

GENETIC EVALUATION OF RIBEYE TENDERNESS AND THE IMPLICATIONS OF SELECTION

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Summary

Tenderness measurements of ribeye steaks from feedlot cattle were collected and analyzed to determine the proportion of the variation controlled by genetics. The variation was quantified and used to produce genetic predictions of tenderness. An example exploring the impact of selection of sires for tenderness showed that the proportion of cattle producing tender beef could be increased using genetic selection.

Introduction

Tenderness of beef is a primary determinant of consumer satisfaction. Sixty-four percent of participants in a Canadian study (Jeremiah *et al.*, 1993) chose tenderness as the primary criterion of satisfaction versus 20% for flavour and 11% for leanness. Several studies have shown that a considerable proportion of beef steaks do not satisfy consumers, for example Roeber, *et al.* (2001). It is known that marbling level influences the juiciness and flavour of beef, and to a lesser extent, tenderness. However, there is considerable variation in tenderness that is independent of marbling. Quantifying and utilizing this variation to identify and select breeding stock with superior genetics for tenderness has the potential to improve customer satisfaction and increase beef market share. The objectives of this study were to assess genetic variation of tenderness, quantify this variation by producing genetic evaluations, and to discuss the implications of selection for tenderness on consumer acceptability.

Materials and Methods

The study is based on Warner-Bratzler shear force measurements from three separate but related studies. The first data source was a detailed study of 200 steers fed together in a typical Ontario feedlot. These cattle were from 17 sires of 4 breeds (Angus, Charolais, Simmental, Limousin). The second data set was obtained from 600 commercially fed cattle of several breed crosses identified and tracked using Beef Improvement Ontario's BIO-LINK system. The third data source was from steer feeding trials conducted at the Elora Beef Research Centre feedlot, with steers originating from three research herds (Elora, New Liskeard, and Kapuskasing) utilizing an Angus and Simmental rotational crossbreeding system. Eighty percent of the cattle were steers, with the remaining being heifers or bulls. Management groups were formed by combination of sex, herd of origin, feedlot location, and year.

For all data sources, a primal rib cut consisting of ribs 6 to 12 from one side of each carcass was purchased and delivered to the Meat Laboratory at the University of Guelph. Five steaks were prepared from the *longissimus* (ribeye) muscle and allocated to post-mortem aging times of 2, 7, 14, 21, and 28 days for subsequent measurements of tenderness using Warner-Bratzler shear. This study is based on shear force measurements from ribeye steaks aged for 7 days. The reported shear force is the average kilograms of force required to shear through eight, 1 centimetre cores from each steak.

Tenderness measurements were combined and analyzed using a single trait animal model with fixed effects of the mean, and random effects of animal, management group, and breed group. Almost all of the animals in the study were crossbred, and were composed of varying levels of several different breeds. Breed group was formed by grouping animals of similar breed combinations based on sire and dam breed. The breed group effect accounts for the effect of each specific breed combination on shear force, rather than the effect of one breed over another. Across breed genetic evaluations were generated utilizing the individual animal solutions in combination with the breed group effect, allowing comparison of animals across several breeds and crosses. Accuracy was approximated from the standard error of prediction of the animal solutions.

Results and Discussion

Shear force measurements from the three data sources were combined for analysis. Table 1 shows the combined summary of the measurements as well as the heritability estimate of 0.11.

Table 1. Summary of shear force measurements from ribeye steaks aged for 7 days.

Variable	N	Mean (kg)	Std. Dev. (kg)	Minimum (kg)	Maximum (kg)	Heritability
Shear force	1269	4.7	1.3	1.8	8.8	0.11

Shear force measures the amount of force required to cut across the muscle fibers, and lower values indicate more tender beef. Across breed genetic evaluations were computed to predict the difference in progeny average shear force due to the genetics of the animal. For example, steaks from progeny of a sire with a -0.20 genetic evaluation are expected to require 0.30 kg less force to shear than steaks from progeny of a sire with a $+0.10$ evaluation. The range of sire evaluations in this study went from -0.25 (most tender) to $+0.24$ (least tender) with accuracy ranging from 0.27 to 0.75.

Currently, there are no exact standards for connecting shear force to consumer acceptability. However, a meat tenderness study involving taste panels (Wheeler *et al.*, 2000) showed that in their sample of 310 carcasses, 20% were considered tender, 68% intermediate, and 11% tough. Assuming these proportions are also representative of the data that we have collected, tender beef would have a shear force of 4.05 kg and under, while tough beef would have a shear force of 5.64 kg and over. Steaks within these two levels would be considered intermediate in tenderness.

Table 2 shows the expected average shear force of progeny for three sires with different shear force evaluations when mated to the same set of cows. This suggests that substituting the ‘Tender’ for the ‘Tough’ sire would increase the percent of tender carcasses from 12% to 30%, while decreasing the proportion of tough carcasses from 18% to 6%.

Table 2. Example effect of sire shear force genetic evaluation on progeny tenderness category

	Tender Sire	Average Sire	Tough Sire
Genetic evaluation (kg)	-0.25	0	+0.24
Average progeny shear force (kg)	4.45	4.70	4.94
Tender (%)	30	20	12
Intermediate (%)	64	69	70
Tough (%)	6	11	18

Conclusion

Many factors influence the tenderness of beef, including genetics, age at slaughter, post-mortem aging, electrical stimulation, and cooking method. This research was able to quantify the variation due to genetics and produce genetic evaluations for individual animals of several breeds and crosses.

Significance to Industry

Sufficient genetic variation exists to change the proportion of animals producing tender beef. Routine genetic selection of beef cattle for tenderness will require the development of technology to measure and collect shear force information on a commercial level. The resulting genetic evaluations could be used to rank sires for potential to produce tender beef.

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