EFFECT OF TWO BREEDS AND TWO CONCENTRATE:ROUGHAGE RATIOS ON THE CARCASS COMPOSITION OF DRYLOT LAMBS

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INTRODUCTION

Many Oklahoma lambs born during February and March fail to reach market weight by the middle of June. These lambs are either sold as feeders or carried through the summer and fattened during the fall months. In either system there is an economical loss to the state. With the improvement made in rations in recent years, it was considered desirable to further test the feasibility of feeding lambs in drylot during the summer months.

Also, considerable interest has been shown in recent years in the use of high energy rations for fattening cattle and lambs. Most feeding trials have indicated satisfactory gain and feed efficiency of lambs to high energy rations; however, very little work has been reported on the effect of ration on carcass composition. This research was initiated to study both the feasibility of feeding lambs during the summer and to study the effect of breed and two concentrate to roughage ratios on the feedlot performance and carcass characteristics of lambs sired by rams of different breeds.

REVIEW OF LITERATURE

A number of factors must be considered in comparing results from experiments in which ratios of C:R[1] vary. These factors include rate of gain, feed consumption, feed efficiency, time required to reach market grade, and carcass merit. Due to the nature of this study, the review of literature will be divided into C:R ratios, live animal measurements, and carcass measurements.

C:R Ratios

A great deal of interest has developed in the last 10 to 15 years concerning the feeding of high concentrate rations to fattening cattle and sheep; however, this is not a new concept. Davenport (1897) found that calves could not be raised on a ration consisting of milk alone or grain alone although no digestive disturbances accompanied such a ration. In earlier work, Sanborn (1890) fed two sheep on whole grain and roots for 5 months, at which time they were slaughtered. The weight of the stomachs of these lambs was only one-half that of the lambs that were fed hay. This effect was most noticeable

[1]C:R denotes concentrate:roughage.

in the rumen. Also, these lambs were as fat or fatter than those fed hay. McCandlish (1923) was unsuccessful in attempting to rear calves on rations devoid of roughage. The explanation offered for this failure was that the bulky foods must be present in the digestive tract of the ruminant in order to distend the digestive organs, stimulate peristalsis, separate the particles of more concentrated feeds, and so allow their being properly mixed with and acted on by the digestive fluids. When digestion is retarded or hindered, as would occur when the digestive system becomes atonic due to the absence of roughage, the materials not completely acted on by the digestive juices would remain in the alimentary canal and undergo putrefactive changes. The products of such putrefaction are toxic and when absorbed from the alimentary canal can produce autointoxication.

By additions of cod-liver oil and alfalfa ash, Mead and Regan (1931) were able to secure satisfactory growth of calves to 19 months of age on a mixture of barley, oats, wheat bran, and linseed meal. These authors stated that the failure to secure continued normal growth of calves in earlier work resulted from a deficiency of Vitamin A alone or in conjunction with an inadequate supply of certain minerals and not from a lack of roughage.

Numerous attempts have been made to determine the optimum physical balance between concentrate and roughage in fattening rations for cattle and sheep. Cox (1948), after a series of experiments with C:R ratios, concluded that an optimum physical balance is desirable in lamb fattening rations. The greatest gain with the least amount of feed per pound of gain was obtained on a ration containing a 45:55 ratio of C:R. It was further observed that gains were not always positively correlated with dry matter or total digestible nutrient intake, but appeared to follow a certain balance between these two factors determined by the crude fiber:total digestible nutrient ratio.

Brent et al. (1961) observed that digestible energy increased in an almost perfect linear relationship with increasing concentrate in the ration. This was due to the fact that the amount of readily available energy increased as the amount of concentrate increased. Hopson et al. (1960), as a result of digestible energy and total digestible nutrient determinations with lambs, concluded that 30 percent was the minimum and 50 percent was the maximum amount of concentrate to feed fattening lambs for best utilization. Richardson et al. (1961) determined that an increase in TDN intake was obtained with 3:1 and 5:1 C:R ratios over a 1:1 ratio. Crude fiber digestion was highest with the 3:1 ratio, nitrogen free extract digestion was lowest on the 1:1 ratio, as was ether extract. Pope et al. (1956,1957) reported that although feed mixtures when fed to calves varied from 57 to 71 percent TDN, actual TDN was not affected due to differences in total feed intake.

McClure et al. (1960) observed that the rate of gain increased with each decrease in the proportion of hay until the ratio reached 60 percent concentrate and 40 percent hay, whether the ration was ground or pelleted. The low concentrate rations (30:70) consistently produced lower carcass grades and yields. Similar results were obtained by Beardsley et al. (1959). Bell et al. (1956) found that unpelleted rations composed of 55 percent alfalfa and 45 percent corn produced larger and more efficient gains with lambs than unpelleted rations containing a larger percentage of alfalfa hay.

Hartman et al. (1959) compared a 71 percent concentrate ration with one containing 41 percent, either pelleted or nonpelleted, fed to lambs. No difference was observed in rate of gain. Lambs on the high concentrate ration had a 12 percent improvement in feed efficiency, 0.86 percent lower shrink, and 1.15 percent higher yield. Pelleting the high concentrate ration gave no advantage to gain or feed efficiency. However, more oily carcasses were observed among the lambs fed the low roughage ration.

Myer and Nelson (1961) compared rations containing 5 percent and 30 percent alfalfa hay fed to lambs. Steamed rolled barley made up 70.5 percent of the low roughage ration and 46.5 percent of the higher roughage ration. Daily gains were significantly reduced when the low-hay or fiber ration was fed. However, the reduction in gain was compensated, to a large extent, by a higher dressing percentage for the lambs fed the low-fiber ration (55.0 percent for the low-hay and 52.4 percent for the high-hay ration). The carcasses were exactly the same in weight indicating that the difference in gain was due to rumen fill. No difference was found in carcass grade. A second trial exhibited no difference in daily gain between lambs that were fed a 90.7 percent ground barley and no hay ration (low-fiber ration) and those that were fed a ration consisting of 50 percent milled alfalfa hay and 30 percent milled barley (high-fiber ration). Lambs fed the low-fiber ration required 10 to 14 days to adjust to the high concentrate ration. It was concluded that it is possible to feed fattening lambs a ration composed of 90 to 95 percent concentrate and obtain satisfactory gains.

Richardson *et al.* (1956) conducted three tests with heifers and one test with steers where the animals were fed milo to alfalfa hay ratios of 50:50, 75:25, 84:16, and a changing ration in which the grain was increased every 28 days. The rate of gain of heifers was found to increase as the percent of the grain in the ration increased; however, the reverse was true for the steers.

Pope *et al.* (1961) observed that steers fed a straight barley ration plus 1.5 pounds soybean meal per head daily outgained by 0.1 pound per head daily those steers that were fed an all milo ration plus protein supplement with the fiber content equalized by the addition of cottonseed hulls. They also required 40 pounds less grain and 79 pounds less roughage to produce 100 pounds of gain. A mineral-vitamin mix containing Vitamin A, and 0.35 pound of a specialized mineral mix, formulated to simulate the major trace minerals contained in 4 pounds of alfalfa hay, was found to be of no benefit to the milo and cottonseed hull diet. However, on the barley ration, an increase of 0.3 pound gain per head per day was attained by the addition of the mineral mix. It was concluded that the difference in rate of gain was either a result of the added minerals in the milo ration promoting a more "normal" fermentation in the paunch, thus resulting in certain nutrients needed by the steers or there being a fundamental difference in the mineral content of the milo and barley.

According to Butcher et al. (1961), the significant advantage of a high barley diet is the reduced feed consumption for the same gain with a resulting improvement in feed efficiency. The significant increase in dressing percentage or carcass yield for a high barley diet further emphasized its superiority over a conventional diet. It was also observed in this work that heavier lambs showed a greater response to the high barley diet than the lighter lambs. Greater development of the skeleton occurred in lambs receiving the conventional roughage diet as indicated by greater carcass length, metacarpus length and circumference, and some indication of increased metatarsus length compared to lambs on the concentrate diet. The lesser skeletal development of the lambs on the high concentrate diet might be considered an advantage since a decrease in bone development might also decrease the inedible portion of the lamb carcass.

When fed to ruminants, carbohydrates are largely degraded by rumen microorganisms to acetic, propionic, and butyric acids. In general, the more acetic acid produced, relative to propionic and butyric, the less the efficiency.

