were greater for ewes than for rams in the light weight group and the differences were greater at the heavier weight. In Season II, however, the differences in 12th rib fat between rams and ewes in the light weight group were very similar to the differences between rams and ewes in the heavy weight group. Since 12th rib fat thickness is the major factor in determining yield grades of lamb carcasses, it is easily seen why the interaction is present in the means for yield grades.

Heavy ram lambs (in Season I and II, respectively) had  $0.09 \pm 0.01$  ( $P < .001$ ) and  $0.07 \pm 0.01$  ( $P < .01$ ) inches more fat over the 12th rib than did the lighter rams. Heavy ewe lambs in Season I had  $0.18 \pm 0.01$  ( $P < .001$ ) inches more fat over the 12th rib than the lighter ewes but were only  $0.06 \pm 0.01$  ( $P < .01$ ) inches fatter at the 12th rib in Season II. Yield grade means were  $0.74 \pm 0.16$  ( $P < .01$ ) and  $0.68 \pm 0.16$  ( $P < .02$ ) greater for the heavier ram carcasses in Seasons I and II, respectively and were  $1.52 \pm 0.16$  ( $P < .001$ ) and  $0.57 \pm 0.16$  ( $P < .05$ )

greater for the heavier ewe carcasses in Seasons I and II, respectively.

Heavy ram lambs in Season I had  $3.26 \pm 0.91$  ( $P < .05$ ) percent higher dressing percentages than the lighter ram lambs and in Season II the heavier rams were  $3.52 \pm 0.94$  ( $P < .05$ ) percent higher in dressing percent. In Seasons I and II, heavier ewe lambs had  $1.47 \pm 0.94$  ( $P > .1$ ) and  $0.90 \pm 0.94$  ( $P > .3$ ) percent higher dressing percentages, respectively. These data indicate that as slaughter weight increased from 100 to 125 pounds, carcass weight of the ram and ewe lambs increased at a faster rate than did the combined weight of the blood, pelt, viscera, head and hoofs.

The data in Table VII indicate that ram lambs of this type can be fed to a 125 pound slaughter weight without an excessive increase in carcass fat indices. In fact, this increase in live weight seems to have improved the merchandising value of the heavier ram carcasses in that a more desirable amount of fat covering was present on the carcasses. This should be of economic interest to shippers and buyers who are very concerned with storage life of lamb carcasses being transported long distances. The data in this table also indicate that at 100 pounds live weight, fat indices for ewe carcasses of this type are already in excess of desirable amounts and an increase of 25 pounds in slaughter weight merely adds to this undesirability.

Table IX presents the means, differences and standard errors of differences for percent major cut fat and rough cut fat of carcass weight of the light and heavy ram and ewe lambs. Mean differences in percent major cut fat of carcass weight between the light and heavy ram carcasses were  $5.45 \pm 1.76$  ( $P < .05$ ) and  $4.79 \pm 1.76$  ( $P < .1$ ) percent in



TABLE IX

MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES  
FOR SOME CARCASS FAT CHARACTERISTICS AS A PERCENT  
OF CARCASS WEIGHT OF RAM AND EWE LAMBS  
SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

Carcass Trait	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level	Season II		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		Approx. Live Wt.				Approx. Live Wt.			
		100 lbs.	125 lbs.			100 lbs.	125 lbs.		
% Major Cut Fat of Carcass Weight	Rams	11.14	16.59	5.45 $\pm$ 1.76	P <.050	13.86	18.65	4.79 $\pm$ 1.76	P <.100
	Ewes	18.00	23.66	5.66 $\pm$ 1.76	P <.050	20.32	22.80	2.48 $\pm$ 1.76	P >.200
% Rough Cut Fat of Carcass Weight	Rams	6.01	7.26	1.25 $\pm$ 0.59	P >.100	6.19	7.53	1.34 $\pm$ 0.59	P <.100
	Ewes	7.49	9.27	1.78 $\pm$ 0.59	P <.050	7.82	8.11	0.29 $\pm$ 0.59	P >.500

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

Seasons I and II, respectively. Percent rough cut fat increased  $1.25 \pm 0.59$  ( $P > .1$ ) and  $1.34 \pm 0.59$  ( $P < .1$ ) percent in the ram carcasses as live weight increased from 100 to 125 pounds in Seasons I and II, respectively. Ewe lambs in Season I had similar increases in percent major cut fat and rough cut fat as the ram lambs. Heavy ewe carcasses in Season I had  $5.66 \pm 1.76$  ( $P < .05$ ) and  $1.78 \pm 0.59$  ( $P < .05$ ) percent more major cut fat and rough cut fat, respectively, than lighter ewe carcasses. However, ewe lambs in Season II had a much lower increase in percent major cut fat and rough cut fat as live weight increased from 100 to 125 pounds. Heavy ewe lambs in Season II had  $2.48 \pm 1.76$  ( $P > .2$ ) and  $0.29 \pm 0.59$  ( $P > .5$ ) percent more major cut fat and rough cut fat, respectively.

