Differences in Growth Pattern and Carcass Development of Angus Bulls, Steers and Heifers*

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In recent years there has been an increased interest in comparisons of the growth and carcass development of young bulls, steers and heifers. It is generally known that steers gain more rapidly than heifers and previous research at this station and others has indicated bulls gain more rapidly than steers.

This study provides information from a relatively large number of cattle of similar genetic background and fed under similar conditions. The present study does not provide information relative to possible differences in consumer acceptability of meat produced from bulls, steers and heifers. However, reliable measures of growth and carcass development were obtained.

Materials and Methods

The data used in this study were obtained from 279 Angus calves raised in the Experiment Station herd at Lake Blackwell Range, Stillwater. The number involved in each sex and year were:

Year	1964	1965	Total
Bulls	35	50	85
Steers	30	47	77
Heifers	44	73	117

All calves were born during the spring and were not creep fed. One-half of the male calves from each sire were selected at random and castrated at an average age of 3 months. Calves were weaned at an average age of 205 days and shipped to the Fort Reno Station where they began a 168 day feeding period.

Weaning weights were adjusted to a 205 day basis as follows: Actual weaning weight minus birth weight divided by actual age in days times 205 plus birth weight. This weight was then adjusted for age of dam by multiplying by 1.15, 1.10, and 1.05 for calves from 2, 3, and 4 year old dams, respectively. No age of dam adjustments were made for calves from cows 5 years of age and older.

Bulls, steers and heifers were self-fed in separate groups, each receiving a similar 40 percent roughage ration each year. Average daily gain was calculated on a 154 day basis from weaning weight to final weight. Final weight being defined as the average of the 140, 154, and

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168 day feedlot weights. Adjusted yearling weight is equal to the adjusted 205 day weaning weight plus 160 times average daily gain in the feedlot.

Upon completion of the feeding period, all animals were shipped to Arkansas City, Kansas, for slaughter. Average age at the time of slaughter was 12.3 months. Carcass conformation score, marbling score, carcass grade and estimated percentage kidney fat were provided by the same packing house personnel each year. Final carcass grades were in agreement with those of the USDA grader. Rib-eye area and fat thicknesses were measured from tracings made in the cooler after the carcasses were quartered in the normal manner between the 12th and 13th ribs.

Carcass cutability was calculated by the following equation developed and reported by Murphey *et al.* (1960).

$$\text{Cutability} = 52.56 - 4.95X_1 - 1.06X_2 + 0.682X_3 - 0.008X_4$$

where:

Cutability = percentage of carcass weight as boneless retail cuts from round, loin, rib and chuck
X_1 = single fat thickness over rib-eye, inches
X_2 = percentage kidney fat
X_3 = area of the rib-eye, square inches
X_4 = hot carcass weight, pounds

Results and Discussion

Growth

Average measures of growth and feedlot performance of bulls, steers and heifers are presented in Table 1.

Male calves were 4 pounds heavier than females at birth. Adjusted weaning weights were 464, 454 and 425 pounds for bulls, steers and heifers, respectively. Bulls and steers were considerably heavier than heifers at weaning, although the difference (10 pounds) between bulls and steers was somewhat less than is generally reported. It should be kept in mind that calves were castrated at an average age of 3 months and without any tendency to select the less desirable individuals for castration.

The data in Table 1 indicate that sex differences became more pronounced during the feedlot period. Bulls gained substantially faster in the feedlot than steers, and steers gained more rapidly than heifers. Average daily gains in the feedlot were 2.88, 2.46 and 1.99 pounds for bulls, steers and heifers, respectively, during the 168 day feeding period. It was interesting to notice that no serious behavioral problems were encountered in self-feeding groups of 35 and 50 bulls.

Table 1: Growth and Feedlot Measures of Bulls, Steers and Heifers

	Average			Standard Error[1]
	Bulls	Steers	Heifers	
Number	85	77	117	
Birth weight, lbs.	62.3[2]	----	58.2	.82
Weaning weight, lbs.[3]	464.0	454.0	425.0	5.25
Av. daily feedlot gain, lbs.[3]	2.88	2.46	1.99	.027
Feed/gain, lbs.	7.85	8.57	9.71	---
Yearling weight, lbs.[3]	925.0	848.0	743.0	7.39

[1] Standard errors based on steer values.
[2] Includes all males.
[3] See materials and methods section for calculation procedures.

All feeding was done on a group basis and therefore only group averages for feed efficiency were available. Pounds of feed per pound of gain were 7.85, 8.57 and 9.71 for bulls, steers and heifers, respectively. Feed efficiency results followed the pattern which would be expected since faster gaining animals generally require less feed per pound of gain. There appeared to be a definite advantage in feed efficiency for bulls over steers and for steers over heifers. Comparisons of feedlot daily gain and feed efficiency are depicted in Figure 1.

