EFFECTS OF EARLY WEANING ON CARCASS AND RIBEYE STEAK CHARACTERISTICS OF BULLS AND STEERS

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Summary

Crossbred Hereford × Angus calves (n = 103) were used to determine the effect of early weaning on carcass and ribeye (longissimus muscle) characteristics of bulls and steers. Treatments were: 1) early-weaned (117 days of age) bulls, 2) early-weaned steers, 3) normal-weaned (220 days of age) bulls, and 4) normal-weaned steers. Cattle were harvested at 360 and 389 days of age. At 36 hours postmortem, carcass quality and cutability were measured. Ribeye steaks were aged 14 days and scored for color, Warner-Bratzler shear force, and sensory panel evaluations. Carcasses from early-weaned cattle had greater dressing percentages, heavier weights, greater fat thicknesses, and higher numerical USDA Yield Grades (lower cutability). They also had more marbling and greater USDA quality grades, but had similar longissimus color, shear force, and sensory panel scores, compared with those of normal-weaned cattle. Bulls had greater dressing percentages, but had similar carcass weights to steers. Bull carcasses had less fat thickness and greater ribeye areas, resulting in lower numerical USDA Yield Grades (higher cutability) than steers had. They also had less marbling, darker color, and lower USDA quality grades than steers did. Longissimus muscles from bulls were darker, had greater shear forces, and had lower sensory panel tenderness scores than those from steers. For early-maturing British-type cattle, early weaning is a viable management strategy to produce heavier, higher-quality carcasses than those of normal-weaned cattle. Carcasses from early-weaned cattle are fatter and have lower cutability. For a non-implant "natural" market, bulls could be an alternative for producing high-cutability carcasses. Steaks may be less tender, however, and pre-harvest management must be optimized to reduce dark-cutting carcasses.

Introduction

Some consumers prefer "natural" non-implanted beef with minimal fat. Feeding bulls may provide an opportunity to meet this specification and improve performance compared with that of steers. Increased muscle gain can be obtained through the use of bulls for beef production. Although the use of bulls for meat production was extensively researched in the early 1980s, it has not been evaluated in combination with the practice of early weaning. Early weaning of steers has been shown to increase marbling and may improve tenderness. Our objective was to investigate the use of early weaning and bulls on carcass composition and ribeye characteristics.

Procedures

One-hundred three male Hereford × Angus calves born from January 31 to April 6, 2003, were used in this experiment. Calves were blocked by birth date and sire, then randomly assigned to one of four treatment groups: 1) early-weaned (117 days of age) bulls, 2) early-weaned steers, 3) normal-weaned (220 days of age) bulls, and 4) normal-weaned steers.

Management and performance data are reported in the companion article. At average ages of 269 and 328 days, calves were weighed, and ultrasound (Aloka, Wallingford,

CT, and Cattle Performance Enhancement Company cattle software; Oakley, KS) was used to determine backfat over the first lumbar vertebra. Ultrasound measures were used to project harvest date. One pen from each treatment was randomly chosen for harvest when the steers were projected to have 0.4 inches of backfat. The remaining four pens were harvested when the bulls were projected to have 0.4 inches of backfat.

Three days before to harvest, four pens (one from each treatment) were assigned to the first harvest group and commingled for shipment. At 360 days of age, the first group was slaughtered at a federally inspected, commercial processing facility, and carcass data were collected. Five days before to the next harvest date, the remaining four pens were commingled for shipment, and they were slaughtered at 389 days of age.

Carcass cutability and quality characteristics were evaluated at 36 hours postmortem. Boneless rib sections (11-12 rib) were collected, transported to Kansas State University, and aged under refrigeration in vacuum-packaged bags for 2 weeks. After aging, rib sections were faced, and three 1-inch thick ribeye (longissimus muscle) steaks were obtained, starting from the posterior end, for Warner-Bratzler shear force, trained sensory panel, and pH evaluations, respectively. Instrumental and visual color at 14 days postmortem was collected on the first steak, which was later used for measuring Warner-Bratzler shear force.

Results and Discussion

Early-weaned cattle had greater dressing percentages, heavier hot carcass weights, greater external fat thicknesses, and higher numerical USDA Yield Grades (lower cutability) than normal-weaned cattle had (Table 1).

