PALATABILITY OF TENDERCUT PORK

MARRIOTT N.G., WANG H., and CLAUS J.R.

Department of Food Science and Technology, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

W-3.24

SUMMARY

Bone and connective tissues at the 14th thoracic vertebra on one randomly selected side of each pork carcass was cut 90 minutes postmortem by the Tender-cut™ procedure, while the companion side served as a control. The carcasses were suspended by the conventional vertical position and chilled for 24 hours. The Longissimus muscle (LM) between the 9th thoracic and 4th lumbar vertebra was removed to determine the effect of this skeletal alteration procedure on Warner-Bratzler and Lee-Kramer shear force, sarcomere length, percentage fat and moisture content. Tendercut resulted in lower ($P<0.05$) Warner-Bratzler peak force, Lee-Kramer peak force and total energy in all locations within the LM. The average decrease was 14.2% for Warner-Bratzler peak force and 14.5% and 16.2% for Lee-Kramer peak force and total energy, respectively. The Tendercut treatment also resulted in longer ($P<0.05$) sarcomere lengths in all locations within the LM, with the average increase of 19%.

INTRODUCTION:

During the past decade, livestock producers and the meat industry have been challenged to produce meat products with maximum palatability at a low cost. Tenderness is the most important factor affecting consumers perception of taste (Morgan **et al.,** 1991). Consumers have focused on low fat products since they are perceived to be more healthy. However, the associated toughness of lean meat influences its acceptability. Wood (1993) reported on the results of a study that compared lean and fat pork carcasses and found that eating quality scores were higher for the fatter carcasses. In addition, there were significant positive correlations between intramuscular fat and taste panel scores for tenderness, juiciness and overall acceptability.

Prusa **et al.** (1993) reported that pork ham roasts with less intramuscular fat from somatotropin produced pigs were acceptable but lacked the tenderness, juiciness and flavor of product with more fat distribution. Thus, the use of compounds such as somatotropin to enhance muscle deposition and reduce fat accumulation may increase the need for tenderness improvement.

Locker (1960) reported that the final contractile state of postrigor muscle depends on the strain imposed on it during rigor mortis. Several efforts have been made to optimize stretch-tension upon muscles during rigor development to improve beef tenderness. Herring et al. (1965) investigated the effect of two carcass suspension methods on the tenderness of beef muscles. Hostetler **et al.** (1972) developed a carcass suspension method called "Texas A&M Tenderstretch" (Orts **et al.**, 1971). Quarrier **et al.** (1972) extended the Tenderstretch process to lamb carcasses. Stouffer **et al.** (1971) developed a patented prerigor method to tenderize muscles by applying tension with weights or a mechanical device.

Tendercut™ is another prerigor treatment of carcasses investigated to improve the tenderness of beef round and loin muscles (Cotroneo, 1992; Wang **et al.**, 1994b). This treatment subjected muscles to more stretch-tension by severing bones and connective tissues. These studies indicated that when the carcass was treated at 45 minutes postmortem, Tendercut resulted in longer sarcomeres and lower shear force values in the Vastus medialis, Rectus femoris, Vastus lateralis, and Longissimus muscles. In a subsequent study, Wang **et al.** (1994a) determined that regardless of the end-point temperature (66.5, 70.0 or 76.7°C), the Tendercut treatment resulted in higher (more tender) sensory scores ($P<0.05$) for myofibrillar and overall tenderness and lower values of Warner-Bratzler and Lee-Kramer shear force in Longissimus and Rectus femoris muscles.

The Tendercut process has not been previously tested on porcine muscle. Therefore, the objective of this research was to determine the effect of prerigor cutting of selected skeletal and connective tissues on the tenderness of postrigor pork.

