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RALGRO-IMPLANTED BULLS: PERFORMANCE, CARCASS CHARACTERISTICS, LONGISSIMUS PALATABILITY AND CARCASS ELECTRICAL STIMULATION[1]

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Summary

Twenty of 40 Angus bulls were implanted (I) five times with 36 mg of Ralgro® at average intervals of 106 d, beginning near birth. All bulls and their dams were on bluestem pasture initially and, at an average age of 320 d bulls were fed a concentrate diet until they were slaughtered, weighing either 454 or 499 kg. One side of each carcass was electrically stimulated. Average daily gain and feed efficiency of I bulls improved 6.5 to 10.4% and 7.9 to 8.1%, respectively, depending upon the end point comparison with nonimplanted (NI) bulls. Implanted bulls attained their slaughter weights 42 d sooner than did NI bulls. Implantation decreased (P<.05) penis weight and length, testicle weight, volume and density, but did not affect (P>.05) seminal vesicle and pituitary weights. Carcasses from I bulls had more (P<.05) skeletal ossification and were fatter than carcasses from NI bulls. Marbling scores, quality grades and longissimus cooking losses and juiciness scores were not affected (P>.05) by implantation. Taste panel flavor intensity and detectable connective tissue scores were higher (P<.05) for steaks from I bulls than from NI bulls. Longissimus steak tenderness evaluations were higher (P<.05) for both I slaughter groups than for the NI light-weight group and were higher (P<.05) for the I light-weight group than for the NI heavy-weight group. Longissimus tenderness tended (P = .11) to be higher for steaks from the I heavy-weight group than those from the NI heavy-weight group. Electrical stimulation produced (P<.05) a softer, coarser textured lean, but it did not affect lean color, marbling or quality grade. Steaks from electrically stimulated sides tended to have higher (P = .09) myofibrillar tenderness scores and lower (P = .06) flavor scores than steaks from nonstimulated sides.

(Key Words: Bulls, Ralgro Implantation, Performance, Electrical Stimulation, Palatability, Zeranol.)

Introduction

Bulls gain more rapidly with less feed and produce leaner carcasses that generally have less marbling, lower quality grades and a darker colored lean (Turton, 1962; Hedrick, 1968; Field, 1971; Seideman et al., 1982) than steers. A majority of researchers also have observed that meat from bulls is less tender than from steers (Seideman et al., 1982), although others (Field et al., 1966; Hedrick et al., 1969) have found that meat from young bulls is comparable in palatability to that of steers.

Implanting steers with Ralgro[4] improved performance compared with nonimplanted steers (Thomas and Armitage, 1970; Nichols and Lesperance, 1973). Ralston (1978) found that weaning weights were slightly heavier for bulls implanted with Ralgro compared with nonimplanted bulls. However, a limited amount of research has been conducted relating Ralgro implantation to feedlot performance and carcass merit of intact males. Lamm et al. (1980) and L. R. Corah (personal communication) indicated that meat from Ralgro-implanted

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[4]Ralgro is the trade name for zeranol, a metabolite of Gibberella zeae, marketed by International Minerals & Chemical Corporation, Terra Haute, IN.

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bulls was more desirable than meat from nonimplanted bulls.

The objectives of our study were to determine the effects of Ralgro on bull performance, carcass traits and palatability characteristics of longissimus steaks. Electrical stimulation effects on carcass and palatability traits also were studied.

Experimental Procedure

Twenty of 40 fall-born Angus bulls (frame scores 1 or 2) from first-calf heifers were implanted (I) with 36 mg of Ralgro® within 3 d after birth and reimplanted with 36 mg of Ralgro at average ages of 123, 198, 324 and 425 d. The remaining 20 bulls served as nonimplanted (NI) controls. All bulls remained with their dams on native bluestem pasture (IFN 2-00-821 and 2-00-825) for about 320 d and then were assigned randomly in approximately equal numbers to six drylot pens. Three pens served as replicates for each treatment. After a 31-d diet adjustment period, in which the proportion of concentrate was progressively increased, animals were fed ad libitum high concentrate diets (table 1) until slaughter. Pen feed consumption and individual animal weights were monitored for feed efficiency and average daily gain calculations.