Substitution of concentrate for roughage tends to lower the production of acetic acid relative to the others. In the work of Butcher *et al.* (1961), as the amount of barley in the diet was increased, acetic acid production decreased and propionic acid production increased. These results indicated that the nutrients absorbed from the barley diets were used more efficiently than an equal quantity of nutrients absorbed from the roughage diets. It was found that 32 percent more feed was required for each pound of gain from the roughage diet. However, when TDN requirements in the roughage diet were compared, only six percent more were needed. Nevertheless, when the poorer carcass yield was considered, a 13 percent disadvantage was found.

Live Animal Measurements

It is becoming more evident that in many animal nutrition and meat production studies, an accurate assessment of the body and/or carcass composition of the experimental animals is essential. It is clear that the quantitative and qualitative assessment of the carcass by eye judgement may not insure a true picture of carcass composition. If a method could be developed estimating quickly and accurately the composition of the carcass it would be very helpful in establishing more definite objectives in animal production. However, the statement of Lush (1928) that in the geometrical sense the animal body is of such a complicated shape that any one or few measurements could approximate a description of it in only the crudest way, may be appropriate in considering this problem.

The obtaining of live animal measurements is subject to a great amount of error. This is especially true in measuring sheep, due to the presence of the fleece. According to Phillips and Stoehr (1945), measurements of animals in fleece are generally less accurate than those of animals taken just after shearing. Width of the hook bones was taken with reasonable accuracy on animals that were in fleece; however, true measures of circumference of the chest were difficult to obtain, owing to packing of wool under the tape measure. A coefficient of variation of seven percent was obtained when the circumference of one leg was taken at approximately the mid-point between the hip joint and the point of the hock. Apparently, the considerable variation in the measurement was due to the difficulty in locating an exact point of measure. This inability to locate an exact point is a large source of error in many live animal measurements on all species. White and Green (1952) substantiated these findings when they concluded that the large coefficients of variation in the live animal measurements of cattle may be due to a lack of an exact point of reference from which to measure.

Orme _et al_. (1962), using animals varying considerably in weight, reported that certain live animal measurements were related sufficiently to the weight of the carcass lean to have a value in a live animal selection program (width of shoulder or leg, $r=0.63$; circumference of heart girth, $r=0.62$ and width of leg, $r=0.55$).

Smith et al. (1950) observed that estimates of repeatability for body length for three age groups, cows, yearlings, and calves, ranged from 0.546 to 0.898. Repeatability for the round measurement (patella to patella) exhibited a range of 0.463 for the cows to 0.769 for the yearlings. Size did not appear to have any appreciable influence upon the errors of measurement, being only slightly greater for the larger animals. Tallis et al. (1957) indicated that heart girth circumference, length of body, circumference at navel, width of chest, depth of chest, and height at hooks and withers were the measures with the highest steer components (higher repeatability) and the lowest investigator interaction and error components.

Ternan et al. (1959) found the round measure (horizontal patella to patella) of live steers to be only slightly associated with other live measures (width of chest and body length) and a small negative correlation was found between the round measure and percent round.

Green (1954) observed a standard deviation of 0.21, when the body length of beef steers was measured from the pin bones to the withers, and a coefficient of variation of 5.1 percent. The standard deviation of the length from the pin bones to the hook bones was 0.13 and the coefficient of variation was 7.9 percent. Simple correlations of the total weight of the round, trimmed loin, and rib with the live weight of the animal, length from pin bones to withers, circumference of heart girth, and width of loin were 0.95, 0.54, 0.88, and 0.74, respectively. The correlations of the weight of the round, trimmed loin, rib, and cross-cut (chuck, brisket, and flank) with the same live measurements were 0.96, 0.55, 0.88, and 0.75. The circumference of the heart girth was correlated with body weight to an extent of 0.93, higher than any other single measurement. The simple correlations between dressing percentage, based on a warm carcass weight, and measurements of live steers were: live weight, 0.08; pin bones to hook bones, -0.01; pin bones to withers, 0.03; circumference of heart girth, 0.11; and width of loin, 0.16.

Carcass Measurements

One of the major tools needed for a more accurate live animal evaluation is an objective method for determining the amount of muscle present in an animal. The most accurate information on the composition of lamb or mutton carcasses may be obtained by complete physical separation and chemical analyses (Mitchell *et al*., 1926; Hammond, 1932; Palsson, 1939; Hankins, 1947; Gee and Preston, 1957; Kirton and Barton, 1958a; Garrett *et al*., 1959; Kirton *et al*., 1959; Kirton *et al*., 1962), cited by Kirton and Barton (1962). In addition, it has been shown that specific gravity (Stouffer, 1955; Barton and Kirton, 1956; Kirton and Barton, 1958b; Garrett *et al*., 1959; Cowan *et al*., 1961), dressing percent (Barton and Kirton, 1958a), carcass weight (Barton and Kirton, 1958b), and sample joints or cuts (Kirton, 1957; Barton and Kirton, 1958b) may be used with varying degrees of accuracy to obtain an estimate of carcass composition.

Kirton and Barton (1962) found that an indication of lamb carcass composition can be obtained from its weight, but the composition of the carcass can be more accurately estimated from the chemical data derived from any one of the 4 parts of the right side. These workers found a correlation of 0.63 between the weight of the carcass and the weight of the carcass fat. The observation that carcass weight was significantly related to the chemical composition of lamb carcasses was in agreement with an earlier finding (Barton and Kirton, 1958b) that carcass weight could be used to predict the weights of the dissectible components of the lamb carcass. In beef, Cole _et al_. (1962) reported that when breed effects were ignored, carcass weight alone was more closely related to separable lean than were combinations of carcass length and rib-eye area or carcass length, rib-eye area, and fat thickness over the rib-eye. Goll _et al_. (1961a) found negative correlations between carcass weight and yields of cuts from the hind quarter of beef, whereas those between weight and yields of cuts from the front quarter, except for the percent rib, were positive. Barton and Kirton (1958a) concluded that although carcass weight can be used to simplify the determination of carcass composition, it will not distinguish between animals of different breed, sex, or growth rate.

Dressing percentage and carcass grade can be accurately estimated, but these factors are not good indicators of the amount of red meat present in a carcass. Kirton and Barton

(1962) found a correlation of 0.34 between dressing percentage and percent carcass fat. In beef, Weseli et al. (1958) observed that loin eye area decreased as fat thickness increased and as fat thickness increased, dressing percent increased. However, Good et al. (1961), using selected steers from the International Livestock Exposition, found a positive correlation between dressing percent and area of the loin eye.

Ament et al. (1962), working with lambs, found that average values for specific gravity and fat thickness at the 12th rib were closely associated with the average fat content of the carcass and after reaching 95 pounds live weight, any increased weight was due more to fat than to lean. Rupnow et al. (1961), using Columbia, Hampshire, and Southdown lambs slaughtered at a constant weight, found no significant difference in fat thickness and dressing percentage, although the Southdowns were highest with the Hampshires being intermediate to the Southdowns and Columbias. Also, no significant difference was found in the percentage of the wholesale cuts between breeds.

Barton and Kirton (1956), using mutton carcasses that ranged in percent fat from 26.1 to 45.4, found that the specific gravity of the whole carcasses ranged from 1.009 to 1.049 and the correlation between ether extract fat in the half-carcass and specific gravity was 0.877. Therefore, it was concluded the specific gravity for estimating percentage fat content could adequately be applied to mutton carcasses.

Garrett et al. (1959) found a correlation coefficient of -.90 between specific gravity of the lamb carcass and the percent carcass fat. Kemp and Varney (1962), using 165 Southdown crossbred lambs, observed correlation coefficients of -.64 and 0.62 between specific gravity and percent carcass fat and lean, respectively. Field et al. (1963) noted a somewhat smaller correlation coefficient (0.47) between specific gravity and percent lean in the carcass.

Enfield et al. (1962) reported that fat thickness at the 12th rib was positively correlated with percent leg (0.24), percent loin (0.43), and dressing percentage (0.22), but negatively correlated with loin-eye area (-.58) of crossbred lambs based on a constant weight. Kemp and Varney (1962) observed a correlation of -.57 between fat thickness over the 12th rib and carcass lean. Judge et al. (1963) took the mean of four linear measurement of backfat made at points coinciding with the medial and lateral edge of each loin muscle and at right angles to the external surface and obtained a correlation of 0.78 between the fat thickness and the percent trimmed fat. Gottsch et al. (1961) found the fat thickness at the 12th rib to be highly related to total fat trim in beef. The two were correlated, whether an average of three backfat measurements or a single measurement, to the extent of 0.57 and 0.58, respectively.

Bailey et al. (1961) observed that lambs that are heavily muscled in the leg-of-lamb have a tendency to produce a large eye muscle. Ament et al. (1962) obtained a simple correlation coefficient of 0.80 between loin-eye area and total lean of the carcass, while Knight et al. (1959) noted no significant differences in total cross-sectional area of the eye muscle between Rambouillet, Suffolk, and Southdown bred lambs.

