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Summary

A two-year study compared steers from the same herd finished as calves or yearlings at a fat thickness endpoint of 0.5 in. Yearlings yielded heavier carcasses with larger ribeye areas, lower marbling scores and lower quality grades. Calves produced more tender steaks measured by shear force and a consumer taste panel. The probability of a tough steak (based on shear force) from calf-fed steers was 1.9 and 0.02% for 7 and 21 days of aging, respectively, while the risk for yearlings was 29.2 and 4.0%, respectively. Calf-fed steers produced more tender steaks and, after 21 days of aging, steaks from yearlings were similar.

Introduction

Beef calves are fed in a variety of systems that supply finished beef every week of the year. Thirty to 35% of the calves are placed on-feed soon after weaning (calf-feds). Others are grown or backgrounded for various time periods before being placed on feed. Yearlings that graze green grass in the summer before entering the feedlot are at the other end of the spectrum from calf-feds. Yearling systems are more extensive, growing calves for a longer period of time on forage before being fed a high concentrate diet for a short period prior to harvest. Although this reduction of days on a high concentrate diet may reduce costs, it has been associated with higher quality grades and less tender beef. Regardless of the management practice used to increase profitability, cattle produced must be acceptable for the feedlot and yield a final product desirable to the consumer.

Variable results exist within the literature when comparing meat quality from finished calves and yearlings. Most studies do not use herdmates in the various production systems, may have varied slaughter end points of age or weight, and use small populations. Therefore, this study compared carcass characteristics and meat palatability of contemporary steers produced in calf-fed and yearling systems to a constant fat thickness endpoint.

Procedure

Steers (3/4 British, 1/4 Continental) were randomly assigned to be finished as calves or yearlings at weaning. Thirty-five and 41 calves and 42 and 41 yearlings were designated in years 1 and 2, respectively.

Each year at weaning, steers to be finished as calves were implanted (Synovex-S©) and were adapted from a 50% concentrate diet to a 92.5% concentrate finishing diet (TDN 84%, CP 12%) fed until harvest. Reimplantation (Revalor-S©) occurred after 90 days on feed. All steers were fed to an estimated 12th-rib fat thickness endpoint of 0.5 in. To achieve this, Year 1 steers were on feed for 203 days and Year 2 steers were fed for 180 days. The calf-fed steers were about 13 to 14 months old at the time of harvest.

Steers to be finished as yearlings were drylotted for 60 days, until corn stalks became available for grazing. While in drylot, these steers were fed ammoniated wheat straw ad libitum and supplemented with mineral and 5 lb/head/day (DM basis) of wet corn gluten feed. Steers then grazed corn stalks for 78 days in Year 1 and 91 days in Year 2. While on corn stalks, these steers were supplemented with mineral and 5 lb/head/day (DM basis) corn gluten feed. Hay was supplemented during heavy snow cover. After grazing corn stalks, steers were again drylotted for the remainder of the wintering period until pasture was available for spring and summer grazing. Spring drylot was 64 days in Year 1 and 50 days in Year 2. Following the spring drylotting period, steers grazed pastures for 96 days in Year 1 and 103 days in Year 2. Steers were implanted (Revalor-G©) before summer grazing. Spring grazing pastures consisted of smooth bromegrass. Summer grazing pastures consisted of big bluestem, indiangrass and switchgrass. Following the summer grazing period, steers entered the feedlot, were reimplanted (Revalor-S©), blocked by weight and assigned randomly to one of two pens. Steers then were fed similarly to the calves for receiving and finishing periods. This final finishing period consisted of 93 days in Year 1 and 90 days in Year 2. Yearling steers were approximately 19 to 20 months old at the time of harvest.

Steers were harvested in a commercial slaughter facility. Shortly after being bled, carcasses were electrically stimulated with 8 to 10 low voltage (40 V) pulses. Hot carcass weights were obtained from all

Table 1. Comparison of means for carcass characteristics from calf- and yearling-finished steers.