An equal number of bulls from the replicate pens of each treatment were slaughtered at either a light (454 kg) or heavy (499 kg) weight. Actual slaughter weights for animals in each treatment combination were: NI-light, 454 kg; NI-heavy, 515 kg; I-light, 453 kg and I-heavy, 501 kg.

Either the left or right side of each carcass was electrically stimulated for 2 min at 45 min postmortem with 420 V, 60 Hz, AC current. Sides were pulse stimulated (.68 s on and .32 s off) with approximately 1 A going through the carcass. Penis weight and length, testicle weight, volume and density and seminal vesicle and pituitary weights were obtained.

Longissimus muscle cores (1.27 cm diameter) from each carcass side were excised at 40 min, 2, 4, 6, 8 and 24 h postmortem and blended with neutralized 5 mM iodoacetate for pH determinations. Temperature in the center of the longissimus muscles at the fourth lumbar vertebra was recorded at 2, 4, 6, 8 and 24 h postmortem.

After chilling for 48 h, visual fat scores were assigned to unribbed carcasses using an eight-point scale (1 = very lean carcass, 8 = very fat carcass). Carcasses were ribbed and USDA carcass quality and yield grades were determined. The 9-10-11th rib section from either the left or right side of each carcass was removed at 48 h postmortem and the soft tissue was ground and sampled for moisture, protein and ether extractable lipid (AOAC, 1965).

A longissimus steak, 2.54 cm thick, was removed from each short loin for taste panel analysis and an adjacent 2.54-cm thick steak

TABLE 1. FINISHING DIET COMPOSITIONS AND NET ENERGY VALUES[a]

Item	Finishing diets[b]		
	1	2	3
Days fed	104	38	94
Diet composition, %			
Grain sorghum (IFN 4-04-444)	75.0	79.0	51.0
Corn (IFN 4-02-931)	0	0	25.0
Corn silage (IFN 3-08-153)	20.0	0	0
Sorghum silage (IFN 3-04-468)	0	16.0	19.0
Supplement[c]	5.0	5.0	5.0
Mcal NE_m/kg	1.7	1.7	1.8
Mcal NE_g/kg	1.1	1.1	1.1

[a]Dry matter basis.

[b]Diets 1, 2 and 3 were fed sequentially during the feedlot period.

[c]Composition: 73.5% soybean meal (IFN 5-04-604); 17.8% limestone; 6% NaCl; .5% trace mineral mix; .5% KCl; .2% 30,000 IU vitamin A; 1.5% fat (IFN 4-00-409).

was removed for Warner-Bratzler shear force determination. Steaks were vacuum packaged in 3 mil Saran-coated surlyn barrier film (<1 cc of $O_2 \cdot 645\ cm^{-1} \cdot 24\ h^{-1}$ at 23 C and 0% Rh), aged for 6 d at 4 C, frozen and stored at −20 C for not more than 7 mo.

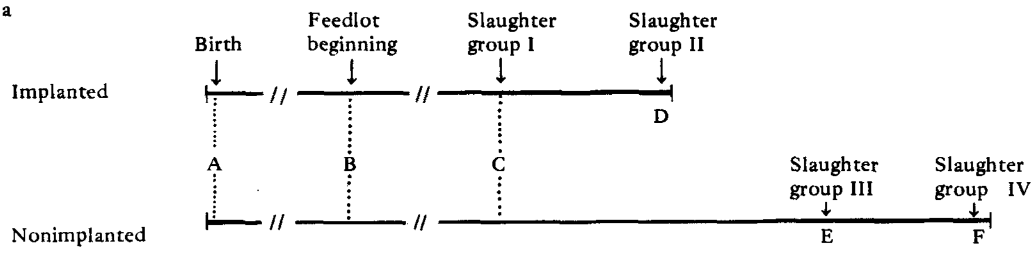
Steaks for taste panel evaluation were thawed overnight at 4 C. Eight steaks (nonstimulated and stimulated pairs from each slaugher group) were modified oven-broiled at 166 C in a rotary oven to an internal temperature of 70 C (monitored with thermocouples). Cores, 1.27 cm diameter, were removed with a mechanical coring device perpendicular to the steak's surface and served warm to a six-member trained taste panel (AMSA, 1978). Evaluations for flavor intensity, juiciness, myofibrillar tenderness, overall tenderness and connective tissue amount were made on the samples using an eight-point scoring scale (8 = extremely intense flavor, extremely juicy, extremely tender or no connective tissue; 1 = extremely bland flavor, extremely dry, extremely tough or abundant connective tissue).