The data in Table IX indicate that an increase of approximately 5.0 percent in major cut fat and approximately 1.3 percent in rough cut fat can be expected when blackface sired ram lambs are slaughtered at 125 pounds rather than at the traditional slaughter weight of 100 pounds. However, it is not clear as to what increase can be expected in these traits for ewe lambs of this type.

From the carcass fat data in Table IX, it is again indicated that either the light ewe lambs in Season II were abnormally fat or the heavy ewe lambs in Season II were abnormally trim. The light ewe lambs of Season II had a carcass major cut fat percentage of 20.32 percent; whereas, this percentage in the light ewe carcasses of Season I was 18.00 percent. The carcass major cut fat percentage in the heavy ewe carcasses was however similar (23.66 and 22.80) for Seasons I and II. In Table VI, which presents some carcass lean characteristics as a percent of carcass weight, a similar relationship is present in the

data for percent closely trimmed major cuts. The light ewe carcasses in Season II had 2.29 percent less closely trimmed major cuts than the light ewe carcasses of Season I; whereas, the heavy ewe carcasses in Seasons I and II had similar percentages (49.22 and 50.16) of closely trimmed major cuts. These data indicate that the light ewe lambs of Season II were abnormally fat and thus was probably a bad sample.

Table X presents the means, differences and standard errors of differences for percent shoulder and leg bone of carcass weight for the light and heavy rams and ewes. It has been shown in previous studies that weight of separable bone from the shoulder and leg are very good indicators of total carcass bone and can be used to illustrate the changes in bone composition as slaughter weight increases. Correlations ranging from  $r = .69$  to  $r = .95$  have been reported for the correlation of shoulder bone weight to total carcass bone (Palsson, 1939; Latham *et al.*, 1966; Munson, 1966 and Field, 1963).

Heavy ram carcasses had  $0.03 \pm 0.17$  ( $P > .5$ ) and  $0.10 \pm 0.17$  ( $P > .5$ ) percent less shoulder bone than lighter ram carcasses in Season I and II, respectively. These differences are very small and not significant and reflect the secondary sex characteristic of ram lambs referred to as "buckiness". Percent leg bone decreased  $0.67 \pm 0.13$  ( $P < .01$ ) and  $0.52 \pm 0.13$  ( $P < .02$ ) percent in Seasons I and II, respectively, as live weight of the ram lambs increased from 100 to 125 pounds. Heavy ewe carcasses had  $0.65 \pm 0.17$  ( $P < .02$ ) and  $0.68 \pm 0.17$  ( $P < .02$ ) percent less shoulder bone than the lighter ewe carcasses in Seasons I and II, respectively. Percent leg bone decreased  $0.84 \pm 0.13$  ( $P < .01$ ) and  $0.29 \pm 0.13$  ( $P < .1$ ) percent in Seasons I and II, respectively, as live weight of the ewe lambs increased from 100 to 125

TABLE X

MEANS, DIFFERENCES AND STANDARD ERRORS OF DIFFERENCES  
FOR SOME CARCASS BONE CHARACTERISTICS AS A PERCENT  
OF CARCASS WEIGHT OF RAM AND EWE LAMBS  
SLAUGHTERED AT TWO LIVE WEIGHTS<sup>a</sup>

Carcass Trait	Sex	Season I		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level	Season II		$\bar{d} \pm S_{\bar{d}}$	$\bar{d}$ Sig. Level
		Approx. Live Wt.				Approx. Live Wt.			
		100 lbs.	125 lbs.			100 lbs.	125 lbs.		
% Shoulder Bone of Carcass Wt.	Rams	4.13	4.10	$0.03 \pm 0.17$	P >.500	4.40	4.30	$0.10 \pm 0.17$	P >.500
	Ewes	3.87	3.22	$0.65 \pm 0.17$	P <.020	4.12	3.44	$0.68 \pm 0.17$	P <.020
% Leg Bone of Carcass Wt.	Rams	4.84	4.17	$0.67 \pm 0.13$	P <.010	4.79	4.27	$0.52 \pm 0.13$	P <.020
	Ewes	4.23	3.39	$0.84 \pm 0.13$	P <.010	4.17	3.88	$0.29 \pm 0.13$	P <.100

<sup>a</sup>10 Rams and 10 Ewes per season at each slaughter weight.

pounds.

