

EFFECT OF AGE AT SLAUGHTER ON BEEF CARCASS QUALITY AND TENDERNESS TRAITS

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Story in Brief

Steers (n = 140) of predominantly Angus heritage were randomly allocated among five chronological age treatment groups: EW = early weaned directly to the feedlot at 3.5 months of age, NW = normally weaned and placed in the feedlot at 7.9 months, WP = backgrounded on wheat pasture for 112 days then placed in the feedlot at 11.6 months, SG = dry wintered and then grazed on early, intensively managed native range for 68 days prior to feedlot placement at 15.4 months, LG = dry wintered and season long grazed on native range for 122 days prior to feedlot placement at 17.4 months of age. Steers were slaughtered after reaching a pen mean of 0.56 inch of subcutaneous fat thickness. No differences were noted in skeletal maturity between carcasses from steers placed directly in the feedlot vs backgrounded steers. Percentages of U.S. Choice carcasses were 78.6, 67.9, 71.4, 82.1, and 64.3% for EW, NW, WP, SG, LG, respectively. Shear force values tended to be higher for the ribeye (EW = 7.97, NW = 8.55, WP = 7.31, SG = 6.61, LG = 6.75 lb) and shoulder clod (EW = 8.30, NW = 9.03, WP = 8.10, SG = 7.53, LG = 7.85 lb) between the steers placed directly in the feedlot (EW and NW) vs backgrounded age groups (WP, SG, LG). Greater than 89% of the ribeye, 78% of the top round, 78% of the shoulder clod, and 64% of the top sirloin butt steaks could be classified as tender (shear force < 10 lb) regardless of age group. Variability in shear force tended to decrease with increasing chronological age at slaughter for the ribeye, top round, and clod steaks; however top sirloin butt steaks failed to show any consistent changes in variation with increasing age.

(Key Words: Beef, Tenderness, Age.)

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Introduction

Results from the National Tenderness Survey (Morgan et al., 1991) indicated considerable variation in tenderness among retail beef steaks, especially steaks from locomotive regions of the carcass. Furthermore, the Oklahoma Market Basket Study (Nick et al., 1992) reported similar results in that approximately 1 out of every 2 steaks surveyed from the beef round could be perceived as tough by consumers. Consequently, the National Cattlemen's Association is considering recommendations to improve the current quality grading system to increase consistency in tenderness of beef retail steaks. One of the questions asked by cattlemen is -- among feedlot steers and heifers, does age at slaughter affect quality grade and tenderness of beef? Hence, the objective of our study was to evaluate the effect of age at slaughter on carcass grade traits and shear force of steaks from four different anatomical locations.

Materials and Methods

One hundred and forty steers of predominantly Angus heritage were obtained from 2 reputable herds and randomly allocated among five chronological age treatment groups: EW = early weaned directly to the feedlot at 3.5 months of age, NW = normally weaned and placed in the feedlot at 7.9 months, WP = backgrounded on wheat pasture for 112 days then placed in the feedlot at 11.6 months, SG = dry wintered and then grazed on early, intensively managed native range for 68 days prior to feedlot placement at 15.4 months, and LG = dry wintered and season long grazed on native range for 122 days prior to feedlot placement at 17.4 months of age. All groups were fed a high concentrate ad libitum diet in 7 head pens. Steers were commercially slaughtered upon reaching a subjectively evaluated pen mean of 0.5 inch of subcutaneous fat thickness. Days on feed varied per treatment (EW = 287, NW = 198, WP = 134, SG = 124, LG = 100 days) resulting in differing ages at slaughter (EW = 13.1, NW = 14.5, WP = 16.1, SG = 19.6, LG = 20.7 months).

Following slaughter, carcasses were chilled for 48 hours at which time data was collected for quality grade determinations (USDA, 1989). The left side of each carcass was then shipped to the Oklahoma State University Meats Laboratory where 1.0 inch thick steaks were removed representing the ribeye, top sirloin butt, top round, and shoulder clod subprimals. Steaks were then vacuum packaged, aged for 14 days, and subsequently frozen at -30°C until the entire feeding trial was completed. Steaks were then removed by type and thawed at 2°C for a period of 18 hours. Steaks were cooked to a medium degree of doneness (70°C) using open hearth broilers. Upon cooling to room temperature, an average of 6 cores 0.5 inches in diameter were removed for Warner-Bratzler shear force determinations.

The statistical model included ranch (n=2), age treatment (n=5), and the ranch x age treatment interaction. All individual carcass variables were adjusted to the mean s.c. fat thickness (0.56 inch) within each ranch x age treatment subclass. Orthogonal contrasts were partitioned to examine the following effects:

DB = directly weaned to the feedlot (EW, NW) vs backgrounded (WP, SG, LG)

EN = early (EW) vs normal weaned (NW)

WG = wheat (WP) vs native range backgrounding (SG, LG)

SL = short (SG) vs long (LG) backgrounding on native range

Results and Discussion

Quality grade traits and shear force values are reported in Table 1. All maturity scores were well within the "A" maturity classification (USDA, 1989). Skeletal, lean, and overall maturity scores differed ($P < .05$) for the short vs long grazed contrast, where carcasses from the short grazed steers exhibited

Table 1. Maturity, marbling, and shear force values stratified by age treatment.

