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Influence of Stocking Rate, Creep Feed, and Electrical Stimulation on Carcasses of Calves Slaughtered at Weaning

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SUMMARY

Forty fall-born calves were divided into four pre-weaning treatments and slaughtered when weaned at an average age of 262 days. Pre-weaning treatments consisted of grazing a bermudagrass-arrowleaf clover-ryegrass sward at three stocking rates with both a creep fed and non-creep fed group on the light stocked paddocks. Average stocking rates during the 133-day trial were .81, .81, 1.39, and 2.71 cow-calf units per acre for light stocked + *ad libitum* creep feed (LSC); light stocked pasture only (LSP); medium stocked (MS); and heavy stocked paddocks (HS), respectively. Weaning weights and corresponding average daily calf gains, respectively, were 789 and 2.86 (LSC); 734 and 2.55 (LSP); 650 and 2.31 (MS); and 597 lbs and 1.70 lbs/hd/da (HS). Light stocked creep fed calves had heavier carcasses, but did not differ from LSP calves with respect to USDA yield grade, *longissimus* muscle area, fat thickness, % KPH, or fat color. Fat color did not differ among groups, but rated relatively high (4.5 to 4.8) on a 5-point scale. Steaks from U.S. Good-Choice steers (Not-ES) were slightly more palatable than those from certain Not-ES calf sides but no definite trends with respect to pre-weaning treatments were evident. There were no palatability differences between steaks from Not-ES U.S. Good-Choice steers and steaks from ES calf sides. Retail steaks from ES sides had brighter ($P<.05$) muscle color on all days of display and were more desirable ($P<.05$) on day 0 of display than steaks from Not-ES sides. Neither stocking rate nor sex of calf substantially altered retail appearance of steaks. In addition, sex of calf did not drastically affect any of the physical or sensory traits evaluated.

Introduction

The rapid acceleration in costs of beef production has caused producers to seek alternative marketing procedures for maximizing net returns for their cattle. One of these alternatives has been that of maintaining continuous ownership of cattle from birth to slaughter, thereby eliminating the separate, traditional stocker and feeder ownership phases. The commercial operator who maintains ownership must produce an animal whose carcass not only meets the quality control criteria of lean, yet palatable, beef, but also that meets the profit demands of the total operation. One such approach to attaining this type lean beef is that of producing a suitable carcass weight and grade as rapidly as possible. By providing animals of superior genetic potential with that of nutritious

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forages, heavyweight weanling calves may be produced and slaughtered directly at weaning. The objective of this study was to evaluate the influence of stocking rate, creep feed, and electrical stimulation on carcass characteristics of heifers and steers slaughtered at weaning.

Procedure

Forty fall-born half-Simmental calves and their F-1 Brahman x Hereford dams grazed bermudagrass-arrowleaf clover-ryegrass paddocks from February 26 to July 8. Three stocking rates, light (LSP), medium (MS), and heavy (HS), were maintained throughout the pre-weaning grazing period. A fourth treatment group was maintained on light stocked paddocks and these calves received a 12% protein, commercially prepared creep feed (LSC). In the three non-fed groups, two steers, two heifers and their dams were assigned to each of two replicate paddocks. Four steers, four heifers and their dams were assigned to each of two replicate paddocks of the LSC groups. All animals were weighed at the start of the trial and at 28-day intervals throughout the 133-day grazing period. Paddock size ranged from 2.5 to 5.3 acres. A put-and-take, variable stocking rate technique was used to maintain the desired forage availability for each stocking rate. The HS paddocks had sufficient grazing pressure to maintain forage height at 2 in. or less. This grazing pressure allowed for less than 175 lbs/ac of dry forage available to the animals. Both the LSC and LSP paddocks had more than 2000 lbs/ac of available forage at all times. Forage availability on the MS paddocks averaged 785 lbs/ac during the trial. Forage availability and production were measured at 28-day intervals using the cage-difference technique. Forage inside and outside the cages was hand-clipped to a 0-in. height on all paddocks.