Steaks used for Warner-Bratzler shear determinations were trimmed of subcutaneous fat, lightly blotted, weighed, cooked according to the procedures outlined for the taste panel steaks, blotted again and reweighed to determine total cooking loss. After weighing, steaks were cooled at room temperature for 2 h before coring. Eight 1.27-cm diameter cores were removed perpendicular to the surface of each steak, sheared once through the center with a Warner-Bratzler shear device and the average shear force calculated.

Data were analyzed by analysis of variance using the Statistical Analysis System (SAS, 1979) General Linear Model procedures. Duncan's New Multiple Range testing procedure

TABLE 2. PERFORMANCE DATA FOR NONIMPLANTED AND RALGRO-IMPLANTED BULLS

	Time comparisons[a]			Implant group	
Trait	Nonimplanted		Implanted	Nonimplanted	Implanted
Average daily gain, kg Birth to feedlot beginning	A to B	vs	A to B	.62[b]	.66[c]
Average daily gain, kg Feedlot beginning to slaughter group I	B to C	vs	B to C	1.07[b]	1.17[c]
Feed efficiency, F/G Feedlot beginning to slaughter group I	B to C	vs	B to C	7.69[c]	7.13[c]
Average daily gain, kg Feedlot beginning to slaughter of groups I and III	B to E	vs	B to C	1.06[b]	1.17[c]
Feed efficiency, F/G Feedlot beginning to slaughter of groups I and III	B to E	vs	B to C	7.71[c]	7.13[c]
Average daily gain, kg Feedlot beginning to actual slaughter end points	B to E plus B to F	vs vs	B to C plus B to D	1.05[b]	1.14[c]

a


[b,c]Means bearing a different superscript differ (P<.05).

was used to separate significant interaction means. Simple correlation coefficients between selected traits of the nonelectrically stimulated sides were pooled over slaughter groups after determining that the within-group correlations were being estimated by the pooled correlation.

Results and Discussion

Performance Data. Average daily gain (ADG) and feed efficiency (F/G) data are presented in table 2. Implanting with Ralgro improved ($P<.05$) ADG 6.5% from birth (time A, footnote table 2) to the time the bulls were placed on feed (time B). From the beginning of the feedlot period until the first group of bulls was slaughtered (time C, 196 d), I bulls gained 9.3% faster ($P<.05$) and tended ($P = .06$) to have an advantage (7.9%) in feed efficiency compared with the NI bulls. Implanted bulls gained 10.4% faster ($P<.05$) and tended ($P = .07$) to consume less feed/kg of gain (8.1%) when comparisons were made from the feedlot beginning until the first group of I (time C) and NI (time E) bulls were slaughtered. In this comparison, NI bulls were fed 35 d longer to attain their first slaughter weight end point. When gain comparisons were made between slaughter groups from the feedlot beginning to the respective slaughter end points (times C, D, E or F), implanting increased ($P<.05$) daily gain 8.6%, and I bulls reached their slaughter weights an average of 42 d earlier than NI bulls.

Advantages in performance of steers implanted with 36 mg of Ralgro from birth through finishing have been found by Ward et al. (1978). However, Corah et al. (1979) and Lamm et al. (1980) reported no differences in gain for bulls implanted (subcutaneously in the middle of the ear; L. R. Corah and W. D. Lamm, personal communication) with 36 mg of Ralgro at either 28 d of age or at birth, and reimplanted every 100 d until slaughter. Our gain data contrasts with those of Corah et al.

