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Introduction

Utilization of the intact male by the beef industry has been the focus of much research in recent years. Advantages of bulls compared to steers in production efficiency, performance, and carcass leanness have been well documented. Disadvantages include aggressive behavior, darker postmortem muscle color, lower USDA quality grades, and, often, less tender meat. The superior production performance of bulls has not been utilized by the meat and livestock industries partly because of these disadvantages.

Postmortem muscle color is associated with energy content of the diet, antemortem muscle glycogen content, postmortem muscle pH decline, and ultimate pH, all of which are affected by the degree and amount of physiological stress induced before slaughter.

Electrical stimulation of prerigor carcasses has resulted in improved tenderness and marbling scores, enhanced lean colors, and increased rate of pH and glycogen decline. Thus, the objectives of this study were to determine the effects of diet and electrical stimulation on postmortem glycogen depletion, muscle color, and sensory properties of bull longissimus dorsi muscle.

Procedure

Eighty young bulls (5 to 6 mo) were randomly assigned to one of two groups and fed either a high-energy or a low-energy diet designed to accelerate or defer growth. The accelerated dietary regimen contained 2.61 Mcal/kg metabolizable energy (ME) fed for the first 100 days, followed by a finishing diet that contained 3.04 Mcal/kg ME fed for the last 110 days. The deferred dietary regimen consisted of good quality pasture for the first 110 days, followed by finishing for 180 days on a high-energy dietary regimen that contained 3.04 Mcal/kg ME. Diets were composed of corn silage (IFN-3-08-153), corn (IFN-4-02-931), and soybean meal (IFN-5-04-604). All animals were implanted with Ralgro at 100-day intervals, and were slaughtered at approximately the same fat thickness. Animals were transported to the MARC abattoir on the morning of slaughter and were all slaughtered within 2 hr after removal from the research feeding facilities.

Carcasses were split; each side was weighed; and the right side was electrically stimulated within 1 hr postmortem. The non-stimulated left sides were used as controls. All sides were evaluated for USDA quality and yield grade traits after chilling for 24 hr. At 7 days postmortem, the ribeye muscle from the short-loin of both sides was removed and sliced into 1 in thick steaks.

Results

Diet and electrical stimulation did not significantly influence liveweight, carcass weight, lean firmness, lean maturity, bone maturity, ribeye area, or kidney, pelvic, and heart fat (Table 1). Meat from animals fed the deferred diet had a brighter, more youthful lean color, lower USDA quality grade, and a lower degree of marbling than carcasses from bulls fed an accelerated diet. Electrical stimulation resulted in a lower incidence of heat ring and brighter, more youthful colored, finer-textured lean and, consequently, a more youthful, overall maturity.

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[2]The full report of this work was published in Meat Science 19:253-263, 1987.

Table 1—Means of carcass traits by diet and electrical stimulation

Trait	Diet: Accelerated	Diet: Deferred	Electrical stimulation: Stimulated	Electrical stimulation: Non-Stimulated
Hot carcass wt (lb)	836	844	837	843
Heat ring[a]	3.6	3.6	4.4[e]	2.7[f]
Lean color[b]	4.6[f]	5.2[e]	5.6[e]	4.3[f]
Lean texture[c]	5.5	5.6	5.9[e]	5.1[f]
Lean firmness[d]	6.0	6.0	5.9	6.0
Overall maturity	A[70]	A[71]	A[59]	A[73f]
Marbling score	Sl[90e]	Sl[51f]	Sl[76]	Sl[64]
USDA yield grade	2.7	2.5	2.8	2.9
Kidney, pelvic, and heart fat (%)	2.1	1.9	2.0	2.0

[a]Scored: 5 = no visible heat ring or two toning; 1 = extreme heat ring or sunken muscle or fat.
[b]Scored: 7 = very light cherry red; 4 = slightly dark red; 1 = black.
[c]Scored: 7 = very fine; 4 = slightly fine; 1 = extremely coarse.
[d]Scored: 7 = very firm; 4 = moderately firm; 1 = extremely soft.
[ef]Means in the same row within treatment with different superscripts differ ($P < 0.05$).

Cooking and sensory properties. The effect of diet and electrical stimulation on cooking, shear, and sensory properties of steaks from the ribeye muscle are presented in Table 2. Diet did not significantly affect purge loss, juiciness, cooking loss, or flavor intensity. However, steaks from animals fed the accelerated diet were easier to fragment, contained less panel-detectable connective tissue, and were rated more tender. These results indicate a slight advantage in overall palatability of bulls fed a high-energy diet from weaning to slaughter. Therefore, the use of the correct dietary management system will affect the acceptability of the young bull. A high-energy diet fed from postweaning until slaughter may reduce the palatability and carcass trait problems seen in young bulls. Also, the younger the intact male is when slaughtered, the fewer sex- and age-related palatability and carcass problems that will occur.

Electrical stimulation resulted in ribeye steaks that were easier to fragment and more tender than non-stimulated steaks (Table 2). These results were probably due to fracture of the muscle fibers and/or the reduction of cold-shortening in lean bull carcasses. (The non-stimulated lean bull carcasses may have been subjected to a larger amount of cold-induced muscle shortening.)

Table 2—Means of cooking, shear, and palatability segregated by diet and electrical stimulation

	Diet		Electrical stimulation	
Trait	Accelerated	Deferred	Stimulated	Non-Stimulated
Purge loss (%)[a]	2.5	2.7	2.5	2.8
Total cooking loss (%)[b]	34.4	35.4	33.7[e]	36.0[d]
Shear force (lb)	9.5[e]	10.4[d]	8.8[e]	10.8[d]
Sensory panel traits[c]				
Juiciness	5.3	5.3	5.4[d]	5.3[e]
Fragmentation	5.2[d]	5.0[e]	5.2[d]	5.0[e]
Connective tissue	5.1[d]	4.9[e]	5.1[d]	4.9[e]
Tenderness	5.3[d]	5.1[e]	5.3[d]	5.1[e]
Flavor intensity	5.4	5.4	5.5[d]	5.4[e]
Off-flavor	2.6[e]	2.8[d]	2.6	2.7

[a]Purge loss = frozen weight - thawed weight x 100.
[b]Total cooking loss = frozen weight - cooked weight x 100.
[c]Sensory scores: Juiciness: 1 = extremely dry to 8 = extremely juicy. Fragmentation: 1 = extremely difficult to 8 = extremely easy. Connective tissue: 1 = abundant amount to 8 = no detectable connective tissue. Tenderness: 1 = extremely tough to 8 = extremely tender. Flavor: 1 = extremely bland to 8 = extremely intense. Off-flavor: 1 = no off-flavor to 8 = extremely intense off-flavor.
[de]Means in the same row within treatment with different superscripts differ ($P < 0.05$).