MATERIALS AND METHODS:

Carcass Treatment

Six hogs that weighed 144.8±10.4 kg (mean±std) were slaughtered in the Meat Laboratory at Virginia Polytechnic Institute and State University. The carcasses were suspended in the conventional vertical position and completely split, except at the epidermal layer near the sacral vertebrae, with one side randomly assigned to the Tendercut treatment and the other half as a control. Within 90 minutes postmortem, the 14th thoracic vertebra and connective tissues were severed. These cuts permitted the weight of a carcass to stretch the longissimus muscle (LM) in the prerigor state. The pH of the LM was monitored (>6.0 within 90 minutes postmortem) to assure that the carcasses were not PSE pork. Both sides were chilled in a cooler at 2-3°C for 24 hours. The LM between the 9th thoracic and 4th lumbar vertebra was removed, vacuum packaged, and stored in the dark at 2-3°C for two days. Each muscle was cut into three equal sections, labeled from anterior to posterior as location 1 through 3 and then frozen at -29°C.

Shear Force Measurement

One 25.4 mm chop was removed from each location and roasted to an internal temperature of 75°C in a 165°C oven according to AMSA guidelines (1978). Cooked samples were cooled to ca 25°C and cores (12.7 mm diameter) were removed. Warner-Bratzler and Lee-Kramer shear force of these samples were determined on an Instron (Model 1011, Instron Corp., Canton, Mass.). Fifty kg and 500 kg load transducers were used in Warner-Bratzler and Lee-Kramer shear force measurements, respectively, with a crosshead speed of 200 mm/min and 10% load range. Four 19 mm length cores were produced for Lee-Kramer shear by cutting a portion of each end of every core. Eight cores were used for Warner-Bratzler determinations. Averages were calculated for each chop.

Sarcomere Length Measurement and Chemical Analysis

Sarcomere length was determined by a laser diffraction method (Cross **et al.**, 1981), using a He-Ne laser (Model OEMIP, Aerotech Inc., Pittsburg, Pa.). Frozen chops (25.4 mm) were thawed at 4°C for 20 hours and five cores (12.5 mm diameter) were removed from each chop. Eight measurements were made per core and the sarcomere length was averaged for each chop. Raw chops were analyzed for fat and moisture (AOAC, 1990).

Statistical Analysis

The split-plot model was used in the data analysis of Instron shear force measurements and sarcomere length, with prerigor treatment as the whole plot and location as the sub-plot. The General Linear Model procedure prepared by SAS (1990) was used. When significance at $P<0.05$ was determined in the model, means were separated using the least significant difference test of SAS (1990).

RESULTS AND DISCUSSION:

Compared with the control samples, Tendercut reduced ($P<0.05$) Lee-Kramer total energy and shear force by 16.1% and 14.5%, respectively (Table 1). The total energy and shear force ranged from 174.9 to 197.4 kg*mm and 28.6 to 32.7 kg, respectively, in three locations of the Tendercut treated muscle. The total energy and peak force of the control samples ranged from 220.5 to 229.0 kg*mm and 34.8 to 35.7 kg, respectively (Table 2). The effect of location as well as the interaction between the treatment and location were not significant ($P>0.05$) in Lee-Kramer peak force and total energy.

The Warner-Bratzler peak force values revealed a significant ($P<0.05$) interaction between treatments and location within the muscles. The Tendercut samples sustained an average of 14% decrease ($P<0.05$) in Warner-Bratzler peak force (Table 1).

The data for sarcomere length indicated an interaction ($P<0.05$) between Tendercut and control samples. However, similar to Warner-Bratzler shear force data, the interaction was orderly, since the sarcomere length in the Tendercut samples was always longer than the controls in all three locations of the LM (Table 2). Sarcomere length in the control samples was similar in the three locations. However, sarcomere length decreased ($P<0.05$) from location 1 (anterior section) to location 3 (posterior) for the treated side. The average sarcomere length was 1.58 µm and 1.88 µm for control and Tendercut samples respectively, representing a 19% increase (Table 1) for the latter.