	Calves		Yearlings	
Trait	Mean	SE	Mean	SE
Hot carcass weight, lb	695.7[b]	7.42	828.0[c]	7.00
Fat thickness, in	0.55	0.018	0.51	0.017
Adjusted fat thickness, in	0.59	0.015	0.56	0.015
Longissimus muscle area, in^2	11.28[b]	0.10	12.56[c]	0.10
Kidney, pelvic, and heart fat, %	2.33[b]	0.053	2.07[c]	0.050
Yield grade	3.49	0.054	3.46	0.050
Marbling score[a]	454.1[b]	8.80	346.1[c]	8.28

[a]Marbling score: modest = 500-599; small = 400-499; slight 300-399.
[bc]Means on the same row without a common superscript are different (P < 0.01).

Table 2. Mean shear force values, in pounds for steaks aged 7, 14, or 21 days from calf- and yearling-finished steers.

	Calves		Yearlings	
Age, d	Mean	SE	Mean	SE
7	7.27[c]	0.196	9.00[e]	0.240
14	6.76[b]	0.196	8.24[d]	0.240
21	6.15[a]	0.196	7.49[c]	0.240

[abcde]Means without a common superscript are different (P < 0.05).

Table 3. Mean sensory panel ratings[a] for steaks aged 7 or 14 days from calf- or yearling-finished steers.

		Calves		Yearlings	
Age, day	Trait	Mean	SE	Mean	SE
7	Juiciness	5.08[e]	0.032	4.88[f]	0.039
	Tenderness	5.46[b]	0.034	4.56[d]	0.043
	Flavor	4.96[e]	0.033	4.64[f]	0.041
	Overall acceptability	5.07[e]	0.032	4.47[f]	0.039
14	Juiciness	4.86[f]	0.032	4.61[g]	0.039
	Tenderness	5.59[c]	0.034	4.63[d]	0.043
	Flavor	4.99[e]	0.033	4.70[f]	0.041
	Overall acceptability	5.03[e]	0.032	4.49[f]	0.039

[a]Evaluated on an 8-point scale where 4 = slightly undesirable and 5 = slightly desirable.
[bcd]Means for a given trait without a common superscript are different (P < 0.05).
[efg]Means for a given trait without a common superscript are different (P < 0.01).

steers at the time of slaughter. In Year 1, carcasses were chilled for an extended 48 hour weekend chill period. Carcasses in Year 2 were chilled for approximately 42 hours. After the chill period, carcasses were ribbed to expose the 12th rib interface and allowed to bloom for approximately 20 minutes. A marbling score was assigned to the carcass by the USDA grader. Other carcass data were measured and evaluated by experienced University of Nebraska personnel. Carcass measurements were used to calculate yield and quality grades. A boneless beef strip loin was collected from the left side of each carcass. Two strip loins from calf-fed cattle were lost during the fabrication process, so additional data analysis continued on 34 and 40 strip loins in Year 1 and Year 2, respectively.

At 7 d postmortem, strip loins were cut into one-inch steaks for proximate analysis, Warner-Bratzler shear force and sensory panel evaluation. After the designated aging time, shear force and sensory steaks were frozen at -8°F.

Steaks were broiled to an internal temperature of 158°F. After cooling, 8 to 10 cores (1/2-inch in diameter) were removed and sheared using a Warner-Bratzler shear attachment to an Instron Universal testing machine. The mean peak shear force (lb) of at least 6 cores was calculated for each steak.

Steaks for sensory evaluation were cooked by the same procedure as described for shear force. After cooking they were cut into 1 x 2 x 1 cm pieces for evaluation. Samples were served to a consumer sensory panel (n≥30). An 8-point Hedonic scale (8 = extremely desirable; 1 = extremely undesirable) was used to evaluate tenderness, juiciness, flavor and overall acceptability.

