A Research Note

Effect of Time of Sampling Postmortem on Myofibril Fragmentation Index of Meat

J.D. CROUSE and M. KOOHMARAIE

ABSTRACT

The usefulness of myofibril fragmentation index (MFI) in predicting shear force of cooked meat was studied on muscle samples obtained immediately after death and aged or after aging the muscle in the intact carcass for about 7 days. The MFI values of cores obtained at the time of death (MFIO) of the animal were lower than those obtained after aging the meat (MFIA) in the intact carcass (69.18 vs. 81.38). However, correlations between MFI values with shear force values were similar for each sampling procedure (MFIO, r = −0.57; MFIA, r = −0.60). Results indicate that the biopsy of animals for MFI observations could possibly be useful in estimating tenderness.

INTRODUCTION

MYOFIBRIL FRAGMENTATION index (MFI) has been shown to account for more than 50% of the variation in tenderness of steaks aged normally (Olson and Parrish, 1977; MacBride and Parrish, 1977; Moller et al., 1973). Culler et al. (1978) observed MFI to be correlated highly with tenderness (r = 0.75) and Warner-Bratzler shear (r = −0.72) in steaks obtained from the longissimus muscle of carcass beef in maturity groups A through E.

In the study by Culler et al. (1978), cores 1.27 cm in diameter and 2.8 cm in length were used for the MFI determinations. Samples of similar size could be obtained through biopsy techniques to make MFI observations. However, the biopsy samples would have to be aged to make meaningful correlations with MFI or shear observations of aged meat. It is not known what the effects of excising core samples by biopsy techniques will be on the postmortem aging processes of the samples and subsequent MFI values.

Therefore, the objectives were to compare the MFI values of samples obtained immediately after death with MFI values of samples obtained after postmortem aging and the usefulness of MFI to estimate shear force of aged, cooked meat.

MATERIALS & METHODS

TWELVE market weight wether lamb carcasses (USDA Choice) were used. The longissimus muscle of one side (selected randomly) of the carcass was cored immediately after death to simulate biopsy procedures. Cores were obtained using a 1.27-cm by 4-cm coring device driven by an electric drill. Difficulty was encountered in obtaining cores of uniform size and weight from the warm, soft muscle tissue of the longissimus muscle immediately after slaughter. Therefore, about 12 to 15 cores, weighing about 2g each, were obtained from the longissimus muscle between the 5th rib and the 4th lumbar vertebra and composited subsequently to 4 or 5 samples. Samples were vacuum-packaged and aged in the cooler with the intact carcasses.

Carcasses were aged 7 (n = 2), 8 (n = 4), 9 (n = 4) or 10 (n = 2) days postmortem in a 2°C cooler. After 7 days, 2 carcasses were selected randomly and 2.7-cm chops obtained from the longissimus muscle between the 5th rib and 3rd lumbar vertebra from sides opposite to the sides from which the cores were obtained at slaughter. Four alternate chops were assigned to shear evaluation and 3 alternate chops cored twice for myofibril fragmentation index (MFI) analysis. The same sampling procedure was used on carcasses days 8, 9 and 10. Chops obtained for shear were frozen at −30°C for subsequent analysis.

The MFI analyses were conducted on cores obtained at slaughter (MFIO) and cores obtained from carcasses after aging (MFIA) on the same days that cores were obtained from carcasses. The MFI was determined by the procedure of Olson et al. (1976) as modified by Culler et al. (1978). The MFI values are expressed as absorbance at 540 nm per 0.5 mg myofibril protein × 200. Cores were scissor-minced with visible fat and connective tissue removed. Values obtained from the samples were averaged and one MFIO or MFIA value was used to represent each carcass.

Chops were prepared for shear force observations following AMSA (1978) guidelines. Frozen steaks were tempered 24 hr at 2°C to 3°C and then broiled. Internal temperature was monitored with iron-constantan wire thermocouples attached to a potentiometer. Steaks were turned at 40°C and removed from the broiler at 70°C. Steaks were stored in ventilated polyethylene bags for 24 hr at 2°C to 5°C before coring. Cores 1.27 cm in diameter were cut such that the fiber direction of the muscle was parallel to the length of the core. Cores were sheared with an Instron 1132/Micron II Universal Testing Instrument (Instron Corporation, Caton, MA.) equipped with a Warner-Bratzler shear blade.