In beef work, Cole et al. (1959) obtained a correlation coefficient of 0.454 between the area of the ribeye and total carcass lean. Kropf (1959) found that loin-eye area per 100 pounds of carcass weight was correlated to percent separable lean (0.41).

Barton and Kirton (1958b) found the leg and loin to be the most preferable anatomical joints to use as indices of the composition of the whole lamb or mutton carcass because they typify the whole carcass in rate of development, the leg being an early developing region and the loin late developing. Also, they are the highest-priced parts of the carcass, they can be removed from the carcass with greater precision than most others, and they are relatively easy to dissect.

Enfield et al. (1962), using 150 crossbred lambs from six inbred lines developed at the Minnesota Agriculture Experiment Station along with the Hampshire and Suffolk breeds found that percent untrimmed loin of the chilled carcass was the only trait where significant breed differences were present. Knight et al. (1959), using Rambouillet, Suffolk-White face cross, and Southdown lambs, noted no significant differences in percent leg, loin, or breast between breeds. Southdown lambs had a significantly greater percent rack than the other two and the Rambouillet lambs a significantly greater percent shoulder than the Southdowns. In recent work, Field et al. (1963) found the rib to be the best indicator of percent fat and bone in the carcass as it showed the highest correlation and lowest standard error (0.89 and 1.82, respectively). The leg and shoulder were quite similar in their predictive values for lean. The correlations between percent lean and leg, loin, rib and shoulder were 0.86, 0.82, 0.82, and 0.87, respectively.

According to Barton and Kirton (1958a), in mature sheep, fatty tissue is laid down approximately twice as rapidly as muscular tissue with increasing carcass weight, but in lamb carcasses these tissues are laid down at about an equal rate. Pitts (1956) found that 96 percent of the added fat in guinea pigs stored in the subcutaneous and internal adipose tissue. The subcutaneous fat accumulation is proportional to total fat accumulation. Females have an appreciably larger fat storage capacity than males. Males have six to seven percent less of their total fat in subcutaneous depot and proportionately more in the internal depots than do females.

Butler (1957) reported that fat caused the major variability in cutting yields. Lean and bone seemed to develop proportionately over a fairly wide range of carcass shapes.

Moulton et al. (1922) found that the composition of the wholesale cuts of meat is affected by increasing age and fatness. In general, the percent of fatty tissue increases and the percent of bone decreases. The percent of lean may increase, remain constant, or decrease, but on the average it decreases. The increases in percent of fat are greatest in the plate, loin, and flank. Luitingh (1962) substantiated this work by finding that the rib and loin constituted a significantly larger percentage of the carcasses of the fattened than of unfattened steers. Goll et al. (1961b) also found that a large amount of fat is deposited in the loin and rib as the grade increases.

Knight et al. (1959) found the correlation between percent lean and percent bone in the carcass to be 0.47. There is a strong negative correlation (-.91) between total carcass lean and total carcass fat in beef as evidenced by Gottsch et al. (1961). Callow (1948) found that carcasses containing 30 percent fatty tissue contained 55.6 percent muscular tissue, 12.4 percent bone, and 2.0 percent tendons, etc. In rather fat carcasses containing 40 percent fatty tissue, there was 48.7 percent muscular tissue, 9.7 percent bone, and 1.6 percent tendons, etc.

EXPERIMENTAL PROCEDURE

Forty-eight, four month-old lambs born of Rambouillet ewes and sired by either Dorset, Hampshire, or Suffolk rams were assigned to the experiment. Twenty-four were Dorset[1] and twenty-four were black-face[2]. Lambs of each breed were randomly allotted into two lots of 12 lambs each, except that twins were separated. Treatments consisted of a standard ration (ST) which contained 45 percent ground milo and a high energy ration (HE) containing 80 percent ground milo. These rations were arranged factorially with the two breeding groups. Ingredient composition and nutrient analyses of the self-fed rations are given in table 1. The primary differences between the rations were the differences in crude fiber and TDN.

All lambs were drenched with phenothiazine and sheared two days prior to the initiation of the experiment. A 24-hour shrunk weight was taken when the lambs were allotted. Live measurements of loin width, leg circumference, rump length, body length, and heart girth circumference were also taken at

[1] Dorset denotes Dorset x Rambouillet crosses.

[2] Black-face denotes either Hampshire or Suffolk x Rambouillet crosses. No distinction is made between the Hampshire and Suffolk.

TABLE 1

COMPOSITION OF RATIONS (%)

Breed	Dorset		Black-face	
Ration	Standard[a]	HE[b]	Standard[a]	HE[b]
Ingredient:				
Ground milo	45	80	45	80
Ground alfalfa hay	50	8	50	8
Cane molasses	5	5	5	5
Soybean oil meal	--	7	--	7
Proximate analyses:				
Dry matter	88.97	88.44	88.97	88.44
Crude protein	11.70	11.49	11.70	11.49
Crude fiber	15.34	4.54	15.34	4.54
TDN	63.77	75.78	63.77	75.78
Calcium	0.78	0.77	0.78	0.77
Phosphorus	0.25	0.29	0.25	0.29

[a]Standard rations were supplemented with 10 pounds of salt and 2 pounds of Aurofac 10 per ton of feed.

[b]HE rations were supplemented with 10 pounds of salt, 1.5 pounds of Vitamin A (10,000 I.U. per gram), 2 pounds of Aurofac 10, and 30 pounds of calcium carbonate per ton of feed.

this time. The lambs were started on feed gradually and by the sixth day were on full feed.

The live measurement areas and procedures were similar to those used by Lush (1928) for steers and Phillips and Stoehr (1945) for sheep.

The loin width was measured with a one-foot square that consisted of 2 handles, one of which was stationary. The measurement was taken midway between the forward edge of the hook bone (ilium) and the 13th rib. The rule of the measuring device was laid against the top of the loin with the stationary handle fitting snugly and perpendicular to the top of the loin. The sliding handle was moved to a position so that it also fit snugly and perpendicular to the top of the loin. This handle was then locked into position simply by tightening the locking screw and the width of the loin was measured to the nearest 1/16 inch.

Rump length was measured with a cloth tape to the nearest 1/4 inch, as was body length, leg circumference, and heart girth circumference. The length of rump was measured from the midpoint of the pin bone (tuber ischii) to the extreme anterior point of the hook bone on the same side.

The length of body was measured from the top of the shoulder (midway between the upper points of the scapula of each shoulder) to the base of the tail (first caudal vertebra).

The circumference of the leg was measured from the stifle joint around the leg, holding the tape horizontal to the ground.

Heart girth circumference was measured by wrapping the tape completely around the heart girth just behind the front legs.

Individual lambs were removed from the experiment when they reached approximately 97-103 pounds full weight. At this time the live measurements mentioned above were repeated. The lambs were hauled from Fort Reno to Stillwater (approximately 100 miles), shrunk for 24 hours, and reweighed. The lambs were then slaughtered and a cold carcass weight was obtained 48 hours after slaughter. Specific gravity of the entire carcass was found using the equation employed by Whiteman et al. (1953):

$$\text{Specific gravity} = \frac{\text{air weight}}{\text{air weight-water weight}}$$

The carcass was ribbed between the 12th and 13th ribs, and the area of the Longissimus dorsi and the depth of backfat were measured. The backfat measurements were taken over the inside edge, the center, and outside edge of the Longissimus dorsi. The depth of backfat in this thesis is an average of the three measurements. The area of the loin-eye is an average of duplicate tracings.

The carcasses were broken into fore and hind saddles. The carcasses were not split down the backbone. The fore shank was removed from the fore saddle at the junction of the radius and humerus bones. The 7-rib rack (6-12 ribs) was cut from one inch outside each loin-eye muscle along a line parallel to the backbone. This cut joined perpendicularly the cut between the 5th and 6th ribs. The area between the fore shank and shoulder was designated as the brisket while the neck was all the area anterior to the 7th cervical vertebra. The remaining lower part of the 6-12 ribs was designated as the "ribs".

The hind saddle was broken into the loin, leg, and flank. The loin was that area posterior to the 12th rib and anterior to the edge of the ilium bone and along the same parallel line to the backbone as the rib was cut. The flank was the area ventral to the loin. The leg was the area posterior to the loin to a point five inches anterior to the tarsal bone. The tail bone was removed from the legs. The shoulders and legs were split after removal from the carcass. The wholesale cuts were trimmed of fat, leaving a maximum of 1/4 inch of outside fat on each cut.