TABLE 3. CARCASS CHARACTERISTICS FOR NONIMPLANTED AND RALGRO-IMPLANTED BULLS SLAUGHTERED AT LIGHT (454 KG) AND HEAVY (499 KG) WEIGHTS

Trait	Implant group		Slaughter group	
	Nonimplanted	Implanted	Light	Heavy
Penis weight, g	364.7[b]	287.0[c]	327.4[b]	324.4[b]
Penis length, cm	29.8[b]	28.6[c]	29.6[b]	28.9[b]
Testicle weight, g	248.2[b]	129.5[c]	186.5[b]	191.3[b]
Testicle volume, cm^3	233.6[b]	124.3[c]	175.8[b]	182.2[b]
Testicle density, g/cm^3	1.06[b]	1.04[c]	1.06[b]	1.04[b]
Seminal vesicle weight, g	71.9[b]	63.6[b]	67.7[b]	67.9[b]
Pituitary weight, g	1.58[b]	1.52[b]	1.50[b]	1.59[b]
Hot carcass weight, kg	301[b]	299[b]	282[c]	318[b]
Dressing percentage	62.2[b]	62.9[b]	62.5[b]	62.7[b]
Quality grade, 48 h	Good-75[b]	Good-76[b]	Good-73[b]	Good-78[b]
Skeletal maturity	A-75[c]	B-03[b]	A-94[b]	A-84[b]
Lean maturity	A-57[b]	A-49[b]	A-52[b]	A-55[b]
Final maturity	A-69[c]	A-80[b]	A-77[b]	A-73[b]
Lean firmness[a]	2.2[b]	2.5[b]	2.4[b]	2.2[b]
Lean texture[a]	3.0[c]	3.3[b]	3.2[b]	3.2[b]
Lean color[a]	2.1[b]	2.2[b]	2.2[b]	2.0[b]
Marbling	Slight-84[b]	Slight-90[b]	Slight-87[b]	Slight-88[b]
Yield grade	2.8[b]	3.1[b]	2.7[c]	3.2[b]
Adjusted fat thickness, cm	1.1[c]	1.4[b]	1.1[c]	1.4[b]
Rib eye area, cm^2	75.5[b]	75.7[b]	73.8[b]	77.4[b]
Kidney, pelvic and heart fat, %	2.0[b]	2.2[b]	2.1[b]	2.2[b]

[a]Scores: 4 = slightly soft, slightly fine or moderately dark red; 3 = moderately firm, moderately fine or slightly dark red; 2 = firm, fine or cherry red.

[b,c]Means in the same row within an implant or slaughter group bearing a different superscript differ ($P<.05$).

(1979) and Lamm et al. (1980) perhaps because we implanted our bulls in the muscle at the base of the ear. Plegge and Corah (1979) reported that implanting steers with Ralgro in the muscle at the base of the ear resulted in improved gains compared with steers implanted subcutaneously in the middle of the ear.

Thiex and Embry (1972) reported little improvement in feedlot performance of bulls implanted at 10 mo of age and reimplanted 4 mo later with 36 mg of Ralgro. Embry (1972), using data from two trials, reported no appreciable effect on performance of yearling bulls implanted with a single 36 mg Ralgro implant. Consequently, the time of initial implantation or the frequency of reimplanting also may affect the response of bulls to Ralgro.

Reproductive Organ Measurements. Penis weight and length and the weight, volume and density of the testicles from I bulls were less (P<.05) than those from NI bulls (table 3). Pituitary and seminal vesicle weights were not affected (P>.05) by implantation. Apparently, Ralgro suppresses sexual development to an extent that it should not be used for breeding bulls. Slaughter weight had no effect (P>.05) on these reproductive characteristics.

Carcass Characteristics. Hot carcass weights were similar (P>.05) for NI and I bulls, (table 3). Dressing percentages were not affected (P>.05) by implanting or slaughter weight.

Lean maturity, firmness and color scores were similar (P>.05) for NI and I bulls and for animals slaughtered at light and heavy weights. However, higher scores (P<.05) for both skeletal maturity and final maturity indicated that I bull carcasses were more mature physiologically than NI bull carcasses, even though the I animals were slaughtered at younger chronological ages. Our results are in contrast with the findings of Sharp and Dyer (1971), who suggested that Ralgro delayed physiological maturity of growing steers, heifers and wether lambs.

