A Comparison of Collagen Content and Organoleptic Attributes of Grain-vs. Forage-Finished Cattle

L.E. Bulgerin, J.E. Williams, T.H. Liao, L.L. Ebro, J.J. Guenther, L.E. Walters, D.G. Wagner

Story in Brief

Collagen content of muscle tissue and organoleptic attributes of steaks were compared in Brangus crossbred steers reared under different management systems. Twenty steers were randomly assigned to two treatments: 1) a conventional 90-percent concentrate finishing ration for 161 days, or 2) a sorghum-sudan and wheat pasture finishing system for 190 days prior to slaughter. After slaughter, samples were taken from the longissimus dorsi muscle at the 13th rib and the semitendinosus muscle (eye of round) for collagen analyses and organoleptic evaluation. Collagen was extracted from the muscle tissue and expressed on the basis of hydroxylysine content. Steaks were evaluated by nine trained panelists using an 8-point hedonic scale. Collagen content was higher in the semitendinosus muscle (2.9 and 2.5 mg collagen/g of wet tissue) and lower in the longissimus dorsi muscle (1.4 and 1.6 mg collagen/g of wet tissue) of grain-than forage-finished cattle. Steaks from semitendinosus muscle had higher scores for tenderness and lower amounts of connective tissue for grain- than forage-finished cattle. Organoleptic evaluation of the longissimus dorsi muscle revealed slight differences in tenderness and connective tissue between Treatments 1 and 2.

Introduction

Tenderness is one of the most important quality attributes of beef palatability. Due to increasing world grain shortages, there is a current trend for more forage-finished beef production. It has been established by several researchers (Bowling *et al.*, 1977,Cross *et al.*,1975) that beef finished on forage is less tender than beef finished on grain. Beef tenderness can be divided into three components; actomyosin effects, intramuscular fat and moisture effects, and background effects which are due to the quantity and/or chemical state of the intramuscular collagen. This study was undertaken to determine whether intramuscular collagen plays a major role in the tenderness of grain- vs. forage-finished beef.

Materials and Methods

This study was conducted over a 2-year period. Each year 20 Brangus X Hereford-Angus crossbred steers, at weaning, were randomly allotted (10 per treatment) to one of two production systems: 1) a 90-percent conventional corn grain diet for 161 days, or 2) a high quality sorghum-sudan and wheat pasture mixture for 190 days prior to slaughter (no grain).

After slaughter, carcasses from both groups were chilled 48 hours or longer at 1° C. Longissimus dorsi (LD) muscle from (short loin) at the area of the 13th rib and semitendinosus (ST) muscle from the round were taken from the right side of the carcass for collagen analyses and organoleptic evaluation. The steaks for collagen analyses were trimmed of all external fat, ground through a ⅛-inch plate and frozen prior to analyses. Crude intramuscular collagen was extracted from the muscle tissue

using the Texas A&M procedure of Wu, Dutson and Carpenter (unpublished data). The total amount of collagen in each muscle sample was determined by amino acid analysis using hydroxylysine as the standard amino acid. Soluble collagen was determined using the procedure of Goll (1964). Sensory quality attributes were evaluated by 9 trained panelists using the 8-point hedonic scale. Organoleptic evaluation of steaks compared tenderness and amount of connective tissue associated with the two feeding treatments.

Results and Discussion

Organoleptic evaluation showed steaks from the grain-finished steers ranked higher (Table 1) than steaks from the forage-finished steers in both years and for both muscles studied. Significant differences were found between the LD steaks in the 1978 (first) study. Here grain-finished LD steaks were significantly more tender and had much less connective tissue than forage-finished LD steaks. In the 1978 study there were greater differences between the grain- and forage-finished LD muscles than the ST muscles. In the 1979 study greater differences were seen between the ST muscles than the LD muscles.