On July 8, all calves were weighed off pasture, transported 125 miles via trailer to a commercial slaughtering facility, and allowed to rest overnight. The calves were slaughtered at approximately 24 hours post-weaning, and each carcass split longitudinally into sides. The left sides were electrically stimulated (ES) using a Britton 300® unit, with 12 impulses of 550 volts (AC), 2 amps for a 3-second duration with a 2-second interval between impulses. At 96-hours postmortem, each side was ribbed and the following yield grades factors and quality characteristics were evaluated by Texas Agricultural Experiment Station personnel: carcass weight; lean, skeletal, and overall maturity; carcass conformation; degree of marbling; USDA quality grade (1972); lean color; firmness, and texture; subcutaneous fat color (1 = extremely yellowish orange; 5 = white); fat thickness over the longissimus muscle at the 12-13th rib interface; estimated percentage of kidney, pelvic, and heart (KPH) fat; longissimus muscle area; USDA yield grade; and amount of marbling.

On the fourth day postmortem, the wholesale rib was removed from both sides of each calf carcass. The longissimus muscle was removed from the 10th-12th rib area of each side on the fifth day postmortem and three steaks (each 1.0 in. thick) were cut beginning at the 12th rib end and proceeding cranially for shear force determinations, sensory panel evaluations, and for retail display. Ten wholesale ribs from U.S.

Good-Choice beef carcasses that were not electrically stimulated (Not-ES) were selected after five days aging, and one steak was cut from the 12th rib end of each for sensory panel comparisons. Steaks for sensory panel and shear force determinations were individually wrapped with polyethylene-coated paper, frozen, and stored at 10 F. The steaks prepared for retail display evaluations were placed in plastic foam trays (one steak per rib per tray) and overwrapped with polyvinyl chloride film. After packaging, all steaks were displayed (36 F, 1625 lux of incandescent light) for 3 days. At 24-hr intervals, a nine-member trained panel visually evaluated the steaks for muscle color, surface discoloration, and overall appearance.

For palatability evaluations, each steak was removed from the freezer, thawed (36 F), and broiled to an internal temperature of 160 F by use of a Farberware Open-Hearth Broiler. Steaks designated for shear force were cooled to room temperature (74 F), cores .5 in. diameter) removed, and shear force determinations made with a Warner-Bratzler shear force machine. An eight-member trained sensory panel evaluated steaks for juiciness, muscle fiber tenderness, overall tenderness, flavor, panel-detectable connective tissue and overall palatability.

Results

Grazing pressures used to maintain desired levels of forage availability resulted in stocking rates of .81 cow-calf units per acre for the light stocked plus creep feed (LSC) and light stocked pasture only (LSP) groups, and increased to 1.39 and 2.71 cow-calf units per acre for medium (MS) and heavy stocked (HS) paddocks, respectively (Table 1). Weaning weights were not only affected by stocking rate, but were also enhanced by creep feeding and depressed by the unseasonably hot, dry weather during June and early July. Calves assigned to the creep-fed group gained slightly more than 1.7 lbs/hd/da during the last 28-day period and only consumed an average of 1.98 lbs/da creep feed during the entire trial. Gain per acre from the HS group was more than double that of either the LSC or LSP groups.

Mean values for USDA yield grade factors and subcutaneous fat color for calf carcasses from the four pre-weaning grazing treatments are presented in Table 2. Except for carcass weight, sides of calves from LSC and LSP did not differ in physical traits. As stocking rate increased, carcass weights were lighter with smaller <u>longissimus</u> muscle area, less adjusted fat thickness, and kidney, pelvic and heart fat, and better yield grade (lower numerical value). Carcasses from the HS calves were significantly different ($P<.05$) in these physical traits than carcasses from LSC calves.

Non-electrically stimulated (Not-ES) sides from calves on HS paddocks had higher ($P<.05$) lean maturity scores, and lower scores for marbling, USDA conformation, USDA quality grades, lean texture, and lean firmness scores than did Not-ES sides of LSC calves (Table 3). Not-ES sides from calves in LSC and LSP groups did not differ, and Not-ES sides from calves in LSP and MS groups did not differ in quality-indicating characteristics. Although the carcasses in this study were not ribbed until 96 hours postmortem, ES improved quality characteristics in 6 of 7 comparisons ($P<.05$) within the LSC group; 3 of 7 ($P<.05$) within the LSP group; 3 of 7 ($P<.05$) within the MS group; and 5 of 7 ($P<.05$) within the HS group.