All cuts were wrapped and frozen for approximately two months, at which time they were thawed for 12 hours and boned. The major muscles were separated from the fat and bone of each carcass. The lean, fat, and bone were weighed separately. The lean and fat were ground separately, first through a 1/4 inch plate and then through a 1/16 inch plate. After each grinding, the meat was mixed and after the last grinding and mixing, duplicate random samples were taken for chemical analysis. Proximate analysis of each sample was determined according to the procedure established by Benne et al. (1956). The total lean and fat in the carcass was determined by the chemical analysis (lean=moisture+protein+ash; fat=ether extract).

Standard errors, analyses of variance, correlation coefficients, and z transformations were calculated according to the procedures set forth by Steel and Torrie (1960).

RESULTS AND DISCUSSION

The average initial, final, shrunk, and cold carcass weights are shown in Table 2. Although some variation existed between lots when the initial and final weights were taken, the averages of the total gain per lamb during the feeding period were very similar, being 28.83, 27.42, 27.67, and 27.00 lbs. for the standard Dorsets, HE Dorsets, standard black-faces, and HE black-faces, respectively.

TABLE 2

AVERAGE OF INITIAL, FINAL, SHRUNK, AND COLD CARCASS WEIGHTS (LBS.)

Breed	Dorset		Black-face	
Ration	Standard	HE	Standard	HE
Measurement:				
Initial Wt.	69.67	72.83	75.08	74.17
Final Wt.	98.50	100.25	102.75	101.17
Shrunk Wt.	89.29	89.58	91.94	90.08
Cold Carcass Wt.	47.08	49.81	47.45	48.41

Live Measurements

The average number of days on feed, average daily gain, and increase in the various live measurements as a result of the feeding period are shown in Table 3. The lambs fed the standard ration gained slightly more (0.50 vs 0.47 lb.), however this difference was not significant. The average time required to reach the slaughter weight of approximately 100 lbs. was also essentially the same.

The increase in loin width was greater ($P < .10$) for the lambs fed the standard ration. This could have been due to the fact that these lambs were lighter in weight at the beginning of the trial and simply gained more weight.

Although there were no significant differences in the increase in leg circumference, due to either breed or ration, it is apparent that this measurement is subject to considerable variation, as indicated by the large standard error (table 3). This agrees with the work of Phillips and Stoehr (1945) when they found considerable variation in measuring the leg circumference due to the difficulty in locating an exact point to measure.

Although there was a trend for the standard-fed lambs to have a larger increase in rump length; this increase was not significant. The black-face lambs had a significantly greater ($P < .05$) increase in body length than did the Dorsets, regardless of the ration fed. No difference was observed for the increase in heart girth circumference between treatments.

Carcass Measurements

All the carcass measurements reported in this thesis, such as percent leg, loin, average backfat, loin-eye area, and etc., are based on the cold carcass weight, unless otherwise specified. The averages by lots of various carcass

TABLE 3

MEANS AND STANDARD ERRORS OF VARIOUS LIVE ANIMAL MEASUREMENTS

Breed	Dorset		Black-face		Standard
Ration	Standard	HE	Standard	HE	Errors
Measurement:					
Days on Feed	69.25	61.83	53.83	60.25	5.96
Average Daily Gain (lbs.)	0.46	0.47	0.54	0.47	0.03
Inc. in Loin Width (in.)*	0.82	0.68	0.76	0.60	0.08
Inc. in Leg Cir. (in.)	0.74	0.45	0.45	0.67	0.25
Inc. in Rump Length (in.)	2.13	1.79	2.14	2.00	0.22
Inc. in Body Length (in.)**	2.65	1.84	2.92	3.00	0.35
Inc. in HG Cir. (in.)	4.35	4.23	4.05	4.13	0.29

*Significant difference ($P < .10$) between rations.
**Significant difference ($P < .05$) between breeds.

measurements with their standard errors are shown in table 4. The mean squares for these carcass measurements are shown in Appendix table 12. No significant interactions existed between breed and ration. Dressing percentage was affected by both breed ($P < .10$) and ration ($P < .01$). The highest dressing group was the HE Dorsets (table 4). These lambs dressed approximately 2.0 percent more than the HE black-face group. Since percent carcass fat is positively correlated to the dressing percentage (Kirton and Barton, 1962), the lambs fattened on the HE diet would be expected to and did have a greater percentage of carcass fat than did those fed the standard ration. This agrees with the work of Myer and Nelson (1961). These workers reported that lambs fed a low-fiber ration dressed 55.0 percent while those fed a high-fiber ration dressed 52.4 percent. Since specific gravity is negatively correlated to percent carcass fat (Kemp and Varney, 1962) and since fat weighs less than lean in water, one would expect a lower specific gravity value for those carcasses containing larger amounts of fat. The Dorset carcasses yielded a significantly lower ($P < .05$) specific gravity value than the black-face carcasses. This breed difference could be due to the fact that Dorsets are an earlier maturing breed than either the Hampshire or Suffolk breed. Therefore, they would have a higher dressing percentage and a lower specific gravity value, indicating a greater percent carcass fat.

The average of three backfat measurements over the Longissimus dorsi per cwt. of the live animal was greater ($P < .10$) for

TABLE 4

MEANS AND STANDARD ERRORS OF CARCASS MEASUREMENTS AND PERCENTAGES OF VARIOUS L.C.[a]

Breed / Ration	Dorset Standard	Dorset HE	Black-face Standard	Black-face HE	Standard Errors
Measurement:					
Dressing Percent[g]	52.73	55.59	52.13	53.77	0.63
Specific Gravity[d]	1.0463	1.0335	1.0426	1.0384	0.0028
Actual Area of L.D.[b] (sq.in.)	2.02	2.08	2.10	2.11	0.08
Area of L.D. per cwt. Live wt. (in.)	2.26	2.32	2.31	2.34	0.08
Area of L.D. per cwt. Car. (in.)	4.28	4.18	4.43	4.36	0.16
Actual BF[c] over L.D.	0.31	0.38	0.30	0.32	0.03
Av. BF over L.D. per cwt. Live wt. (in.)	0.35	0.42	0.33	0.36	0.03
Av. BF over L.D. per cwt. Car. (in.)	0.66	0.76	0.63	0.67	0.05
Percent Untrmd. Leg[e]	24.49	23.62	25.34	25.28	0.31
Percent Trmd. Leg[e]	22.62	21.70	23.60	23.49	0.38
Percent Untrmd. Loin	8.72	8.66	8.63	8.37	0.13
Percent Trmd. Loin[f]	6.77	6.45	7.07	6.46	0.17
Percent Untrmd. Rib	6.34	6.53	6.51	6.31	0.14
Percent Trmd. Rib	5.56	5.61	5.61	5.48	0.13
Percent Untrmd. Shoulder	22.99	23.39	22.93	23.61	0.29
Percent Trmd. Shoulder	20.75	21.05	20.97	21.48	0.34
Yield of Trmd. L.C. as a Percent of Live Wt.[f]	29.34	30.35	29.83	30.56	0.38
Trmd. Fat from L.C. as a Percent of Car. Wt.	6.84	7.35	6.17	6.56	0.54

TABLE 4 (Continued)

[a]Denotes Trimmed Lean Cuts
[b]Denotes _Logissimus_ _dorsi_ Muscle.
[c]Denotes Backfat.
[d]Significant difference ($P<.05$) between breeds.
[e]Significant difference ($P<.01$) between breeds.
[f]Significant difference ($P<.05$) between rations.
[g]Significant difference ($P<.01$) between rations.

those lambs fed the HE diet than for those fed the standard ration. Since backfat is negatively correlated to total carcass lean (Kemp and Varney, 1962), and positively correlated to dressing percentage (Enfield et al., 1962), a lamb having a greater yield, lower specific gravity, and a greater amount of backfat should have a greater amount of carcass fat than one with a lower yield, higher specific gravity, and less backfat. From these values (table 4), one would predict a greater percent of carcass fat for those lambs fed the HE ration than for those fed the standard ration. Also, the Dorset carcasses should contain more fat than the carcasses of the black-face lambs. The HE-fed lambs had a larger amount of backfat than those fed the standard ration when the backfat was expressed on a liveweight basis. Since there was a significant ration difference in dressing percentage, by expressing the backfat on a carcass weight basis and removing this source of variation, the ration differences in backfat were not nearly so great (Appendix table 12). No significant difference for the fat trimmed from the lean cuts was found, although there was a trend for the HE lambs to yield a greater percent fat trim than the standard-fed lambs.