Differences between MFIO and MFIA were analyzed by least-squares procedures using a model that included time of coring and animal. Residual variation was used for an error term. Linear and quadratic regression analyses of shear force on MFIO or MFIA and residual correlations were computed after fitting days of aging in models.

RESULTS & DISCUSSION

MEANS and standard deviations (SD) for MFIO, MFIA and shear force are given in Table 1. The SD for shear force indicated considerable variation (CV = 35%) existed among the 12 carcasses for shear force. The CV of MFI values within MFIO or MFIA treatments was similar and was 10 or 11%, respectively. Values for MFI were less ($P < 0.01$) for the MFIO treatment than for the MFIA treatment. The MFI procedure essentially reflects the degree of proteolysis that myofibrils undergo that is associated with aging (Koohmaraie, 1988). Evidently, the myofibrils that were aged after excising (MFIO) underwent less proteolysis than myofibrils aged in the intact muscle (MFIA). The MFIA values observed here are greater than those observed for tender meat in the work by Culler et al. (1978).

Variation in MFIO with variation in MFIA was highly correlated (r = 0.72, not tabulated). Correlations between MFIO or MFIA with shear force were similar (r = −0.57, r =

—Continued on page 256

Table 1—Means and standard deviations for myofibril fragmentation index by time of coring and peak load

Time of coring				Shear force	
MFIO[a]		MFIA[a]			
$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
69.18[b]	7.04	81.38[b]	9.03	4.23	1.47

[a] Absorbance per 0.5 mg myofibril protein × 200.
[b] Means differ at $P < 0.01$.

Authors Crouse and Koohmaraie are with the [1]USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center, P.O. Box 166, Clay Center, NE 68933.

−0.60, respectively). However, correlations of MFI with tenderness were lower than the 0.72 observed by Culler et al. (1978) where MFI accounted for about 50% of the variation in shear force. Correlations of MFI with shear force observed here were similar to the correlation of −0.65 observed by Olson and Parrish (1977) in meat aged 1 day.

Length of time of aging meat accounted for 34% of the variation in shear force (Table 2). Linear regression of MFIO and aging time postmortem accounted for 56% of the variation in shear force. Samples obtained after aging the meat in the intact carcass accounted for 58% of the variation in shear force in a similar equation. Regression coefficients of equations using MFIO or MFIA were also similar in magnitude. Evidently, method of aging, sample core vs intact muscle, had no effect on the relationship of MFI with shear force.

Results of the work reported here indicated that MFI was useful for predicting shear force. Additional work should be done to test the usefulness of muscle samples obtained by biopsy techniques in estimating shear or sensory panel tenderness. The technique, if successful, would be very useful in live-animal selection projects.

Table 2—Regression equations that estimate shear force by myofibril fragmentation index samples obtained at slaughter or after aging

	Independent variable regression coefficient			
Intercept	Aging postmortem	MFIO	MFIA	R^2
11.6	−0.87			0.34
19.3	−0.97	0.10		0.56
18.0	−0.86		0.08	0.58

REFERENCES

AMSA. 1978. Guidelines for cookery and sensory evaluation of meat. American Meat Science Association and National Live Stock and Meat Board.

Culler, R.D., Parrish, F.C. Jr., Smith, G.C., and Cross, H.R. 1978. Relationship of myofibril fragmentation index to certain chemical, physical and sensory characteristics of bovine longissimus muscle. J. Food Sci. 43: 1177.

Koohmaraie, M. 1988. The role of endogenous proteases in meat tenderness. Recip. Meat Conf. Proc. 41: 89.

MacBride, M.A. and Parrish, F.C., Jr. 1977. The 30,000 dalton component of tender bovine longissimus muscle. J. Food Sci. 42: 1627.

Møller, A.J., Vestergaard, T., and Wismer-Pederson, J. 1973. Myofibril fragmentation in bovine longissimus dorsi as an index of tenderness. J. Food Sci. 38: 824.

Olson, D.G. and Parrish, F.C., Jr. 1977. Relationship of myofibril fragmentation index to measures of beef steak tenderness. J. Food Sci. 42: 506.

Olson, D.G., Parrish, F.C., Jr., and Stromer, M.H. 1976. Myofibril fragmentation and shear resistance of three bovine muscles during postmortem storage. J. Food Sci. 41: 1036.

Ms received 8/4/89; accepted 8/4/89.

Mention of trade names, proprietary products or specific equipment does not constitute a guarantee or warranty of the product by the USDA and does not imply its approval to the exclusion of other products that may also be suitable.