Results

Carcass characteristics for calf-finished and yearling-finished steers are summarized in Table 1. Yearling steers yielded heavier (P<0.01) carcass weights with larger (P<0.01) longissimus muscle areas, and less (P<0.01) kidney, pelvic and heart fat. They also had lower (P<0.01) marbling scores, USDA quality grades and percentage of carcasses grading USDA Choice or higher when compared to carcasses of calf-fed steers. The differences in marbling scores were confirmed with chemical analysis (8.5 versus 5.5% fat). Production data from this experiment are in the 2003 Nebraska Beef Report, pp. 3-5.

Steaks from calves had lower (P < 0.01) shear force values at 7, 14 and 21 days of age (Table 2) than steaks from yearlings. They were also rated higher (P<0.01) for tenderness, as well as juiciness, flavor, and overall acceptability (Table 3) after 7 and 14 days of aging. As

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expected, increased aging time from 7 to 14 to 21 days produced steaks with lower (P<0.10) shear force values, regardless of production system (Table 3). Yearlings produced steaks that, after aging 21 days, had similar shear force values to calf-fed steaks aged 7 days.

When quality grades were grouped to compare palatability traits at equal quality grades, USDA Choice steaks from calf-fed steers had lower shear forces and were more desirable for all palatability attributes (P<0.05) than Choice steaks (Table 4) from yearlings. The same was true for USDA Select grade steaks; differences in palatability and tenderness were not due solely to differences in marbling.

Wheeler et al. (Proceedings, Recip. Meat Conf. 50:68-77) categorized "tender," "intermediate," and "tough" steaks as having less than 6.6 lb, between 6.6 and 10.5 lb, and greater than 10.5 lb of shear force. Using these limits, the risk probability was calculated for steaks from calf-fed and yearling systems at 7, 14 and 21 days of aging (Table 5). Steaks from calves had a very low risk of being "tough" at 7 days (1.92%) and relatively no risk (0.02%) by 21 d. Steaks from yearlings showed a much higher risk (29.2%) of being "tough" after 7 days of aging than steaks from calves. This risk decreased substantially with increasing aging time to 11.89% (14 days) and 4.02% (21 days). Previous research (1995 Nebraska Beef Report, pp. 53-56) revealed less risk of tough (high shear force) beef from yearlings. It is unclear why the results of this study are of greater magnitude.

Growing steers for a longer period of time on forage with a short finishing period resulted in heavier carcasses with lower quality grades and beef that was less tender than calf-fed steers. Steers finished as calves spent more days in the feedlot and in this study produced beef that was more tender with more acceptable eating characteristics than yearlings. Objective tenderness differences that were evident after 7 days of aging were similar after 21 days of aging.

Table 4. Mean sensory ratings for USDA Choice and Select steaks from calf- and yearling-finished steers.

		Calves		Yearlings	
Grade	Trait[a]	Mean	SE	Mean	SE
Choice	Juiciness	5.07[b]	0.026	4.93[c]	0.051
	Tenderness	5.62[e]	0.028	4.77[g]	0.055
	Flavor	5.01[e]	0.027	4.76[f]	0.053
	Overall acceptability	5.11[e]	0.026	4.65[g]	0.051
Select	Juiciness	4.87[c]	0.036	4.57[d]	0.022
	Tenderness	5.43[f]	0.039	4.41[h]	0.024
	Flavor	4.94[e]	0.038	4.58[g]	0.023
	Overall acceptability	4.99[f]	0.036	4.32[h]	0.022

[a]Evaluated on an 8-point scale where 4 = slightly undesirable and 5 = slight desirable.
[bcd]Means for a given trait without a common superscript are different (P < 0.05).
[efgh]Means for a given trait without a common superscript are different (P < 0.01).

Table 5. Risk probability for shear force values of loin (longissimus muscle) steaks from calf- and yearling-finished steers (percentages).

	Calves			Yearlings		
Age	tender	intermediate	tough	tender	intermediate	tough
7	41.00	57.08	1.92	8.11	62.68	29.20
14	52.81	46.52	0.67	12.67	75.44	11.89
21	69.68	30.30	0.02	21.08	74.90	4.02

[a]Shear force rate: <6.6 lb = tender; between 6.6 and 10.5 lb = intermediate; >10.5 lb = tough.

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