Meat and Muscle Biology™

Relationships between Intramuscular Fat, Meat Quality and Collagen Characteristics in Bovine Longissimus Thoracis

M. Khaliq*, J. Puente, B. C. Roy, and H. L. Bruce

Department of Agriculture, Food and Nutritional Science, University of Alberta, Edmonton, Canada

Objectives

The presence of intramuscular fat within beef muscle has been associated with decreased meat toughness and studies suggest that intramuscular connective tissue (ICT) and myofibrils contribute to cooked beef toughness. The objective of this study was to determine the variation in collagen characteristics among beef quality grades and their relationship with meat toughness.

Materials and Methods

Twelve *longissimus thoracis* (LT, rib eye) muscles from each of the Canada quality grades (Prime, AAA, AA, and A equivalent to USDA Prime, Choice, Select and Standard) were obtained direct from abattoir within 3 d postmortem for a total of 48 LT. Three steaks were removed followed by 14 d of ageing for 1) color, pH, proximate analysis; 2) cooking loss and Warner-Bratzler shear force; and 3) drip loss. The remaining muscle was frozen at –20°C until thawed, cut into meat cubes, mixed to homogeneity and divided into three fractions. Fraction A was analyzed as whole muscle, Fraction B was used for isolation of ICT with alkali extraction and Fraction C was for the isolation of ICT with a salt buffer extraction. Fraction A was lyophilized and analyzed for proximate composition, total collagen concentration and collagen heat solubility, while ICT isolated by alkali and salt were compared for total collagen and Ehrlich chromagen (EC) concentration. Data were analyzed using Statistical Analysis Software (SAS Inst. Inc., Cary, NC). The effects of grade on beef quality and collagen characteristics were analyzed by one way analysis of variance with grade as the sole source of variation, while the isolation and comparison of ICT used grade and isolation methods and their interaction as sources of variation with sig-

nificance at $P < 0.05$. Mean differences between sources of variation were determined by Student-Newman-Kuel multiple range test and Pearson correlations and partial least square regression estimated linear relationships between the measurements ($P < 0.05$).

Results

Grade had no effect on pH, cook time and drip loss. Mean shear force value was lower for LT from Canada Prime (37.5 kg) and AAA (33.6 kg) than LT from Canada A (45.0 kg) and AA (50.6 kg; $P = 0.001$). Canada Prime LT had lower cooking loss than other quality grades ($P = 0.0204$) but the highest intramuscular fat content (11.57%), followed by LT from Canada AAA (4.62%), AA (3.11%), and A (2.92%) ($P < 0.0001$). Strong correlations were found between fat and moisture ($r = –0.84$) and protein ($r = –0.65$). Prime LT showed a higher collagen content (2.49 mg/g fresh muscle) than LT from AA (2.05 mg/g fresh muscle), AAA (1.99 mg/g fresh muscle) and A (1.92 mg/g fresh muscle; $P = 0.0057$). Grade had no effect on collagen heat solubility ($P = 0.4945$); however, solubility increased with total collagen content ($r = –0.47$, $P = 0.000745$). Salt extraction yielded more ICT (14.9% of muscle) than alkali (8.53%) with Prime LT having the greatest proportion of perimysium (12.41%; $P = 0.0057$). Alkali-extracted ICT contained more collagen (2.94 mg/g fresh muscle) and EC concentration (0.38 mol/mol collagen) than salt-extracted ICT collagen (2.38 mg/g fresh muscle, EC concentration 0.29 mol/mol collagen) with no effect of grade.

Conclusion

Results showed that Prime and AAA LT with inherent increased intramuscular fat content produce a tenderer product than Canada AA and A LT despite increased collagen content.