Sensory characteristics and cooking losses of rib steaks from Not-ES and ES calf sides, and U.S. Good-Choice beef carcasses (Not-ES) are shown in Table 4. Steaks from Not-ES U.S. Good-Choice carcasses were generally superior to those steaks from Not-ES calves with respect to muscle fiber tenderness, overall tenderness, and overall palatability. Significant $P<.05$) differences between steaks from Not-ES calf sides from the stocking rate groups were found for juiciness, connective tissue amount, overall palatability and shear force values, but these differences did not suggest any clearly defined trends.

It has been reported that except for juiciness, grain-fed steers generally were more palatable than forage-fed calves at weaning, and it has been well-documented that grain-fed beef has superior physical and sensory traits than does forage-fed beef. Data from this study, however, (Table 4) suggests that the ES of carcasses from LSC, LSP, MS, and HS results in steaks that do not differ in palatability from Not-ES U.S. Good-Choice beef steaks. When comparing steaks from ES sides to their paired sides within each stocking rate, no significant differences were found within LSP, MS, and HS groups. However, within the LSC group, steaks from ES sides had higher ($P<.05$) sensory panel ratings for muscle fiber tenderness and overall tenderness.

Past research has indicated that forage-fed beef steaks deteriorate rapidly under retail sales conditions. Table 5 reports comparisons of retail appearance for boneless rib steaks from Not-ES and ES calf sides stratified according to stocking rate. At the beginning of the retail case period, steaks from Not-ES sides from LSC and LSP had brighter ($P<.05$) muscle color than steaks from Not-ES HS sides. However, no significant differences ($P>.05$) were observed between retail cuts from Not-ES sides for muscle color, surface discoloration and overall appearance after day 0. Unlike results for steaks from Not-ES sides, ES resulted in muscle color being increasingly less desirable with increased stocking rate and remained so for the duration of the display period. Among the stocking rate groups, ES sides were more desirable than Not-ES sides in the LSC and LSP groups.

With only minor exceptions, neither physical, sensory, nor retail carcass characteristics substantially differed ($P>.05$) with sex of calf. Thus, for calf carcasses there is no basis upon which price differentials for differences due to sex class can be justified. Heifer calves should be as valuable as steers if slaughtered at weaning; and this, alone, would result in a significant increase in positive cash flow at the producer level if the lack of difference was recognized by packers.

From these data, the use of weanling calf meat should not receive negative criticism because of age or size of carcass. The use of creep feed did not produce any significant advantages over non-fed, pasture-only calves with respect to physical or sensory carcass traits. There was evidence, however, that electrical stimulation of carcasses from creep-fed calves had a more positive effect on carcass characteristics than on those carcasses from non-fed calves. Therefore, unless the weight-gain advantage or USDA quality grade improvement is sufficient to offset the cost of the supplemental feed, it may be difficult to justify the use of creep feed in preparing calves for slaughter at weaning.

Table 1. Weanling calf performance from various stocking rate paddocks

Item	Light Stocked: Creep Fed	Light Stocked: Pasture Only	Medium Stocked	Heavy Stocked
Stocking rate, AU/ac	.81	.81	1.39	2.71
Age at weaning, days	265	265	258	259
Avg. weaning wt., lbs	789[a]	734[a]	650[b]	597[b]
Steer weaning wt., lbs	821[a]	763[ab]	692[bc]	622[c]
Heifer weaning wt., lbs	757[a]	698[b]	610[c]	572[c]
Calf ADG, lbs/da	2.86[a]	2.55[b]	2.31[b]	1.70[c]
Steer ADG, lbs/da	3.09[a]	2.73[ab]	2.53[b]	1.68[c]
Heifer ADG, lbs/da	2.63[a]	2.36[b]	2.08[b]	1.71[c]
Gain/ac, lbs/ac	308[a]	275[a]	427[b]	613[c]

[abc] Means within the same row with a common superscript are not different (P>.01).

Table 2. Mean values for USDA yield grade factors and subcutaneous fat color for calf carcasses stratified according to stocking rate.