Total collagen content, expressed in mg collagen/g of wet tissue, and percentages of total collagen solubilized are presented in Tables 2 and 3. There were no significant differences between forage- and grain-finished steers. In the 1978 study (Table 2) the average LD muscle from the forage-finished steers contained more collagen (3.20 vs. 1.01 mg collagen/g wet tissue) than from the grain-finished steers; however the ST muscles show the reverse trend (1.98 vs. 3.20 mg collagen/g wet tissue). In the 1979 study (Table 3) collagen content was lower in the LD muscle (1.56 vs. 1.80 mg collagen/g wet tissue) and higher in the ST muscle (3.07 vs. 2.58 mg collagen/g wet tissue) for forage- than grain-finished beef. The collagen was more soluble in the grain-finished beef in each muscle except the LD muscle in the 1978 study as shown in Tables 2 and 3.

The percent soluble and insoluble collagen on a wet muscle tissue basis are

Table 1. Organoleptic evaluation of steaks

Sensory quality attributes	Muscle	1978 Forage-finished	1978 Grain-finished	1979 Forage-finished	1979 Grain-finished
Tenderness**	LD	4.53	5.88*	4.67	5.02
	ST	3.78	4.69	4.62	5.49
Amount of connective tissue**	LD	4.22	5.60*	4.47	4.76
	ST	3.51	4.31	4.31	4.98

*significantly different $P < .05$.
**8 = most desirable 1 = least desirable.

Table 2. 1978 collagen analyses of ST and LD muscles from forage-vs. grain-finished beef

	Muscle	Forage-finished	Grain-finished
Collagen content (mg/g fresh muscle tissue)	LD	1.71± 0.43	1.01± 0.24
	ST	1.98± 0.48	3.20± 0.85
% of total collagen solubilized	LD	20.64± 1.81	17.30± 1.53
	ST	9.94± 0.72	10.06± 0.94

Table 3. 1979 collagen analyses of ST and LD muscles from forage-vs. grain-finished beef

	Muscle	Forage-finished	Grain-finished
Collagen content (mg/g fresh muscle tissue)	LD	1.56± 0.22	1.80± 0.17
	ST	3.07± 0.77	2.58± 0.18
% of total collagen solubilized	LD	28.40± 1.93	29.40± 2.93
	ST	16.22± 1.97	20.97± 1.76

Table 4. 1978 collagen solubility of ST and LD muscles from forage-vs. grain-finished beef

	Muscle	Forage-finished	Grain-finished
% soluble collagen in the muscle	LD	0.03± 0.009	0.02± 0.003
	ST	0.02± 0.009	0.03± 0.007
% insoluble collagen in the muscle	LD	0.14± 0.035	0.09± 0.024
	ST	0.18± 0.043	0.29± 0.080

Table 5. 1979 collagen solubility of ST and LD muscles from forage--vs. grain-finished beef

	Muscle	Forage-finished	Grain-finished
% soluble collagen in the muscle	LD	0.05± 0.007	0.06± 0.009
	ST	0.05± 0.014	0.05± 0.005
% insoluble collagen in the muscle	LD	0.11± 0.016	0.12± 0.011
	ST	0.26± 0.064	0.20± 0.015

presented in Tables 4 and 5. The percent soluble collagen in the muscle tissue was very similar between feeding treatments. The collagen remaining in the muscle tissue after the steak has been cooked is the insoluble collagen. In the 1978 study (Table 4) there was more insoluble collagen remaining in the LD muscle (.14 vs. .09 percent) and less in the ST muscle (.18 vs. .29 percent) of the forage-finished than the grain-finished beef. In the 1979 study (Table 5) the percent insoluble collagen in the LD muscle was similar between feeding treatments. There was considerably more insoluble collagen in the ST muscle of the forage-finished than the grain-finished beef (.26 vs. .20 percent). In general, there did not appear to be any strong relationships between the collagen analyses and the organoleptic evaluation of the steaks from the different feeding treatments.

Literature Cited

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