No significant differences existed for actual loin-eye area per cwt. of live animal, or for loin-eye area per cwt. of carcass. However, a significant breed difference was found for the percent trimmed leg. The black-face lambs yielded a significantly greater percent trimmed leg than the Dorsets. The percent trimmed loin was greater ($P < .05$) for those lambs fed the standard ration (Appendix table 12). This may have been due to the fact that the lambs fed the standard ration laid down more muscle while those fed the HE ration deposited more fat, which in turn was trimmed off. The standard-fed lambs' loin width increased more during the feeding period ($P < .10$) than those fed the HE diet (table 3). Also, the yield of trimmed lean cuts, expressed as a percent of the live weight, was significantly greater ($P < .05$) for those fed the HE diet. Again, the explanation for this difference may be due to the presence of the significant variable mentioned above, dressing percentage. It is apparent from table 4 that the average percentages of trimmed lean cuts were somewhat less than would normally be expected from a similar group of lambs. This smaller percentage is due to the cutting procedure employed, especially the loin and rib being cut somewhat smaller than usual.

The means and standard errors of the fat trimmed from each lean cut and the yield of each cheap cut are given in table 5. Appendix table 13 shows the mean squares calculated in the analysis of variance for each of these traits. There was a trend for the Dorset lambs to yield a greater percent fat trim from the leg than the black-face lambs. However, the breed difference was not large enough to be statistically significant. No significant difference existed between rations. The only lean cut that exhibited a significantly different amount of fat trim due to either breed or ration was the loin. When expressed as a percent of the carcass weight, the fat

TABLE 5

MEANS AND STANDARD ERRORS OF FAT TRIMMED FROM EACH LEAN CUT AND YIELD OF CHEAP CUTS

Breed	Dorset		Black-face		Standard
Ration	Standard	HE	Standard	HE	Errors
Item:					
Fat Trmd. from Leg as a Percent of car. wt.	1.88	1.91	1.74	1.79	0.15
Fat Trmd. from Leg as a Percent of Untrmd. Leg wt.	7.65	8.13	6.89	7.10	0.63
Fat Trmd. from Loin as a Percent[a] of car. wt.	1.95	2.22	1.56	1.90	0.17
Fat Trmd. from Loin as a Percent[c] of Untrmd. Loin wt.	22.27	25.53	17.90	22.64	1.93
Fat Trmd. from Rib as a Percent of car. wt.	0.78	0.92	0.90	0.83	0.12
Fat Trmd. From Rib as a Percent of Untrmd. Rib wt.	12.26	13.92	13.31	13.23	1.63
Fat Trmd. from Shoulder as a Percent of car. wt.	2.23	2.33	1.97	2.13	0.24
Fat Trmd. from Shoulder as a Percent of Untrmd. Shoulder wt.	9.74	9.97	8.53	9.00	1.07
Percent Kidney Knob	4.19	4.78	3.69	4.09	0.33
Percent Fore Shank[b]	3.61	3.41	4.04	3.85	0.10
Percent Rear Shank	2.27	2.31	2.47	2.41	0.11
Percent Neck	3.44	3.06	3.49	3.16	0.13
Percent Brisket	4.07	4.06	3.90	4.03	0.16
Percent "Ribs"	9.88	9.58	9.68	9.62	0.24
Percent Flank	7.28	7.85	7.39	6.99	0.24

[a] Significant difference ($P<.05$) between breeds.
[b] Significant difference ($P<.01$) between breeds.
[c] Significant difference ($P<.05$) between rations.
[d] Significant difference ($P<.01$) between rations.

trimmed from the loin of the Dorset lambs was significantly greater ($P<.05$) than the trim of the black-face lambs. This agrees with the work of Barton and Kirton (1958b). They reported that the loin was one of the most preferable anatomical joints to use as an index of lamb carcass composition, because it is late in its development. Since the Dorset breed is early maturing, it should yield more fat trim from the loin than a late maturing breed. Therefore, after reaching maturity, fat is added to the loin to a greater extent than prior to maturity, resulting in a greater fat trim from the loin of the early maturing breeds. The lambs fed the HE diet also yielded a greater ($P<.10$) percent fat trim from the loin than those fed the standard ration (Appendix table 13). Therefore, the standard-fed lambs' loin width increased more (table 3), had a greater percent trimmed loin (table 4), and yielded a significantly smaller percentage of trimmed fat from the loin (table 5) than the HE lambs. From this analysis, it can be seen that lambs fed a high energy (concentrate) ration can produce more fat in the loin region than lambs fed a conventional standard ration (50:50 C:R ratio).

No significant difference existed between either breed or ration for the percent fat trimmed from the rib and shoulder. This is in disagreement with the work of Knight et al. (1959), who found that Southdown lambs had a significantly greater percent rack than either Rambouillet or Suffolk-White-face cross lambs, while the Rambouillet lambs had a greater percent shoulder than the Southdowns.

The Dorset lambs had a greater ($P<.10$) percent kidney knob than the black-face lambs. Since the Dorset-bred lambs were earlier maturing, they had a longer period in which to convert their feed into fat than did the black-faces. Consequently, the carcasses of these lambs should contain a greater percent fat in the region of the kidney.

The black-face lambs had a greater percent fore shank than the Dorsets. The standard rations produced a greater percent fore shank than the HE rations. These results are substantiated by those of Butcher et al. (1961), who found that a greater development of the skeleton occurred in lambs receiving a conventional roughage diet when compared to lambs on a high concentrate diet. The standard-fed lambs also produced a greater ($P<.10$) percent neck. Since standard rations produce more skeletal growth and the neck is composed primarily of bone, the greater percent neck produced on a standard ration would be expected when compared to a HE ration.

The means and standard errors for the carcass composition are found in table 6, while the mean squares for the analysis of variance are shown in Appendix table 14. From these two tables, it can be seen that the black-face lambs yielded carcasses that contained a greater ($P<.10$) percent protein. However, no significant differences existed between either breed or ration for total percent lean in the carcass. Although the differences between rations were not significant,

TABLE 6

MEANS AND STANDARD ERRORS OF CARCASS COMPOSITION

Breed Ration	Dorset Standard	 HE	Black-face Standard	 HE	Standard Errors
Item:					
Percent Protein in Chem. Analysis	19.56	19.26	19.66	19.77	0.15
Total Lbs. Lean in Car.	24.65	25.40	25.30	25.38	0.45
Total Lbs. Fat in Car.[a,c]	14.08	16.19	13.48	14.33	0.60
Total Lbs. Bone in Car.[b]	6.83	6.67	7.52	7.16	0.19
Percent Lean in Car.	52.39	50.98	53.10	52.44	0.67
Percent Fat in Car.[a]	29.84	32.47	28.29	29.54	1.07
Percent Bone in Car.[b,c]	14.54	13.41	15.81	14.84	0.42
Percent Waste in Car.	3.24	3.04	2.80	3.18	0.45
Total Lbs. Bone in L.C.[b]	4.01	4.11	4.58	4.43	0.13
Bone in L.C. as a Percent of Untrmd. L.C. wt.[b]	13.67	13.30	15.23	14.43	0.44
Bone in L.C. as a Percent of Trmd. L.C. wt.[b]	15.32	15.10	16.87	16.09	0.43

[a]Significant difference (P<.05) between breeds.
[b]Significant difference (P<.01) between breeds.
[c]Significant difference (P<.05) between rations.
[d]Significant difference (P<.01) between rations.

there was a trend for the standard-fed lambs to produce a leaner carcass than the lambs fed the HE diet. A significant difference was found for percent fat in the carcass between breeds ($P<.05$). The differences between rations was much smaller ($P<.10$). However, this measurement was subject to considerable variation as evidenced by the relatively large standard errors. The Dorset-bred lambs yielded carcasses containing a greater percent fat than the black-faces, while the HE lambs produced a greater percent fat than the standard-fed lambs. These results agree with the findings of Kirton and Barton (1962), who found a correlation of 0.34 between dressing percentage and percent carcass fat. Barton and Kirton (1956) also found that specific gravity for estimating percentage fat content could adequately be applied to sheep.

The percent bone in the carcass was significantly different between breeds ($P<.01$) and between rations ($P<.05$). The black-face lambs had a greater percent bone in the carcass than the Dorsets and the lambs fed the HE diets had a smaller percent bone than those lambs fed the standard ration. An explanation for this type of finding could be that as the degree of fatness increases, the percent of bone decreases (Moulton et al., 1922). The Dorsets were fatter than the black-faces and the lambs fed the HE ration were fatter than those fed the standard ration. If Moulton's theory holds true, then the Dorsets and the HE animals should have a smaller percent bone. This exact pattern developed in this experiment. The pounds of bone in the lean cuts were significantly greater ($P<.01$) for the black-face lambs. When this was expressed as a percent of the untrimmed and trimmed lean cuts, no significant difference was found due to the ration. This is in agreement with the work of Butcher (1961) who found that lambs fed a conventional diet had a greater skeletal development than those fed a high concentrate diet.