Adjusted yearling weights were 925, 848 and 743 pounds for bulls, steers and heifers, respectively. These weights reflect the differences in weaning weight and feedlot gain. Weaning, yearling and hot carcass weights of bulls, steers and heifers are shown in Figure 2. It is interesting to note that bulls were only 2.2 percent heavier than steers in adjusted weaning weight, but the difference had increased to 9.1 percent in adjusted yearling weight and 10.1 percent in carcass weight.

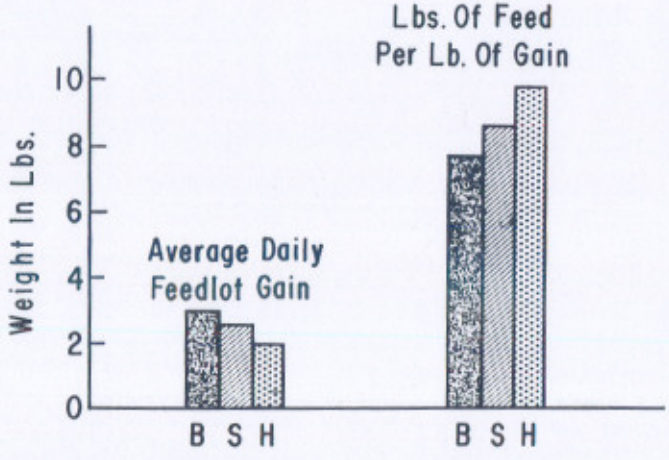

Figure 1. Average daily feedlot gain and feed efficiency for bulls, steers and heifers.

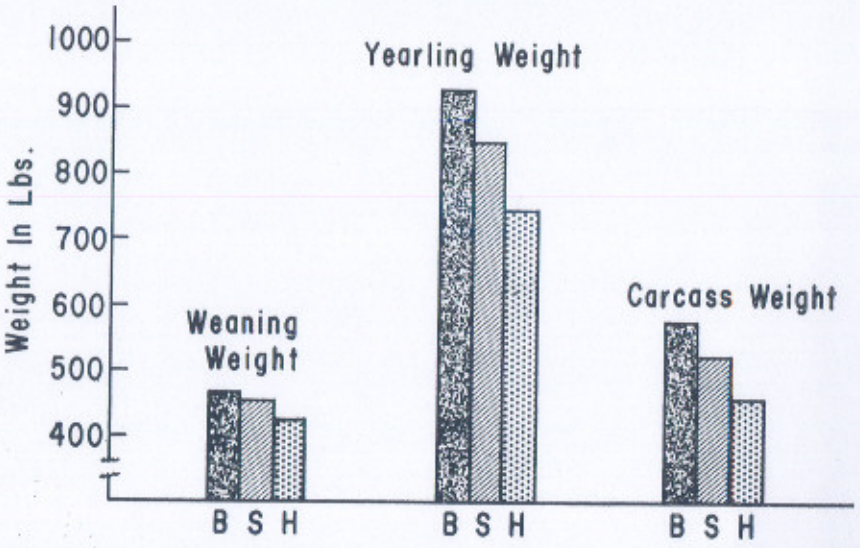

Figure 2. Comparisons of weaning, yearling and carcass weight of bulls, steers and heifers.

Carcass

It is important to keep in mind when reviewing the results from this study that all animals were fed for the same length of time. In some studies of this type cattle are slaughtered on a weight constant basis. Many of the carcass measurements might be different in the two cases because they are closely associated with carcass weight and dimensions.

Measures of carcass merit and development are summarized in Table 2. Large differences in carcass weight were found. The average carcass weights were 575, 522, and 457 pounds for bulls, steers and heifers, respectively. Although bull carcasses were heavier, they had less fat cover as measured by both average and single fat thickness between the 12th and 13th ribs. The average fat thickness was 0.54, 0.75 and 0.67 inches for bulls, steers and heifers, respectively. There was little difference between steers and heifers in fat thickness per hundred pounds of carcass weight. Estimated percentage kidney fat was considerably less for bulls (2.61 percent) than for steers (3.24 percent) or heifers (3.53 percent). When all of the measures of fatness are considered, we can conclude that bulls produced carcasses with substantially less fat while there was little difference in steers and heifers in this study. It must be remembered that different rations might have resulted in different gains and degrees of fatness and that the most desirable feeding regime may not be the same for the sexes.