Trait	Light Stocked: Creep Fed	Light Stocked: Pasture Only	Medium Stocked	Heavy Stocked
Carcass weight, lbs	439[a]	399[b]	346[c]	324[c]
USDA yield grade[d]	1.9[b]	1.6[ab]	1.4[a]	1.3[a]
Longissimus muscle area, $in.^2$	9.9[a]	9.8[a]	9.5[ab]	8.9[b]
Adjusted fat thickness 12th rib, in.	.18[a]	.12[ab]	.09[b]	.05[b]
Kidney, pelvic and heart fat, %	2.4[b]	2.1[b]	1.8[ab]	1.3[c]
Fat color[e]	4.5[a]	4.5[a]	4.8[a]	4.8[a]

[abc]Means in the same row with a common superscript letter are not different (P>.05).

[d]All calves were yield graded according to USDA (1975) grade standards for carcass beef.

[e]5 = nearly white; 1 = yellowish orange.

Table 3. Mean values for certain quality-indicating characteristics from untreated (Not-ES) and electrically stimulated (ES) calf sides stratified according to stocking rate.

Trait	Not-ES				ES			
	Light Stocked				Light Stocked			
	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked
Lean maturity[d]	Ca^{50a}	Ca^{40a}	Ca^{48a}	Ca^{78b}	Ca^{39a}	Ca^{38a}	Ca^{29a}	Ca^{60b}
Skeletal maturity[d]	Ca^{66a}	Ca^{70a}	Ca^{63a}	Ca^{59a}	Ca^{66a}	Ca^{70a}	Ca^{63a}	Ca^{59a}
Overall maturity[d]	Ca^{59a}	Ca^{56a}	Ca^{55a}	Ca^{68a}	Ca^{53a}	Ca^{50a}	Ca^{51}	Ca^{59a}
Marbling score[e]	PD^{76a}	PD^{45ab}	PD^{35b}	PD^{10b}	PD^{66a}	PD^{36ab}	PD^{46ab}	PD^{16b}
Carcass conformation score[e]	Ch^{85a}	Ch^{53ab}	Ch^{28b}	Ch^{23b}	Ch^{85a}	Ch^{53ab}	Ch^{28b}	Ch^{23b}
USDA quality grade[e]	G^{99a}	G^{99a}	G^{88a}	G^{38b}	CH^{09a}	Ch^{11a}	Ch^{05a}	G^{69b}
Lean color[f]	7.3^{ab}	7.9^{a}	7.1^{ab}	6.4^{b}	7.6^{a}	8.0^{a}	7.4^{ab}	6.8^{b}
Lean firmness[g]	7.1^{a}	7.3^{a}	6.8^{a}	5.1^{b}	7.4^{a}	7.6^{a}	7.3^{a}	6.3^{b}
Lean texture[h]	6.4^{a}	7.1^{a}	6.4^{a}	4.6^{b}	7.3^{b}	8.0^{a}	7.2^{b}	6.1^{c}

[abc]Means in the same row within the same treatment (ES or Not-ES) with a common letter are not different (P>.05).

[d]Calves slaughtered at chronological ages of 3 to 9 months generally produce carcasses with physiological maturity indicators described as Ca^{00} to Ca^{100}, respectively in USDA (1972) grade standards for calf carcasses.

[e]Based on descriptions included in USDA (1972) grade standards of calf carcasses.

[f]8 = light grayish-red; 1 = very dark red or purple.

[g]8 = very firm; 1 = very soft.

[h]8 = very fine; 1 = very coarse.

*Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr et al., 1979). P>.05 was reported as nonsignificant (NS).

Table 4. Mean values for palatability characteristics and cooking losses of rib steaks from untreated (Not-ES) and electrically stimulated (ES) calf sides and U.S. Good-Choice beef carcasses (Not-ES)