Correlation Coefficients

In order to determine if the same correlation existed between two measurements between treatments, intraclass correlations were calculated. These are given in Appendix tables 15, 16, 17, and 18. Since discrepancies between the various correlations in different treatment groups is more likely to be due to chance than most other things, a z transformation test was used to determine how much difference between two r_i must be needed to be significant.

The intraclass correlations were based only on 10 degrees of freedom. Since no breed x ration interactions were found in the analyses of variance calculations, pooled correlations within breed, within ration, and on an over-all pooled basis were obtained in order to study the interrelationships between certain variables.

Average daily gain, loin-eye area, backfat, and percent trimmed loin were correlated to the same, selected live animal and carcass measurements in both the intraclass and pooled correlations.

Table 7 gives the pooled correlation coefficients between average daily gain and selected live animal and carcass measurements. Although the average daily gain was negatively correlated with the increase in leg circumference in the standard-fed lambs, the correlation was positive in the HE-fed lambs and the difference between the correlations was significant ($P<.05$). This difference could be due to chance alone. Loin-eye area per cwt. of carcass was positively correlated when the standard ration was fed, but negatively correlated when the HE diet was fed. Over-all pooled correlations suggest that as the average daily gain increased, percent loin and percent carcass bone increased, while percent carcass fat decreased.

Table 8 gives the pooled correlation coefficients between loin-eye area and selected live animal and carcass measurements. Several highly significant over-all relationships were found. Loin-eye area was correlated to percent leg (0.508), percent loin (0.378), percent rib (0.293), and percent lean in carcass (0.436), irregardless of breed and ration. This agrees with the work of several investigators (Bailey et al., 1961; Ament et al., 1962; Cole et al., 1959; and Kropf, 1959). Although the correlations for these individual cuts were quite large, the correlation for percent trimmed lean cuts was only 0.154. This could have been due

TABLE 7

CORRELATIONS BETWEEN AVERAGE DAILY GAIN AND SELECTED LIVE AND CARCASS MEASUREMENTS POOLED WITHIN BREED AND RATION, AND OVER-ALL POOLED

	Breed		Ration		Over-All
	Dorset	Black-face	Standard	HE	Pooled
Pooled Correlation Coefficient Between Average Daily Gain and:					
Inc. in Loin Width	0.098	-.401	-.106	-.137	-.119
Inc. in Leg Cir.	-.112	-.401	-.475*[2]	0.168[2]	-.224
Inc. in Rump Length	-.116	-.268	-.123*	-.274	-.181
Inc. in Body Length	-.412*	-.294	-.436	-.318	-.382**
Inc. in HG Cir.	-.054	0.058	-.094	0.109	-.015
LEA/cwt. Car.	0.294	0.278	0.518**[2]	-.113[2]	0.284
BF/cwt. Car.	-.232	0.284	-.198	0.064	-.038
Percent Trmd. Leg	0.346	0.129	0.486*	-.021	0.256
Percent Trmd. Loin	0.465*	0.106	0.549**	0.173	0.356*
Percent Trmd. Rib	-.225	-.148	0.083	-.439*	-.179
Percent Trmd. Shoulder	0.288	-.170	0.290	-.023	0.149
Percent Bone in Carcass	0.465*	0.075	0.419*	0.141	0.309*
Percent Lean in Carcass	0.283	-.031	0.305	-.044	0.077
Percent Fat in Carcass	-.475*	-.082	-.586**	-.001	-.323*
L.C. Yield (Live Wt. Basis)	0.364	-.178	0.263	0.028	0.158

*P<.05 = .404 with 22 DF within each breed and ration and .288 with 46 DF within over-all pooled.

**P<.01 = .515 with 22 DF within each breed and ration and .372 with 46 DF within over-all pooled.

[1]Significantly different correlations (P<.05=1.96) between breeds.

[2]Significantly different correlations (P<.05=1.96) between rations.

TABLE 8

CORRELATIONS BETWEEN LEA/CWT. CARCASS AND SELECTED LIVE AND CARCASS MEASUREMENTS POOLED WITHIN BREED AND RATION, AND OVER-ALL POOLED

	Breed		Ration		Over-All
	Dorset	Black-face	Standard	HE	Pooled
Pooled Correlation Coefficient Between LEA/CWT. Carcass and:					
Inc. in Loin Width	-.226	-.020	-.102	-.148	-.120
Inc. in Leg Cir.	-.190	-.379	-.391	-.077	-.278
Inc. in Rump Length	-.046	-.446*	-.408*	-.022	-.256
Inc. in Body Length	-.126	0.120	0.079	-.196	-.034
Inc. in HG Cir.	-.061	0.039	0.006	-.063	-.019
BF/Cwt. Car.	-.561**	-.215	-.442*	-.454*	-.405**
Percent Trmd. Leg	0.689**	0.313	0.501*	0.536**	0.508**
Percent Trmd. Loin	0.552**	0.107	0.308	0.486*	0.378**
Percent Trmd. Rib	0.415*	0.207	0.254	0.360	0.293*
Percent Trmd. Shoulder	0.420*	-.038	0.198	0.320	0.245
Percent Bone in Carcass	0.389	0.063	0.278	0.167	0.237
Percent Lean in Carcass	0.589**	0.249	0.395	0.507*	0.436**
Percent Fat in Carcass	-.712**	-.264	-.459*	-.591**	-.507**
L.C. Yield (Live Wt. Basis)	0.472*[1]	-.231[1]	0.103	0.232	0.154

*P<.05=.404 with 22 DF within each breed and ration and .288 with 46 DF within over-all pooled.

**P<.01=.515 with 22 DF within each breed and ration and .372 with 46 DF within over-all pooled.

[1]Significantly different correlations (P<.05=1.96) between breeds.

[2]Significantly different correlations (P<.05=1.96) between rations.

to the fact that the individual cuts were expressed as a percentage of the carcass and did not include the dressing percentage variable, while the total percent lean cuts were expressed on a live weight basis.

In table 9 it can be seen that there were no significantly different correlations between breeds when backfat per cwt. of carcass was correlated to the various live and carcass measurements. However, there were strong negative correlations in both breeds for percent shoulder and percent carcass lean, while a strong positive relationship was found between backfat and percent carcass fat. Over-all correlations of -.252 and -.357 were noted for percent leg and loin, respectively. This is in disagreement with the work of Enfield et al. (1962), who found a positive relationship between these variables. Some of this difference could have been due to differences in cutting procedures or fat trimming procedures. Backfat was negatively correlated with percent carcass lean (-.421), but positively correlated with percent carcass fat (0.501). The percent lean correlation agrees with the findings of Kemp and Varney (1962) and the percent fat relationship agrees with the work of Judge et al. (1963).

According to Barton and Kirton (1958b), the loin is one of the most preferable anatomical joints to use as an index of the entire lamb carcass composition. Therefore, table 10 gives the correlations found between percent trimmed

TABLE 9

CORRELATIONS BETWEEN BF/CWT. CARCASS AND SELECTED LIVE AND CARCASS MEASUREMENTS POOLED WITHIN BREED AND RATION, AND OVER-ALL POOLED

	Breed		Ration		Over-All
	Dorset	Black-face	Standard	HE	Pooled
Pooled Correlation Coefficient Between BF/CWT. Carcass and:					
Inc. in Loin Width	0.131	-.119	-.327	0.255	-.030
Inc. in Leg Cir.	-.005	-.283	-.294	-.023	-.098
Inc. in Rump Length	-.245	-.073	-.187	-.166	-.159
Inc. in Body Length	0.319	-.122	-.223[2]	0.402[2]	0.171
Inc. in HG Cir.	-.301	-.197	-.356	-.058	-.261
Percent Trmd. Leg	-.319	-.169	-.478*	-.146	-.252
Percent Trmd. Loin	-.397	-.289	-.329	-.381	-.357*
Percent Trmd. Rib	-.251	-.106	-.369	-.087	-.170
Percent Trmd. Shoulder	-.500*	-.563**	-.361	-.627**	-.511**
Percent Bone in Carcass	-.315	-.035	-.200	-.068	-.196
Percent Lean in Carcass	-.403	-.448*	-.608**	-.352	-.421**
Percent Fat in Carcass	0.528**	0.464*	0.481*	0.540**	0.501**
L.C. Yield (Live Wt. Basis)	-.369	0.162	-.036	-.047	-.150

*P<.05=.404 with 22 DF within each breed and ration and .288 with 46 DF within over-all pooled.