Rib-eye area in square inches was significantly greater for bulls (12.16) than for steers (10.32) and heifers (9.88). However, there were only small differences in rib-eye area per hundred pounds of carcass

Table 2: Measures of Carcass Merit and Development of Bulls, Steers and Heifers

	Average			Standard Error[1]
	Bulls	Steers	Heifers	
Number	85	77	117	
Hot carcass weight, lbs.	575.0	522.0	457.0	5.95
Rib-eye area, sq. in.	12.16	10.32	9.88	.115
Rib-eye area/cwt. carcass	2.12	1.99	2.17	.021
Average fat thickness, in.	.54	.75	.67	.014
Single fat thickness, in.	.43	.61	.51	.014
Single fat thick./cwt. carcass	.074	.117	.113	.003
Kidney fat, percent	2.61	3.24	3.53	.087
Conformation score[2]	11.4	11.6	10.9	.15
Marbling score[3]	3.7	5.3	5.2	.08
Carcass grade[2]	8.8	10.9	10.4	.15
Dressing percentage[4]	61.9	62.7	61.3	----
Cutability, percent[5]	51.4	49.0	49.4	.140
Round yield, percent[6]	21.2	20.8	20.5	.109

[1] Standard errors based on steer values.
[2] Converted to the following numerical designations: low prime—13, high choice—12, average choice—11, low choice—10, high good—9, average good—8.
[3] Marbling score equivalents: moderate—7, modest—6, small—5, slight—4, traces—3.
[4] Calculated on basis of shrunk Ft. Reno live weight and hot carcass weight.
[5] Percent of carcass as boneless retail cuts from the round, loin, rib and chuck as described in materials and methods.
[6] Trimmed round expressed as a percent of hot carcass weight.

weight, with heifers actually having the largest ratio (Table 2). This would indicate the differences in rib-eye area were primarily due to differences in carcass weight.

Carcass conformation and marbling scores and final carcass grades are listed in Table 2. There was relatively little difference in carcass conformation scores of bulls (11.4) and steers (11.6) but both were higher than heifers (10.9). Bulls were significantly lower in marbling score, the averages being 3.7, 5.3 and 5.2 for bulls, steers and heifers, respectively (modest=6, small=5, slight=4, traces=3). The average final carcass grade for bulls was in the low end of high good, steers graded average choice and heifers low choice. The major reason for the lower carcass grade for bulls was probably their lack of marbling.

The percentage of carcass weight in trimmed round (round yield) is sometimes used as an indication of muscling in the carcass. Round yield percentages were 21.2, 20.8 and 20.5 for bulls, steers and heifers, respectively. Carcass cutability (percentage of carcass as boneless retail cuts from the round, loin, rib and chuck) values were 51.4, 49.0 and 49.4 for bulls, steers and heifers, respectively. If it can be assumed the cutability equation works equally well for different sexes, these results indicate bulls produced a greater percentage of lean meat in the carcass. Dressing percentages were 62.7 for steers, 61.9 for bulls and 61.3 for heifers.

Summary

Growth and carcass information from 85 bulls, 77 steers and 117 heifers were studied. All were Angus cattle raised and fed under similar conditions in each of the two years. One-half of the male calves from each sire were randomly selected for castration at an average age of 3 months. The cattle were self-fed for 168 days following weaning.

Male calves averaged 4 pounds heavier than females at birth. Heifers were substantially lighter than bulls and steers at weaning and bulls were only slightly heavier than steers.

Sex differences in growth became more pronounced during the feeding period. Average daily gain in the feedlot was 2.88 pounds for bulls, 2.46 pounds for steers and 1.99 pounds for heifers. Bulls were the most efficient in feed conversion requiring 7.85 pounds of feed per pound of gain as compared to 8.57 pounds for steers and 9.71 pounds for heifers. Differences in weaning weights and feedlot gains were reflected in yearling weights of 925, 848 and 743 pounds for bulls, steers and heifers, respectively.

Bulls produced significantly more lean meat with less fat than steers and heifers. There was little difference in carcass fatness of steers and heifers in this study. Bulls were higher in carcass cutability and yield of round. Steers were highest in dressing percentage with little difference between bulls and heifers.

Steers and heifers had a consistant advantage over bulls in carcass grade. Steers graded average choice, heifers low choice, and bulls in the low end of high good. The lower carcass grade for bulls was apparently a result of their deficiency in marbling.

The advantage of bulls in weight gain, feed efficiency and carcass cutability indicate the feeding of young bulls for slaughter may hold promise for increasing efficiency of production. Although, at the present time merchandising of bull meat may be a problem unless established marketing channels are available.

Literature Cited

Murphey, C. E., D. K. Hallett, W. E. Tyler and J. C. Pierce. 1960. Estimating yield of retail cuts from beef carcasses. J. Animal Sci. 19:1240 (Abstr.).