Yield grade numbers were larger (P<.05) for carcasses in the heavy weight slaughter groups compared with carcasses in the light weight groups, and yield grade numbers tended (P = .10) to be higher for carcasses from the I bulls than those from the NI bulls (table 3). Carcasses in the I and heavy weight groups had greater (P<.05) adjusted fat thickness values than carcasses in the NI and light weight groups, respectively. Carcasses from I bulls also tended (P = .07) to have higher percentages of kidney, pelvic and heart fat than carcasses from the NI bulls. Rib eye areas were not different (P>.05) between implant treatment groups or slaughter weight groups. Although carcasses in the I and heavy weight groups were fatter than carcasses in the NI and light weight groups, respectively, no differences (P>.05) between those groups were found for either marbling or quality grade.

Rib Section Chemical Composition. Chemical composition of the 9-10-11th rib sections is summarized in table 4. Carcasses in the NI group tended (P = .06) to have higher percentages of moisture and lower percentages of ether extractable material than carcasses in the I group. Percentages of protein in the rib sections were not different (P>.05) between NI and I groups. Rib sections from bulls in the heavy weight slaughter groups had lower (P<.05) percentages of moisture and protein and higher (P<.05) percentages of ether extractable material than did rib sections from the light weight animals. Rib composition data for both implant and slaughter weight groups are in accord with the carcass composition data.

Cooking Losses, Taste Panel Ratings and

TABLE 4. CHEMICAL COMPOSITION OF THE 9-10-11th RIB SECTIONS FOR NONIMPLANTED AND RALGRO-IMPLANTED BULLS SLAUGHTERED AT LIGHT (454 KG) AND HEAVY (499 KG) WEIGHTS

	Implant group		Slaughter group	
Chemical composition	Nonimplanted	Implanted	Light	Heavy
	%			
Moisture	49.4[a]	46.5[a]	50.1[a]	45.9[b]
Ether extractable material	36.1[a]	39.7[a]	35.4[b]	40.4[a]
Protein	14.2[a]	13.2[a]	14.3[a]	13.1[b]

[a,b]Means in the same row within an implant or slaughter group bearing a different superscript differ (P<.05).

Warner-Bratzler Shear Forces. Cooking loss percentages were similar (P>.05) for longissimus steaks from NI and I bulls (table 5). However, steaks from bulls in the heavy weight slaughter groups had greater (P<.05) cooking losses than steaks from bulls in the light weight groups.

Taste panel juiciness ratings for longissimus steaks were not affected (P>.05) by implanting or slaughter weight (table 5). Implanting with Ralgro increased taste panel flavor intensity (P<.05) and decreased taste panel detectable connective tissue (P<.05). No differences (P>.05) between slaughter weight groups were found for either of those traits.

Interaction means (implant group × slaughter weight group) for taste panel myofibrillar tenderness, overall tenderness and Warner-Bratzler shear forces are presented in table 5. For all three traits, steaks from NI light-weight bulls were less tender (P<.05) than steaks from bulls in the other treatment combinations. Steaks from the I light-weight bulls were more tender (P<.05) than steaks from NI heavy-weight bulls. Steaks from bulls in the I heavy-weight slaughter group tended (P = .11) to be more tender than steaks from the NI heavy-weight group. No differences (P>.05) in tenderness were found for steaks of I animals in the light and heavy slaughter weight groups. Although differences in tenderness were not significant for all comparisons in the four treatment combinations, it seems that implanting resulted in improved tenderness values for longissimus steaks, even though NI bulls were less mature physiologically than I bulls.