**P<.01=.515 with 22 DF within each breed and ration and .372 with 46 DF within over-all pooled.

[1]Significantly different correlations (P<.05=1.96) between breeds.

[2]Significantly different correlations (P<.05=1.96) between rations.

TABLE 10

CORRELATIONS BETWEEN PERCENT TRIMMED LOIN AND SELECTED LIVE AND CARCASS MEASUREMENTS POOLED WITHIN BREED AND RATION, AND OVER-ALL POOLED

	Breed		Ration		Over-All
	Dorset	Black-face	Standard	HE	Pooled
Pooled Correlation Coefficient Between Percent Trimmed Loin and:					
Inc. in Loin Width	-.393	-.111	-.142	-.357	-.271
Dressing Percent	-.214	-.416*	-.318	-.249	-.278
Specific Gravity	0.423*	0.529**	0.568**	0.335	0.447**
LEA/Cwt. Car.	0.551**	0.107	0.308	0.486*	0.378**
BF/Cwt. Car.	-.289	-.289	-.329	-.381	-.357*
Percent Trmd. Leg	0.516**	0.448*	0.551**	0.421*	0.479**
Percent Bone in Carcass	0.400	0.484*	0.607**	0.238	0.420**
Percent Lean in Carcass	0.539**	0.389	0.690**	0.288	0.484**
Percent Fat in Carcass	0.107[1]	-.648**[1]	0.149	-.378	-.141
L.C. Yield (Live Wt. Basis)	0.768**[1]	0.059[1]	0.564**	0.499*	0.527**

*P<.05=.404 with 22 DF within each breed and ration and .288 with 46 DF within over-all pooled.

**P<.01=.515 with 22 DF within each breed and ration and .372 with 46 DF within over-all pooled

[1]Significantly different correlations (P<.05=1.96) between breeds.

[2]Significantly different correlations (P<.05=1.96) between rations.

loin and selected live animal and carcass measurements. No significantly different correlations for any of the variables were found between rations. However, a positive correlation for percent carcass fat in the Dorset breed was noted, while a negative one was found for the black-face breed. Also, there was a greater positive relationship between percent loin and lean cut yield in the Dorset lambs than in the black-faces. A negative relationship existed between percent loin and the increase in loin width, irregardless of breed or ration. An over-all correlation of -.278 was found for dressing percent. This may be expected since the percent loin had been trimmed of fat and dressing percent is influenced by the degree of fatness. Percent loin was highly correlated with specific gravity (0.447), loin-eye area (0.378), and backfat (-.357). Therefore, as the percent trimmed loin increases, specific gravity and loin-eye area should increase. Percent leg exhibited a positive correlation (0.479). Since percent loin was correlated to percent carcass lean to the extent of 0.484, the loin and leg may best typify whole carcass composition (Barton and Kirton, 1958b). Percent loin and percent carcass bone were also positively correlated (0.420), while a small negative correlation was found for percent carcass fat (-.141). These findings indicate that percent trimmed loin could be of some predictive value in estimating percent carcass lean and bone, irregardless of the breed of lambs or rations fed in this experiment.

SUMMARY

A study involving 48 Dorset x Rambouillet and Hampshire or Suffolk x Rambouillet (black-face) crossbred lambs was conducted to determine the effects of two breeds and two concentrate:roughage ratios on the carcass composition of lambs fed in drylot in early summer. A standard ration containing 50 percent concentrate was fed to 12 Dorsets and 12 black-faces. A HE ration containing 92 percent concentrate was fed to the same number of lambs of each breed.

Evidently lambs can be fed in drylot in the summer under Oklahoma climatic conditions. Also, lambs can be fed a high concentrate ration under these conditions without the occurrence of any major digestive disturbances.

The average daily gain for the four groups was 0.46, 0.47, 0.54, and 0.47 pounds for the standard Dorsets, HE Dorsets, standard black-faces, and HE black-faces, respectively. The only live measurement that exhibited any real difference between rations during the feeding period was the increase in loin width. The lambs fed the standard ration increased in this measurement to a greater extent than did those fed the HE ration, however, these lambs were smaller at the beginning of experiment. This measurement

was also the least variable of the live animal measurements. The black-face breed increased more in body length than did the Dorset breed.

The HE lambs dressed higher than the standard lambs and yielded lower specific gravity values, indicating the presence of more carcass fat. These lambs also had a tendency to have a greater backfat depth, while no difference due to either breed or ration was found for the area of the Longissimus dorsi. The lambs fed a standard ration developed larger trimmed loins, when expressed as a percent of the carcass, than did the HE-fed lambs. These lambs also yielded smaller percentages of fat trim from the loin. The Dorsets had a greater percent carcass fat than did the black-faces. The HE lambs also produced more carcass fat than did the standard-fed lambs. However, the reverse was true for the percent carcass bone. No significant treatment differences were found for total pounds of carcass lean.

There was a trend for the live measurements to be negatively correlated to average daily gain, irregardless of treatment. This could have been due to chance, since a large variation existed within the live measurements. This was due to the lack of a definite point from which to measure each time.

The loin-eye area was negatively associated with the percent of fat in the carcass, while high positive correlations were found between the backfat and percent fat in the carcass. Percent trimmed loin was highly correlated to percent trimmed leg, percent carcass lean, and percent carcass bone. Therefore, a combination of the leg and loin could be used to predict whole carcass composition.

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APPENDIX

TABLE 11

ANALYSIS OF VARIANCE OF LIVE MEASUREMENTS

	Breed MS[b]	Ration MS[b]	Breed x Ration MS[b]	Error MS[c]
Measurement:[a]				
Days on Feed	867.00	3.00	574.09	426.36
Average Daily Gain	0.01	0.01	0.02	0.01
Inc. in Loin Width	0.06	0.26[d]	0.00	0.09
Inc. in Leg Cir.	0.01	0.01	0.79	0.75
Inc. in Rump Length	0.16	0.69	0.10	0.57
Inc. in Body Length	6.20*	1.60	2.40	1.48
Inc. in HG Cir.	0.49	0.01	0.12	0.99

[a] Total DF=47
[b] 1 DF Trt
[c] 44 DF Error
[d] $P<.10$
* $P<.05$

TABLE 12

ANALYSIS OF VARIANCE FOR CARCASS MEASUREMENTS AND YIELD OF LEAN CUTS

Item[a]	Breed MS[b]	Ration MS[b]	Breed x Ration MS[b]	Error MS[c]
Dressing Percent	17.63[d]	60.96**	4.49	4.77
Specific Gravity	0.0004	0.002[d]	0.00	0.0001
Actual Area of L.D.	0.04	0.02	0.01	0.07
Area of L.D. per cwt. live	0.02	0.03	0.00	0.07
Area of L.D. per cwt. car.	0.32	0.09	0.00	0.29
Actual BF over L.D.	0.01	0.03[d]	0.01	0.01
Av. BF over L.D. per cwt. live	0.02	0.04	0.01	0.01
Av. BF over L.D. per cwt. car.	0.04	0.06	0.01	0.03
Percent Untrmd. Leg	18.93**	2.59	2.01	1.19
Percent Trmd. Leg	23.03**	3.11	1.89	1.74
Percent Untrmd. Loin	0.44	0.30	0.14	0.22
Percent Trmd. Loin	0.29	2.32	0.52	0.34
Percent Untrmd. Rib	0.01	0.00	0.44	0.25
Percent Trmd. Rib	0.02	0.02	0.10	0.22
Percent Untrmd. Shoulder	0.09	3.46[d]	0.22	1.01
Percent Trmd. Shoulder	1.21	1.96	0.14	1.41
Yield of Trmd. L.C. as a Percent of Live Wt.	1.46	9.20*	0.24	1.76
Trmd. Fat from L.C. as a Percent of Car. Wt.	5.61	3.28	0.01	3.57