Bulls had greater dressing percentages, larger ribeye areas, and lower numerical USDA Yield Grades than steers had (Table 1). Sex class did not affect hot carcass weight. In a harvest group × sex class interaction, steers harvested at 389 days of age had the greatest fat thicknesses (Table 2); steers harvested at 360 days of age had greater fat thicknesses than did bulls harvested at 360 days of age, with bulls harvested at 389 days of age being intermediate.

Early-weaned cattle had greater marbling scores, resulting in higher average USDA quality grades than those of normal-weaned cattle (Table 1). Weaning time did not affect bone maturity or ribeye color.

Bulls had ribeyes with less marbling and a darker color than ribeyes from steers (Table 1). Bulls and steers exhibited similar bone maturity. In addition, bulls had a larger number of dark-cutting carcasses than steers did. Dark cutting results from the depletion of glycogen before harvest. When commingled before harvest, bulls in this study were more likely to become stressed and have greater energy (glycogen) expenditure than steers were, resulting in a larger percentage of dark-cutting carcasses.

At 14 days postmortem, longissimus muscle instrumental color, visual color, and pH were not affected by weaning time (Table 1). A sex class × harvest group interaction was observed, in which lower visual color scores (brighter and more cherry red) were observed for longissimus muscles from steers harvested at either 360 or 389 days of age than for longissimus muscles from bulls harvested at either 360 or 389 days of age (Table 2). In addition, longissimus muscles from bulls harvested at 389 days of age had lower visual color scores than did longissimus muscles from bulls harvested at 360 days of age. In support of visual color observations, longissimus muscles from bulls had lower L* and b* values, but greater a* values, than did longissimus muscles from steers (Table 1), indicating that bulls had

darker, redder, and less-yellow longissimus muscles.

In a harvest group × sex class interaction, steers harvested at 360 days of age had a lower longissimus muscle pH than did steers harvested at 389 days of age and bulls harvested at either 360 or 389 days of age (Table 2). These data agree with the greater incidence of dark cutters in bulls in the first harvest group, because dark-cutting beef has higher muscle pH and darker color scores than typical beef does.

Weaning time did not affect Warner-Bratzler shear force or sensory panel scores (Table 3). Cooked longissimus muscles from bulls were less tender than were longissimus muscles from steers, as indicated by greater shear force values, as well as lower sensory panel scores for myofibrillar tenderness, connective tissue amount, and overall tenderness. Steaks from bulls and steers had similar ($P>0.10$) sensory panel scores for juiciness, flavor, and off-flavor intensity.

Sensory panelists found more connective tissue in steaks from bulls than in those from steers. The amount of connective tissue detected by a sensory panel is often associated with connective-tissue maturation and collagen cross-linking. In addition, muscle dehydration due to pre-harvest stress may have contributed to decreased myofibrillar tenderness. The combination of myofibrillar and connective-tissue factors resulted in greater Warner-Bratzler shear force values and lesser overall sensory panel tenderness scores in steaks from bulls than in those from steers.

Except for flavor, sensory attributes and Warner-Bratzler shear forces were not affected by harvest group. Steaks from cattle harvested at 389 days of age had more beef flavor than did those from cattle harvested at 360 days of age. This may be partly attributed to a tendency of the later harvest group to have greater marbling scores.

For early-maturing British-type cattle, early-weaned cattle had heavier carcasses that were higher quality, but were fatter and had lower cutability, than those of normal-weaned cattle. Bulls may be an option for the production of “natural” non-implanted beef that has higher cutability than beef from steers, but steaks from bulls were less tender and had less marbling than did steaks from steers. Pre-harvest management must be optimized to prevent the occurrence of dark-cutting carcasses.

Table 1. Effects of Weaning Time, Sex Class, and Harvest Group on Carcass and Ribeye (Longissimus Muscle) Characteristics of Early-maturing British-type Cattle