Simple Correlations of Quality Indicating Factors and Palatability Traits. Visual fat scores were correlated (P<.05) with 48-h marbling score (.42) and taste panel myofibrillar tenderness ratings (.37) when the slaughter groups data were pooled. Adjusted fat thickness was correlated (P<.05) with 48-h marbling score (.43) and Warner-Bratzler shear forces (−.32), and adjusted fat thickness tended to be related (P = .10) with taste panel myofibrillar tenderness (.27), connective tissue amount (.28) and overall tenderness scores (.29). Correlations between 48-h marbling score and taste panel flavor intensity (.16), juiciness scores (−.01) and shear forces (−.03) were low and nonsignificant. Skeletal maturity was correlated (P<.05) with shear force values (−.44), taste panel myofibrillar tenderness (.32) and overall tenderness ratings (.29). Therefore, adjusted fat thickness, visual fat score and skeletal maturity

TABLE 5. COOKING LOSS PERCENTAGES, TASTE PANEL SCORES AND SHEAR FORCE VALUES FOR LONGISSIMUS STEAKS FROM NONIMPLANTED AND RALGRO-IMPLANTED BULLS SLAUGHTERED AT LIGHT (454 KG) AND HEAVY (499 KG) WEIGHTS

Trait	Implant group		Slaughter group		Treatment combination			
	Nonimplanted	Implanted	Light	Heavy	Nonimplanted light	Nonimplanted heavy	Implanted light	Implanted heavy
No interaction								
Cooking loss, %	23.38^{b}	22.98^{b}	22.56^{c}	23.80^{b}				
Taste panel juiciness[a]	6.2^{b}	6.1^{b}	6.2^{b}	6.1^{b}				
Taste panel flavor[a]	6.1^{c}	6.2^{b}	6.2^{b}	6.1^{b}				
Taste panel connective tissue amount[a]	6.5^{c}	6.8^{b}	6.5^{b}	6.7^{b}				
Interaction								
Taste panel myofibrillar tenderness[a]					5.6^{d}	6.1^{e}	6.6^{f}	6.4^{ef}
Taste panel overall tenderness[a]					5.8^{d}	6.2^{e}	6.6^{f}	6.5^{ef}
Warner-Bratzler shear forces, kg					3.4^{f}	2.8^{e}	2.3^{d}	2.6^{de}

[a]Scores: 7 = very juicy, very intense, practically none or very tender; 6 = moderately juicy, moderately intense, traces or moderately tender; 5 = slightly juicy, slightly intense, slight or slightly tender.

[b,c,d,e,f]Means in the same row within an implant or slaughter group and treatment combination bearing a different superscript differ (P<.05).

seem to be better predictors of palatability than marbling in bull carcasses. Carcass fat measurements and skeletal maturity each accounted for 8 to 20% of the variability in palatability of longissimus steaks, while 48-h marbling accounted for less than 3% of the variability.

Electrical Stimulation Effects on Bull Carcass Quality Characteristics. Because there were no interactions (P>.05) between electrical stimulation and either implantation or slaughter weight, data were pooled for electrical stimulation effects on bull carcasses.

Savell et al. (1978b) reported that electrical stimulation (ES) improved lean color and maturity scores in heifer carcasses. We found, however, no differences (P>.05) in lean color, lean maturity, final maturity, 48-h quality grades and marbling scores between nonstimulated and stimulated bull carcass sides (table 6). Stimulated sides had a softer, coarser textured lean (P<.05) than nonstimulated sides. Electrical stimulation may have induced a condition similar to that reported by Hunt and Hedrick (1977) where the lean is soft and exudative, but with normal color. Bendall and Rhodes (1976) hypothesized that if pH values fell below 6.0 within 1.5 h postmortem while the deep muscle temperature was above 35 C, a pale, soft and exudative condition could occur. Temperture and pH decline data (figure 1) indicate that the pH for ES sides fell below 6.0 between 1.5 and 2.0 h postmortem and that the longissimus muscle temperatures would have been at least 35 C at that time.