The data in Table X indicate that percent carcass bone of the rams and ewes decreased as live weight increased from 100 to 125 pounds and that the decrease was not as rapid in the ram carcasses as in the ewe carcasses because of the similarity in percent shoulder bone between the light and heavy ram carcasses.

## CHAPTER V

### SUMMARY

This study involved the feedlot performance and carcass data of 40 ram lambs and 40 ewe lambs born in October-November, 1975 and June-July, 1976 at the Southwestern Livestock and Forage Research Station, El Reno, Oklahoma. The lambs were a sample of ram and ewe lambs produced by mating Hampshire, Suffolk, Hampshire X Suffolk and Suffolk X Hampshire rams to a flock of crossbred ewes consisting of various levels of Rambouillet, Dorset and Finnsheep breeding. In each season, feed efficiency data was determined for twenty ram lambs and twenty ewe lambs fed from 70 to 100 pounds live weight. After reaching 100 pounds, one-half of the ram lambs and one-half of the ewe lambs were slaughtered and carcass data obtained. The remaining half of the rams and ewes were fed from 100 pounds live weight to a 125 pound slaughter weight with feed efficiency data determined for this feeding interval and carcass data obtained at this 125 pound slaughter weight.

Ram lambs fed from 100 to 125 pounds required  $1.94 \pm 0.256$  pounds of feed more per pound of gain than ram lambs fed from 70 to 100 pounds live weight. Ewe lambs fed from 100 to 125 pounds required  $2.20 \pm 0.477$  pounds more feed per pound of gain than ewe lambs fed from 70 to 100 pounds live weight. The feedlot performance data indicated that ram and ewe lambs of this type can be fed to heavier than 100 pound weights without an excessively large increase in the feed/gain ratio.

In general, mean differences in carcass traits of the light versus heavy ram lambs were similar between seasons. However, the mean differences in some carcass traits of the light and heavy ewe lambs were of a lesser magnitude in Season II than in Season I. It was concluded that the light ewe lambs of Season II were abnormally fat, thus resulting in smaller differences in some carcass traits between the light and heavy ewe lambs of Season II as compared to those same differences between the light and heavy ewe lambs of Season I.

Heavy ram lambs had  $0.51 \pm 0.04$  square inches more rib eye area in Seasons I and II, respectively. Heavy ewe lambs had  $0.19 \pm 0.04$  square inches and  $0.42 \pm 0.04$  square inches more rib eye area in Seasons I and II, respectively.

Percent closely trimmed major cuts as a percent of carcass weight decreased  $1.73 \pm 1.12$  percent and  $2.81 \pm 1.12$  percent in the ram lambs as slaughter weight increased from 100 to 125 pounds in Seasons I and II, respectively, and  $3.79 \pm 1.12$  percent and  $0.56 \pm 1.12$  percent in the ewe lambs. However, when closely trimmed major cuts was expressed as a percent of live weight, it was found that the light and heavy ram and ewe lambs did not differ appreciably in this trait.

Heavy ram lambs exceeded the light ram lambs in 12th rib fat thickness by  $0.09 \pm 0.01$  inches and  $0.07 \pm 0.01$  inches in Seasons I and II, respectively. Heavy ewe lambs exceeded the light ewe lambs in 12th rib fat thickness by  $0.18 \pm 0.01$  inches and  $0.06 \pm 0.01$  inches in Seasons I and II, respectively. Percent major cut fat of carcass weight was  $5.45 \pm 1.76$  percent and  $4.79 \pm 1.76$  percent greater in the heavy ram lambs in Seasons I and II, respectively, and was  $5.66 \pm 1.76$  percent and  $2.48 \pm 1.76$  percent greater in the heavy ewe lambs in

Seasons I and II, respectively.

Heavy ram lambs had  $0.03 \pm 0.17$  percent and  $0.10 \pm 0.17$  percent less shoulder bone than the light ram lambs in Season I and II, respectively, and  $0.67 \pm 0.13$  percent and  $0.52 \pm 0.13$  percent less leg bone than the light ram lambs in Seasons I and II, respectively. Heavy ewe lambs had  $0.65 \pm 0.17$  percent and  $0.68 \pm 0.17$  percent less shoulder bone and  $0.84 \pm 0.13$  percent and  $0.29 \pm 0.13$  percent less leg bone than the light ewe lambs in Seasons I and II, respectively.



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