Item	Early weaned	Normal weaned	Wheat pasture	Short grazed	Long grazed	Effect ^c
Maturity Score ^a						
Skeletal	A49	A59	A51	A38	A61	SL
Lean	A33	A34	A45	A37	A45	DB,SL
Overall	A41	A46	A48	A38	A53	SL
Marbling Score ^b	Sm36	Sm19	Sm21	Sm47	Sm27	--
Shear Force, lb						
Ribeye	7.97	8.55	7.31	6.61	6.75	DB
Clod	8.30	9.03	8.10	7.53	7.85	DB
Top Round	7.87	8.47	8.35	8.28	8.48	--
Top Butt	8.71	9.34	9.26	8.90	9.04	--

^a Maturity scores of "A" = approximately 9 to 30 months of chronological age at slaughter (USDA, 1989).

^b Marbling score of "Sm" = small degree, the minimum required for U.S. Choice quality (USDA, 1989).

^c SL = Significant difference ($P < .05$) for short grazed (SG) vs long grazed (LG) steers; DB = Significant difference ($P < .05$) for steers sent directly to the feedlot (EW, NW) vs backgrounded steers (WP, SG, LG).

more youthful scores coinciding with younger chronological ages. Furthermore, lean maturity differed ($P < .05$) for the directly placed steers vs the backgrounded steers in that carcasses from steers placed directly in the feedlot were observed to have more youthful lean scores. Interestingly, despite the 7.6 month range in chronological age at slaughter, no ($P > .05$) differences were noted using the current methodology for assessing skeletal maturity between carcasses from directly placed (EW and NW) steers vs those from backgrounded steers.

Marbling scores were similar ($P > .05$) for all age groups with all groups attaining a "small" degree of marbling, the minimum requirement for the U.S. Choice quality grade. High percentages of U.S. Choice carcasses were observed regardless of age group. Percentages ranged from 64.3% for the long grazed group to 82.1% for the short grazed group. Interestingly, even the early weaned treatment group exhibited 78.6% U.S. Choice.

No ($P > .05$) differences were noted in shear force values for top round or top sirloin butt steaks between age groups. However, there was a significant difference between ribeye and clod steaks; steaks from directly placed steers had higher shear force values than those from backgrounded steers.

Shackelford et al. (1991) recommended categorizing steak shear force values into tender (10 lbs. or less) and very tender (8.5 lbs. or less) levels. Greater than 89% of the ribeye, 78% of the top round, 78% of the shoulder clod, and 64% of the top sirloin butt steaks could be classified as tender regardless of age group. These percentages are higher than those observed by Morgan et al. (1991) and Nick et al. (1992), in retail surveys, especially for the top round steaks. Our study differs in that the round steaks were cut 1 inch thick instead of the historical 0.5 inch thickness at retail. Upon cooking, thicker round steaks could yield more tender cores due to less moisture loss and increased core length. Furthermore, the steers used in this study were similar in breed type and were fed a high concentrate diet to a constant fat thickness endpoint. Relative to steak types, a similar pattern in tenderness was observed within each age group in a declining fashion ranging from the ribeye (most tender) to the top sirloin butt (least tender). A noticeable decline in tenderness was observed for all steaks within the normally weaned age group; however, these percentages are still considered to be high relative to retail tenderness surveys which represent a much more diverse population of cattle.

Very tender ratings across age treatment groups tended to be highest for ribeye steaks except among directly placed (EW and NW) steers where the top round steaks exhibited the highest percentages. Percentage very tender steaks increased with increasing age at slaughter for ribeye and clod steaks; top round steaks, normally higher in connective tissue tended to decrease with advancing animal age. Top sirloin butt steaks showed the lowest percentage of very tender steaks and showed very little change regardless of age group.

