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PRERIGOR SKELETAL CUTS TO IMPROVE BEEF TENDERNESS UNDER COMMERCIAL CONDITIONS

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INTRODUCTION

Lack of consistent beef tenderness is still a problem in the meat industry. The Tendercut process is a relatively new method to improve meat tenderness (Claus and Marriott, 1991). To impose this technology, local bones and connective tissues are severed to permit the weight of the carcass to stretch the selected muscle before the onset of rigor (Claus and Marriott, 1991).

Cotroneo (1992) and Wang et al. (1994) indicated that when carcasses were treated 45 min postmortem, the Tendercut process resulted in longer sarcomere length and lower shear force in Longissimus and three round muscles: *Vastus medialis, Rectus femoris,* and *Vastus lateralis*. Tendercut had no negative effects on thawing loss and cooking loss. Previous studies were conducted under well-controlled laboratory conditions which were different in some respects than those used in the industry. Under industry standards, the slaughter operation is much faster and utilize electrical stimulation (ES). Thus, in the industry, Tendercut could be performed earlier and may enhance the benefits by stretching the muscles well before the onset of rigor. Furthermore, industrial chilling operations are more efficient and often use spray chilling. Rapid chilling may reduce the effect of aging and therefore enhance the benefit of tenderness improvement by Tendercut. This study was designed to evaluate the effect of Tendercut under industry conditions.

MATERIALS AND METHODS

Carcass Treatment: Fed cattle were slaughtered in a commercial meat plant. Carcasses were electrically stimulated (75 volts, 24 sec; BV80 Jarvis Products, Inc.). Carcasses were suspended in the common vertical position and split, with one randomly selected side designated for the Tendercut treatment and the other side as a control. After 35 min postmortem, the 12th thoracic vertebra and connective tissues of treatment sides were completely severed, leaving only the Longissimus muscle (LM) intact in this area. In addition, the ischium of the pelvic bone, junction between the 4th/5th sacral vertebrae, and connective tissues at the round/loin region of the treatment sides were severed. After chilling (24 h) the carcasses were ribbed and graded. Nine U.S. Select carcasses weighing 312.3±38.8 kg (mean±std) and sixteen U.S. Choice carcasses weighing 308.0±46.5 kg were selected for further testing. The LM between the 2nd/3rd lumbar and 9th/10th thoracic vertebrae was removed. Steaks (25.4 mm) were also collected (sliced perpendicularly to muscle bundles) from each *Rectus femoris* (RF, part of round tip), *Biceps femoris* (BF, bottom round), and *Gluteus medius* (GM, top sirloin) muscles. Samples were vacuum packaged and aged for 10 days (4°C). Samples were then frozen at -32°C and stored at -29°C.

Sensory Evaluation: Only LM samples were evaluated by a trained sensory panel (AMSA, 1978). Steaks were prepared using the same procedure as for shear force measurements. Eight panelists evaluated samples from both Select and Choice carcasses using an 8-point scale (1=extremely tough and 8=extremely tender for myofibrillar and overall tenderness; 1=extremely dry and 8=extremely juicy for juiciness; and 1=abundant and 8=none for amount of connective tissue).

Physical, Chemical Determinations, and Statistical Analysis: Shear force measurements were made on steaks roasted to an internal temperature of 70°C according to AMSA guidelines (1978). Cores (12.7 mm diameter) were removed perpendicular to the cut steak surface. For BF, RF, and GM muscles, cores were removed from frozen steaks (perpendicular to the cut steak surface) and vacuum packaged in bags. These bags were put into a 72°C water bath and cooked for 68 min. Warner-Bratzler and Lee-Kramer shear force were determined with an Instron (Model 1011, Instron Corp., Canton, Mass.). Uniform, 19 mm length, Lee-Kramer cores (n=4) were produced by cutting a portion of each end of every core. Sarcomere length of the LM was determined by a laser diffraction method (Cross et al., 1981). Data was analyzed using the General Linear Model procedure prepared by SAS (1990). When significance ($P<0.05$) was determined in the model, means were separated using the least significant difference test of SAS (1990).