TABLE 6. CARCASS QUALITY CHARACTERISTICS FOR NONELECTRICALLY STIMULATED AND ELECTRICALLY STIMULATED BULL CARCASS SIDES

	Side treatment	
Trait	Nonelectrically stimulated	Electrically stimulated
Quality grade, 48 h	Good-76	Good-75
Lean maturity	A-55	A-52
Final maturity	A-75	A-74
Lean firmness[a]	2.1[b]	2.6[c]
Lean texture[a]	3.0[b]	3.4[c]
Lean color[a]	2.2	2.1
Marbling	Slight-89	Slight-85

[a]Scores: 4 = slightly soft, slightly fine or moderately dark red; 3 = moderately firm, moderately fine or slightly dark red; 2 = firm, fine or cherry red.

[b,c]Means bearing a different superscript differ (P<.05).

Electrical Stimulation Effects on Cooking Losses, Taste Panel Ratings and Warner-Bratzler Forces. Eikelenboom et al. (1981) found greater cooking losses for longissimus samples from ES bull carcasses than for nonstimulated carcasses. Our cooking loss percentages for steaks from the ES sides were not different (P>.05) from cooking loss percentages for steaks from the nonstimulated sides (table 7). Warner-Bratzler shear values were similar (P>.05) for steaks from ES and nonstimulated sides. Taste panel scores for juiciness and connective tissue amount were not affected (P>.05) by ES.

Taste panel scores for steaks from ES sides tended to have lower (P = .06) flavor intensity and higher (P = .09) myofibrillar tenderness scores than steaks from nonstimulated sides. The tendency for improved tenderness may be the result of either structural damage (Savell et al., 1978a) or enhanced autolytic enzyme activity (Dutson et al., 1980) caused by the rupture of lysosomal membranes at a low pH while carcass temperatures are high. Prevention of cold toughening by ES was not likely because conditions (muscles at either 10 C in less than 10 h postmortem, Bendall, 1972; or 10 C before a pH of 6.0 has been reached, Chrystall et al., 1980) for muscle shortening did not exist.

Conclusions

In our study, the consecutive implantation of small frame Angus bulls with 36 mg of Ralgro from birth to slaughter had a positive

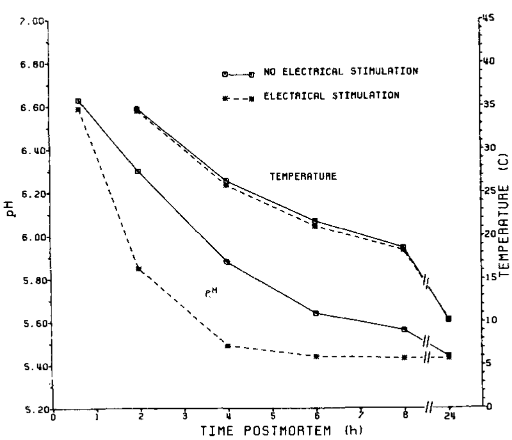


Figure 1. Longissimus muscle temperature and pH curves for nonelectrically stimulated and electrically stimulated bull carcass sides.

TABLE 7. COOKING LOSS PERCENTAGES, TASTE PANEL SCORES AND SHEAR FORCE VALUES FOR LONGISSIMUS STEAKS FROM NONELECTRICALLY STIMULATED AND ELECTRICALLY STIMULATED BULL CARCASS SIDES

	Side treatment[a]	
Trait	Nonelectrically stimulated	Electrically stimulated
Cooking loss, %	22.64	23.72
Taste panel juiciness[b]	6.1	6.1
Taste panel flavor[b]	6.2	6.1
Taste panel connective tissue amount[b]	6.6	6.6
Taste panel myofibrillar tenderness[b]	6.1	6.3
Taste panel overall tenderness[b]	6.2	6.4
Warner-Bratzler shear force, kg	2.8	2.8

[a]Stimulated and nonstimulated sides did not differ (P>.05).

[b]Scores: 7 = very juicy, very intense, practically none or very tender; 6 = moderately juicy, moderately intense, traces or moderately tender.

effect on gain, feed efficiency and longissimus tenderness. However, carcasses from I bulls were fatter, indicating that these bulls could be slaughtered at a lighter weight. Electrical stimulation of bull carcasses had little effect on the improvement of longissimus muscle characteristics. Visual fat score, adjusted fat thickness and skeletal maturity were better predictors of palatability in longissimus steaks from bulls than was marbling.

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