	Not-ES					ES				
	Light Stocked					Light Stocked				
	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	U.S. Good-Choice	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	U.S. Good-Choice
Juiciness	5.5[b]	6.0[ab]	5.7[ab]	6.1[a]	5.8[ab]	5.4[b]	5.8[ab]	5.8[ab]	6.1[a]	5.8[ab]
Muscle fiber tenderness[d]	4.9[b]	4.2[b]	4.3[b]	5.4[ab]	6.2[a]	5.8[a]	5.4[a]	5.8[a]	4.9[a]	6.2[a]
Connective tissue amount[e]	7.5[a]	7.4[a]	6.8[b]	7.5[a]	7.4[a]	7.5[a]	7.3[a]	7.3[a]	7.3[a]	7.4[a]
Overall tenderness	4.9[a]	4.3[b]	4.0[b]	5.4[ab]	6.2[a]	5.9[a]	5.5[a]	5.6[a]	4.9[a]	6.2[a]
Flavor[d]	5.6[a]	5.5[a]	5.5[a]	5.7[a]	5.4[a]	5.4[a]	5.6[a]	5.2[a]	5.7[a]	5.4[a]
Overall palatability[d]	4.7[abc]	4.1[bc]	3.9[c]	5.1[ab]	5.3[a]	5.1[a]	5.1[a]	5.2[a]	4.7[a]	5.3[a]
Warner-Bratzler shear force, lbs	11.4[a]	14.5[b]	11.2[a]	11.7[ab]	-.-	9.9[a]	10.6[a]	11.7[a]	12.3[a]	-.-
Cooking loss, %	22.8[a]	21.7[a]	21.6[a]	19.8[a]	23.4[a]	22.6[a]	21.5[a]	23.7[a]	21.3[a]	23.4[a]

[abc] Means in the same row within the same treatment (ES or Not-ES) with a common superscript letter are not different (P>.05).

[d] Means based on eight-point descriptive scales (8 = extremely juicy, tender or desirable; 1 = extremely dry, tough or undesirable).

[e] Means based on an eight point rating scale (8 = none; 1 = abundant).

[*] Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr et al., 1979). P>.05 was reported as nonsignificant (NS).

Table 5. Mean values for muscle color, surface discoloration, and overall appearance for boneless rib steaks from untreated (Not-ES) and electrically stimulated (ES) calf sides stratified according to stocking rate.

		Not-ES				ES			
		Light Stocked				Light Stocked			
Trait	Day	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked
Muscle color[d]	0	6.1[a]	6.2[a]	5.9[ab]	5.5[b]	6.6[a]	6.5[ab]	5.9[bc]	5.6[c]
	1	5.6[a]	5.3[a]	5.1[a]	5.2[a]	5.9[a]	5.8[ab]	5.5[ab]	5.2[b]
	2	5.5[a]	5.3[a]	5.1[a]	5.2[a]	5.9[a]	5.7[ab]	5.3[b]	5.1[b]
	3	5.2[a]	5.3[a]	4.9[a]	4.7[a]	5.7[a]	5.5[ab]	5.1[bc]	4.6[c]
Surface discoloration[e]	0	6.9[a]	6.9[a]	6.9[a]	6.9[a]	6.9[a]	6.9[a]	6.9[a]	6.9[a]
	1	6.0[a]	5.7[a]	5.6[a]	6.2[a]	5.9[a]	6.0[a]	5.6[a]	5.6[a]
	2	5.5[a]	5.5[a]	5.3[a]	5.6[a]	5.7[a]	5.7[a]	5.3[a]	5.4[a]
	3	5.0[a]	4.9[a]	4.5[a]	5.3[a]	5.0[a]	5.2[a]	4.7[a]	4.6[a]
Overall appearance	0	6.4[a]	6.5[a]	6.4[a]	6.0[a]	6.8[a]	6.9[a]	6.3[ab]	6.0[b]
	1	5.5[a]	5.0[a]	4.9[a]	5.4[a]	5.5[a]	5.5[a]	5.1[a]	5.0[a]
	2	5.2[a]	4.8[a]	4.8[a]	5.1[a]	5.4[a]	5.4[a]	4.8[a]	4.8[a]
	3	4.6[a]	4.4[a]	4.0[a]	4.6[a]	4.8[a]	4.9[a]	4.3[a]	3.9[a]

[abc] Means in the same row within the same treatment (ES or Not-ES) with a common superscript letter are not not different (P>.05).

[d] 9 = very light cherry red; 1 = very dark purple.

[e] 7 = no surface discoloration; 1 = total surface discoloration.

[f] 8 = extremely desirable; 1 = extremely undesirable.

* Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr et al., 1979). P>.05 was reported as nonsignificant (NS).