RESULTS AND DISCUSSION

The LM of the ribeye of the Tendercut was less ($P<0.05$) red (CIE a^*, 25.3) than the control (26.7). This disagrees with results of Cotroneo (1992) and Wang et al. (1995), who did not report a difference in redness between these two treatments. Tendercut did not affect ($P>0.05$) CIE L^* and b^* values of the ribeye, but resulted in a smaller ($P<0.05$) ribeye area (70.45 cm^2) and higher yield grade (3.30) than the control (ribeye, 78.32 cm^2; yield grade, 2.92). Cotroneo (1992) and Wang et al. (1995) did not find a significant difference in ribeye area. The difference may be that since under commercial conditions the carcasses were treated earlier prerigor might have permitted the muscle to more extensively stretch.

Tendercut (Table 1) did not affect (P>0.05) LM juiciness in either Choice or Select beef. However, in the LM from Choice and Select Tendercut treated carcasses, tenderness was increased for myofibrillar tenderness (25.7% and 18.2%, respectively), connective tissue (26.1% and 14.8%, respectively), and overall tenderness (28.3% and 18.1%, respectively). LM on Tendercut carcasses resulted in a reduction (P<0.05) in Warner-Bratzler peak force (18.2%, Choice; 13.6%, Select) and Lee-Kramer total energy (22.2%, Choice; 13.3%, Select). As expected sarcomere lengths were shorter (P<0.05) for the Tendercut LM. In Choice beef, myofibrillar tenderness was slightly higher in the LM closer to the treatment site. All instrumental measures of tenderness for the GM and RF muscles (Choice and Select) were lower (P<0.05) for the Tendercut treatment, except for Lee-Kramer total energy in the Choice RF steaks (P>0.05). The BF was not affected (P>0.05) by the Tendercut process.

CONCLUSIONS

The Tendercut process has been shown to be an effective means of improving tenderness of some beef muscles under commercial conditions. In addition, this research demonstrates that this technology can be used in existing commercial facilities without additional new equipment required of other technologies.

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TABLE 1. EFFECTS OF TENDERCUT (TC) ON BEEF MUSCLES

Trait[1]	U.S. Choice Treatment Control	U.S. Choice Treatment TC	U.S. Choice S.E.	U.S. Select Treatment Control	U.S. Select Treatment TC	U.S. Select S.E.
Longissimus						
Sensory evaluation[2]						
Myofib. tenderness	5.29^b	6.65^a	0.13	5.23^b	6.18^a	0.15
Juiciness	5.64^a	5.68^a	0.08	5.65^a	5.76^a	0.10
Connective tissue	4.94^b	6.23^a	0.13	5.08^b	5.83^a	0.11
Overall tenderness	5.16^b	6.62^a	0.14	5.19^b	6.13^a	0.12
Warner-Bratzler Peak force (kg)	3.95^a	3.23^b	0.11	4.27^a	3.69^b	0.12
Lee-Kramer (LK) Shear force (kg)	30.6^a	25.3^b	0.74	30.8^a	27.5^b	0.36
LK Total energy (kg*mm)	213.6^a	166.2^b	4.56	211.8^a	183.6^b	5.26
Sarcomere length (μm)	1.65^b	2.41^a	0.02	1.72^b	2.45^a	0.05
Rectus femoris (RF)						
Warner-Bratzler Peak force (kg)	4.28^a	3.76^b	0.12	4.05^a	3.62^b	0.10
Lee-Kramer (LK) Shear force (kg)	30.3^a	27.7^b	0.69	28.1^a	25.2^b	0.70
LK Total energy (kg*mm)	197.2^a	189.1^a	5.58	192.8^a	178.0^b	4.04
Gluteus medius (GM)						
Warner-Bratzler Peak force (kg)	4.74^a	3.99^b	0.14	4.07^a	3.55^b	0.12
Lee-Kramer (LK) Shear force (kg)	32.5^a	28.5^b	0.91	28.3^a	25.6^b	0.80
LK Total energy (kg*mm)	202.7^a	171.0^b	4.82	187.3^a	161.7^b	3.97

[1] Trait: Significant (P<0.05) treatment by location interactions: Choice LM (juiciness, sarcomere length) and Select LM (Warner-Bratzler peak force, sarcomere length).

[2] Sensory trait: Myofibrillar and overall tenderness: 1=extremely tough, 8=extremely tender; Juiciness: 1=extremely dry, 8=extremely juicy; Connective tissue: 1=abundant, 8=none

[a,b] Means bearing unlike superscripts within each trait and U.S. Quality grade are different (P<0.05).