Sarcomere length was significantly (P<0.05) correlated with both Warner-Bratzler and Lee-Kramer shear force measurements. The Pearson correlation co-efficients for sarcomere length were -0.51 with Lee-Kramer total energy, -0.52 with Lee-Kramer shear force, and -0.55 with Warner-Bratzler peak force. Hostetler **et al.** (1972) reported that the correlation coefficient was -0.34 between sarcomere length and Warner-Bratzler shear force in some bovine muscles. In the study of Herring **et al.** (1965), the correlation coefficient was -0.46.

Since the treatment time was 90 minutes postmortem, the delayed time may allow the onset of rigor mortis which could reduce the effect of stretch-tension initiated by the Tendercut process. An earlier Tendercut treatment on the car-casses may have resulted in more improvement in tenderness. As expected, there were no differences (P>0.05) in fat and moisture percentage between the control and Tendercut LM (Table 1).

The Tendercut treatment significantly improved the indices of tenderness in porcine LM muscle. This research provides evidence that the Tendercut process is effective even after delaying implementation 90 minutes post-exsanguination.

REFERENCES:

AMSA. 1978. Guidelines for Cookery and Sensory Evaluation of Meat. Am. Meat Science Assoc. Nat'l. Live Stock and Meat Board. Chicago, Ill.

AOAC. 1990. Official Methods of Analysis. 15th Ed. Association of Official Analytical Chemists, Washington, D.C.

Cotroneo, C.J. 1992. Selected skeletal alteration to improve beef tenderness. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Cross, H.R., West, R.L., and Dutson, T.R. 1981. Comparison of methods for measuring sarcomere length in beef semitendinosus muscle. Meat Sci. **5:** 261-266.

Herring, H.K., Cassens, R.G. and Briskey, E.J. 1965. Further studies on bovine muscle tenderness as influenced by carcass position, sarcomere length, and fiber diameter. J. Food Sci. **30:**1049-1054.

Hostetler, R.L., Link, B.A., Landmann, W.A. and Fitzhugh, H.A. Jr. 1972. Effect of carcass suspension on sarcomere length and shear force of some major bovine muscles. J. Food Sci. **37:** 132-135.

Locker, R.H. 1960. Degree of muscular contraction as a factor in tenderness of beef. Food Res. **25:**304-307.

Morgan, J.B., Savell, J.W., Hale, D.S., Miller, R.K., Griffin, D.B., Cross, H.R. and Shackelford, S.D. 1991. National beef tenderness survey. J. Animal Sci. **69:**3274-3283.

Orts, F.A., Smith, G.C. and Hostetler, R.L. 1971. Texas A & M Tender-stretch. Tex. Agr. Ext. Svc. Bull. L-1003.

Prusa, K.K., Fedler, C.A. and Miller, L.F. 1993. National in-home consumer evaluation of pork roasts from pigs administered porcine somatotropin (pst). J. Food Sci. **58:**480-481, 496.

Quarrier, E., Carpenter, Z.L. and Smith, G.C. 1972. A physical method to increase tenderness in lamb carcasses. J. Food Sci. **37:**130-131.

SAS. 1990. SAS/STAT User's Guide, Version 6. Statistical Analysis Systems Institute, Inc., Cary, N.C.

Stouffer, J.R., Buege, D.R. and Gillis, W.A. 1971. Meat tenderizing method. U.S. patent 801,483. May 25.

Wang, H., Claus, J.R., and Marriott, N.G. 1994a. Palatability of postrigor beef from prerigor stretched muscles as affected by cooking temperature. Abstr., Institute of Food Technologists Annual Meeting.

Wang, H., Claus, J.R., and Marriott, N.G. 1994b. Selected skeletal alteration to improve tenderness of beef round muscles. J. Muscle Foods. In Press.

Wood, J.D. 1993. Relationships between composition and quality of meat. p. 37-49. Abstracts and Review Papers 39th Int. Cong. Meat Sci. and Tech. Calgary, Canada.