Variation reported as plus or minus 2 standard deviations is shown for shear force values of each steak type stratified by age treatment in Figure 1. A

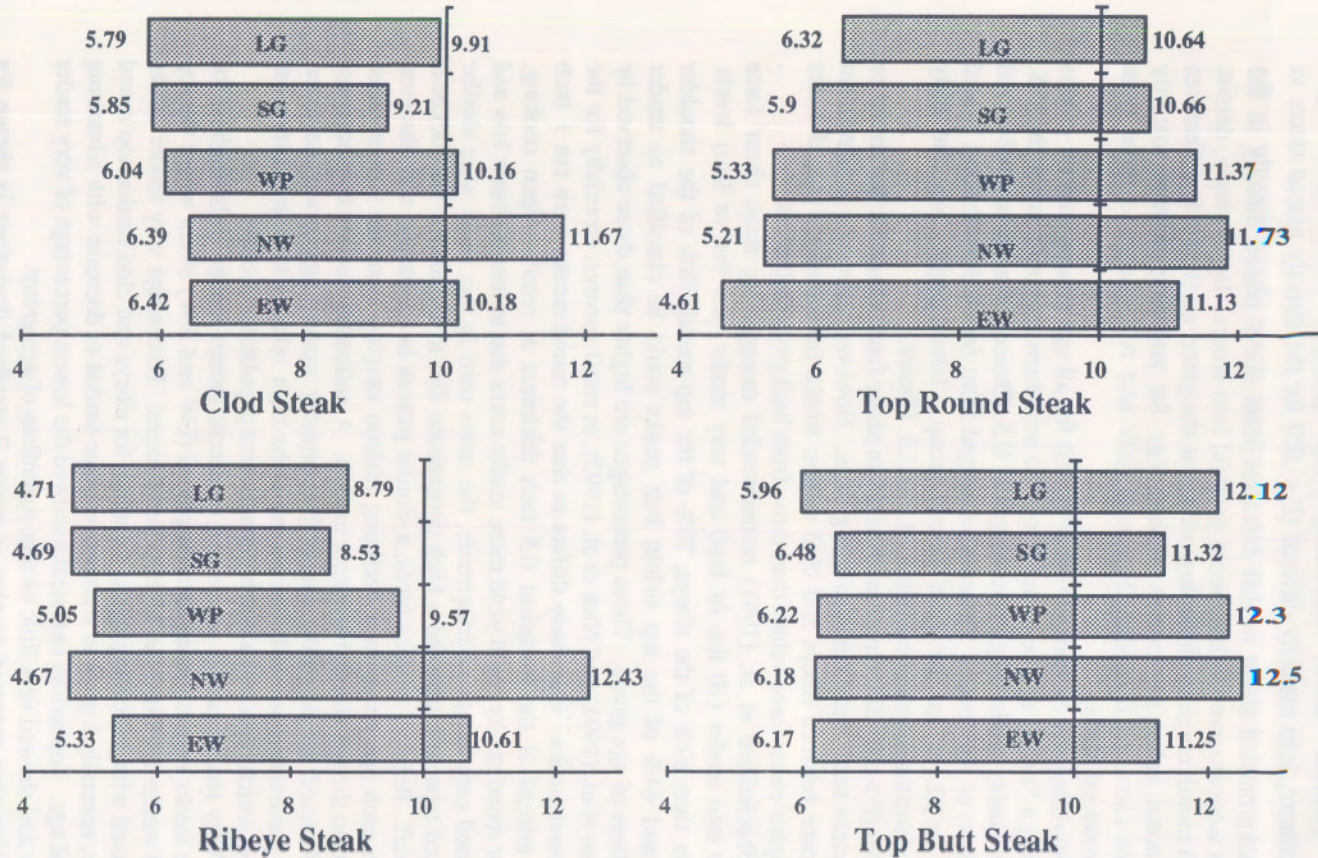


Figure 1. Variation in shear force for each steak by age treatment (NW = Normal Weaned, EW = Early Weaned, WP = Wheat Pasture, SG = Short Grazed, and LG = Long Grazed).

similar trend was observed for clod, ribeye, and top round steaks in that shear force values became more consistent (less variable) with increasing chronological age at slaughter beyond the normally weaned treatment group. Top sirloin butt steaks did not change in shear force variation regardless of age group. Consequently, the belief that baby-fed beef, or calves placed directly in the feedlot, will be less variable in tenderness compared to yearling or long yearling fed beef is unfounded in this study.

Implications

In this study, similar skeletal maturity characteristics were noted despite known differences in chronological age. Furthermore, considering the breed type used, steers slaughtered at a constant subcutaneous fat thickness endpoint (0.56 in) may achieve high percentages of U.S. Choice carcasses, even if slaughtered at less than 15 months of age. High percentages of tender steaks were observed regardless of steak type or age class. Therefore, accelerated beef management programs can be utilized for the production of tender beef. However, more extensive research is needed to address tenderness variation within certain steak types, namely the top sirloin butt.

Literature Cited

- Morgan, J.B. et al. 1991. National tenderness survey. *J. Anim. Sci.* 69:3278-3280
- Nick, C.L. et al. 1992. Oklahoma market basket survey. Master's Thesis, Oklahoma State University, Stillwater, OK
- Shackelford, S.D. et al. 1991. Identification of threshold levels for Warner-Bratzler shear force in beef top loin steaks. *J. Musc. Foods* 2:289
- USDA. 1989. Official United States standards for grades of carcass beef. AMS-USDA, Washington, DC