	Weaning Time		Sex Class		Harvest Group[a]		
Item	Early[b]	Normal[c]	Steers	Bulls	360 days	389 days	SEM
No. of cattle	45	51	47	49	49	47	
Dressing percentage	61.6[j]	60.1[k]	60.5[m]	61.3[l]	60.3[o]	61.5[n]	0.3
Hot carcass weight, lb	695[j]	688[k]	672	666	655[o]	695[n]	10.6
Fat thickness, inches[d]	0.53[j]	0.41[k]	-	-	-	-	0.2
Ribeye area, inches[2]	11.90	12.10	11.7[m]	12.2[l]	11.9	11.9	0.14
USDA Yield Grade	3.22[j]	2.70[k]	3.24[l]	2.68[m]	2.80[o]	3.12[n]	0.08
Bone maturity[e]	160	163	161	162	165	158	5
Marbling scored[f]	399[j]	350[k]	387[l]	363[m]	369	381	8
Visual color (36 hours)[g]	4.20	4.50	3.5[m]	5.2[l]	4.4	4.2	0.2
USDA quality grade[h]	4.2[j]	3.6[k]	-	-	-	-	0.1
No. of dark cutters	5	6	2	9	7	4	
Instrumental color[i]							
L*	42.50	43.00	44.2[l]	41.2[m]	42.8	42.68	0.6
a*	27.40	28.10	26.7[m]	28.8[l]	26.9[o]	28.6[n]	0.4
b*	18.30	18.90	19.9[l]	17.3[m]	18.1	19.1	0.4
Visual color[dgi]	5.60	5.60	-	-	-	-	0.11
pH[di]	5.80	5.70	-	-	-	-	0.04

[a]One pen from each treatment combination was randomly selected for harvest at 360 or 389 days of age.
[b]Early-weaned calves were weaned at 117 days of age and entered the feedlot at 134 days of age.
[c]Normal-weaned calves were weaned at 220 days of age and entered the feedlot at 242 days of age.
[d]Sex class x harvest group interaction (P<0.05, Table 2).
[e]100=A-00, 200=B-00.
[f]Slight00=300, Small00=400.
[g]Scale of 1-8: 1=bleached red, 4=cherry red, 8=dark red.
[h]5=Choice-, 4=Select+, 3=Select-.
[i]Ribeye measurements at 14 days postmortem.
[jk]Within a row and weaning time, means having different superscript letters differ (P<0.05).
[lm]Within a row and sex class, means having different superscript letters differ (P<0.05).
[no]Within a row and harvest group, means having different superscript letters differ (P<0.05).

Table 2. Harvest Group x Sex Class Interaction Means for Carcass Traits and Ribeye Longissimus Muscle) Characteristics of Early-maturing British-type Cattle

	360 Days of Age		389 Days of Age		
Item	Steers	Bulls	Steers	Bulls	SEM
No. of cattle	24	25	23	24	
Fat thickness, inches	0.48[d]	0.38[e]	0.61[c]	0.41[de]	0.03
USDA quality grade[a]	4.0[d]	3.8[d]	4.4[c]	3.7[d]	0.2
Visual color[b]	5.1[e]	6.2[c]	5.2[e]	5.7[d]	0.15
pH, 14 days postmortem	5.6[d]	5.9[c]	5.8[c]	5.8[c]	0.06

[a]5=Choice-, 4=Select+, 3=Select-.
[b]Ribeye color scores of 1 to 8 at 14 days postmortem: 1=bleached red, 4=cherry red, 8=very dark red.
[cde]Within a row means having different superscript letters differ (P<0.05).

Table 3. Effects of Weaning Time, Sex Class, and Harvest Group on Ribeye (Longissmus Muscle) Sensory Panel Scores and Warner-Bratzler Shear Force Values of Early-maturing British-type Cattle

	Weaning Time		Sex Class		Harvest Group		
Item	Early	Normal	Steers	Bulls	360 days	389 days	SEM
No. of cattle	45	50	47	48	49	46	
Sensory panel[a]							
Myofibrillar tenderness	5.6	5.6	5.9[b]	5.3[c]	5.5	5.6	0.12
Connective tissue amount	6.8	6.8	7.0[b]	6.5[c]	6.0	7.0	0.07
Overall tenderness	5.7	5.7	6.0[b]	5.4[c]	5.7	5.8	0.12
Juiciness	5.7	5.7	5.7	5.7	5.8	5.7	0.07
Flavor	5.8	5.8	5.8	5.8	5.7[e]	5.9[d]	0.06
Off flavor	7.7	7.6	7.6	7.7	7.7	7.6	0.06
Shear force, lb	11.7	11.7	10.1[c]	12.6[b]	11.7	11.7	0.44

[a]Sensory panels evaluated steaks on an eight-point scale; (myofibrillar and overall tenderness: 1=extremely tough to 8=extremely tender; connective tissue: 1=abundant to 8=none; juiciness: 1=extremely dry to 8=extremely juicy; flavor: 1=extremely bland to 8=extremely intense; off flavor: 1=abundant to 8=none).
[bc]Within a row and sex class, means having different superscript letters differ (P<0.05).
[de]Within a row and harvest group, means having different superscript letters differ (P<0.05).