[a] Total DF=47
[b] 1 DF TRT
[c] 44 DF Error
[d] P<.10
* P<.05
** P<.01

TABLE 13

ANALYSIS OF VARIANCE OF FAT TRIMMED FROM EACH LEAN CUT AND YIELD OF CHEAP CUTS

Item[a]	Breed MS[b]	Ration MS[b]	Breed x Ration MS[b]	Error MS[c]
Fat Trmd. from Leg as a Percent of Car. wt.	0.20	0.03	0.00	0.26
Fat Trmd. from Leg as a Percent of Untrmd. Leg wt.	9.54	1.44	0.22	4.79
Fat Trmd. from Loin as a Percent of Car. wt.	1.47*	1.13[d]	0.01	0.36
Fat Trmd. from Loin as a Percent of Untrmd. Loin wt.	157.69[d]	192.32*	6.60	43.60
Fat Trmd. from Rib as a Percent of Car. wt.	0.01	0.02	0.12	0.17
Fat Trmd. from Rib as a Percent of Untrmd. Rib wt.	0.39	7.39	9.10	31.92
Fat Trmd. from Shoulder as a Percent of Car. wt.	0.66	0.21	0.01	0.70
Fat Trmd. from Shoulder as a Percent of Untrmd. Shoulder wt.	14.35	1.48	0.18	13.88
Percent Kidney Knob	4.23[d]	2.96	0.10	1.33
Percent Fore Shank	2.27**	0.46[d]	0.00	0.13
Percent Rear Shank	0.27	0.00	0.03	0.16
Percent Neck	0.07	1.56[d]	0.01	0.22
Percent Brisket	0.13	0.05	0.06	0.33
Percent Ribs	0.08	0.38	0.19	0.67
Percent Flank	1.68	0.07	2.84	0.67

[a]Total DF=47
[b]1 DF TRT
[c]44 DF Error
*P<.10
**P<.01

TABLE 14

ANALYSIS OF VARIANCE OF CARCASS COMPOSITION

Item[a]	Breed MS[b]	Ration MS[b]	Breed x Ration MS[b]	Error MS[c]
Percent Protein in Chem. Analysis	1.08[d]	0.11	0.50	0.28
Total Lbs. Lean in Carcass	1.25	1.93	1.28	2.44
Total Lbs. Fat in Carcass	18.19*	26.30*	4.73	4.43
Total Lbs. Bone in Carcass	4.19**	0.78	0.13	0.44
Percent Lean in Carcass	14.08	12.87	1.66	5.32
Percent Fat in Carcass	59.90*	45.16[d]	5.66	13.76
Percent Bone in Carcass	21.90**	13.19*	0.07	2.34
Percent Waste in Carcass	0.27	0.11	0.98	2.44
Total Lbs. Bone in L.C.	2.33**	0.01	0.18	0.20
Bone in L.C. as a Percent of Untrmd. L.C. Wt.	21.83**	4.13	0.56	2.29
Bone in L.C. as a Percent of Trmd. L.C. Wt.	19.30**	3.05	0.94	2.23

[a]Total DF=47
[b]1 DF TRT
[c]44 DF Error
[d]P<.10
*P<.05
**P<.01

TABLE 15

INTRACLASS CORRELATIONS BETWEEN AVERAGE DAILY GAIN AND SELECTED LIVE AND CARCASS MEASUREMENTS

Breed	Dorset		Black-face	
Ration	Standard	HE	Standard	HE
Correlation Coefficient Between Average Daily Gain and:[a]				
Inc. in Loin Width	0.706*[2,3]	-0.042	-0.513[2]	-0.290[3]
Inc. in Leg Cir.	-0.503[1]	0.505[1,4,5]	-0.464[4]	-0.333[5]
Inc. in Rump Length	-0.068	-0.197	-0.213	-0.359
Inc. in Body Length	-0.441	-0.421	-0.423	-0.122
Inc. in HG Cir.	-0.190	0.128	0.055	0.089
LEA/Cwt. Car.	0.617*[1]	-0.224[1]	0.431	0.053
BF/Cwt. Car.	-0.379	-0.181	0.093	0.404
Percent Leg	0.681*[1]	-0.162[1]	0.133	0.127
Percent Loin	0.642*	0.276	0.257	0.000
Percent Rib	0.032	-0.587*	0.167	-0.359
Percent Shoulder	0.375	0.154	0.000	-0.291
Percent Bone in Carcass	0.615*	0.146	0.007	0.139
Percent Lean in Carcass	0.429	-0.106	-0.079	0.000
Percent Fat in Carcass	-0.703*	-0.055	-0.247	0.000
L.C. Yield (Live Wt. Basis)	0.455	0.266	-0.046	-0.333

*$P < .05 = .576$ with 10 DF

**$P < .01 = .708$ with 10 DF

[a]Any correlations bearing the same superscript number are significantly ($P \leq .05 = 1.96$) different by z transformation test.

TABLE 16

INTRACLASS CORRELATIONS BETWEEN LEA/CWT. CARCASS AND SELECTED LIVE AND CARCASS MEASUREMENTS

Breed	Dorset		Black-face	
Ration	Standard	HE	Standard	HE
Correlation Coefficient Between LEA/Cwt. Carcass Wt. and:[a]				
Inc. in Loin Width	-0.192	-0.265	-0.046	0.029
Inc. in Leg Cir.	-0.288	-0.064	-0.483	-0.101
Inc. in Rump Length	-0.203	0.161	-0.555	-0.173
Inc. in Body Length	0.031	-0.289	0.140	0.070
Inc. in HG Cir.	0.013	-0.142	0.000	0.216
BF/Cwt. Car.	-0.674*	-0.567	-0.233	-0.259
Percent Leg	0.772**	0.586*	0.229$_2$	0.491
Percent Loin	0.632*[2]	0.477	-0.183[2]	0.510
Percent Rib	0.451	0.377	0.095	0.394
Percent Shoulder	0.301	0.573	0.051	-0.160
Percent Bone in Carcass	0.502	0.204	0.028	0.132
Percent Lean in Carcass	0.664*	0.482	0.016	0.594*
Percent Fat in Carcass	-0.723**	-0.702*	-0.096	-0.520
L.C. Yield (Live Wt. Basis)	0.459	0.491	-0.224	-0.259

*$P<.05=.576$ with 10 DF
**$P<.01=.708$ with 10 DF
[a]Any correlations bearing the same superscript number are significantly ($P<.05=1.96$) different by z transformation test.

TABLE 17

INTRACLASS CORRELATIONS BETWEEN BF/CWT. CARCASS AND SELECTED LIVE AND CARCASS MEASUREMENTS

Breed Ration	Dorset Standard	 HE	Black-face Standard	 HE
Correlation Coefficient Between BF/Cwt. Carcass Wt. and:[a]				
Inc. in Loin Width	-0.084	0.207	-0.517	0.323
Inc. in Leg Cir.	-0.020	0.003	-0.577*	-0.066
Inc. in Rump Length	-0.079	-0.374	-0.280	0.099
Inc. in Body Length	0.071	0.448[4]	-0.641*[4,6]	0.316[6]
Inc. in HG Cir.	-0.240	-0.350	-0.473	0.111
Percent Leg	-0.657*	-0.169	-0.264	-0.121
Percent Loin	-0.628*[2]	-0.316	0.216[2]	-0.521
Percent Rib	-0.238	-0.275	-0.493	0.058
Percent Shoulder	-0.365	-0.636*	-0.422	-0.612*
Percent Bone in Carcass	-0.523	-0.244	0.234	-0.202
Percent Lean in Carcass	-0.625*	-0.376	-0.650*	-0.364
Percent Fat in Carcass	0.727**	0.507	0.056	0.605
L.C. Yield (Live Wt. Basis)	-0.290	-0.425	0.235	0.123

$*P<.05=.576$ with 10 DF

$**P<.01=.708$ with 10 DF

[a]Any correlations bearing the same superscript number are significantly ($P<.05=1.96$) different by z transformation test.

TABLE 18

INTRACLASS CORRELATIONS BETWEEN THE PERCENT TRIMMED LOIN AND SELECTED LIVE AND CARCASS MEASUREMENTS

Breed	Dorset		Black-face	
Ration	Standard	HE	Standard	HE
Correlation Coefficient Between Percent Trimmed Loin and:[a]				
Inc. in Loin Width	-0.157	-0.542	-0.199	-0.041
Dressing Percent	-0.770**[1,2]	0.158[1,5]	0.011[2,6]	-0.819**[5,6]
Specific Gravity	0.607*	0.182	0.454	0.568
LEA/Cwt. Car.	0.632*[2]	0.477	-0.182[2]	0.510
BF/Cwt. Car.	-0.628*[2]	-0.316	0.216[2]	-0.521
Percent Leg	0.757**	0.291	0.135	0.657*
Percent Bone in Carcass	0.695*	0.039	0.415	0.545
Percent Lean in Carcass	0.864**[1,2]	0.091[1]	0.058[2]	0.558
Percent Fat in Carcass	0.362[2,3]	-0.200	-0.641*[2]	-0.658*[3]
L.C. Yield (Live Wt. Basis)	0.672*[3]	0.844**[5]	0.419	-0.260[3,5]

*$P < .05 = .576$ with 10 DF

**$P < .01 = .708$ with 10 DF

[a]Any correlations bearing the same superscript number are significantly ($P < .05 = 1.96$) different by z transformation test.

VITA

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