GENETIC PARAMETER ESTIMATES FOR MEAT QUALITY TRAITS IN BEEF CATTLE MANAGED UNDER A CONSTANT FINISHING PROGRAM

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INTRODUCTION

Flavour and tenderness are key components contributing to a good eating experience. Intramuscular fat extracted from the *longissimus* muscle is related to flavour and juiciness, (Fernandez *et al.*, 1999), with marbling related to percent intramuscular fat, (Kazala *et al.*,1999; Campeneere *et al.*, 1999). Warner-Bratzler shear force measurements have been shown to be an objective method of assessing tenderness (Shackleford *et al.*, 1999). Literature estimates of heritability for carcass quality traits such as hot carcass weight and backfat thickness are moderate to high (0.38-0.45, Devitt and Wilton, 2001; 0.08-0.10, Lee *et al.*, 2000; 0.26-0.68, Reverter *et al.*, 2000). Improvements in flavour, juiciness, and tenderness, and hence overall meat quality could be made possible through increased information on genetic parameters for quality traits. The objective of this study was to measure the genetic parameters of these traits, particularly percent intramuscular fat, shear force and marbling.

MATERIALS AND METHOD

Data. Carcass data were collected on 610 crossbred steers and heifers at the Elora Beef Research Centre over four years. Forty sires were used between the four years, with a range of 8 to 34 progeny per sire. In the first year of the trial, the cattle were fed one of four diets: 1) high grain from start to finish, 2) haylage for 112 days and then grain to finish, 3) haylage for 112 days, followed by pasture then high grain to finish, and 4) pasture from start to finish. In year 2, the cattle were fed either diet 1) or 2) from the previous year. In the latter two years, there were four diets used: 1) high grain from starting to finish; or one of three types of corn silage (unprocessed, processed, and processed with inoculants), followed by high grain. In all four years, animals were finished to a constant backfat thickness of 8 mm, as determined by ultrasound measurements taken every 28 day. Carcass data including shear force measurements (an instrumental measurement of the force in kilograms required to cut through muscle fibres) and intramuscular fat content (via ether extract) of *longissimus* and *semitendinosus* steaks were collected. Marbling measurements collected were based on a point scale from 1 to 10 with 1 = devoid, 5 = small, and 10 = abundant.

Statistical analyses. (Co)variance components for all traits were estimated using restricted maximum likelihood (REML) methodology within a multiple-trait animal model that included the fixed effect of breed composition and the random effect of contemporary-group (year and nutritional treatment), and animal.

RESULTS AND DISCUSSION

Simple statistics for carcass quality traits are reported in table 1. The mean backfat thickness at 9.1 mm was slightly greater than the targeted backfat endpoint of 8 mm. Percent intramuscular fat was higher in the *longissimus* muscle than in the *semitendinosus* muscle. The opposite was true for shear force values. These results are consistent with findings whereby the *longissimus* muscle has a higher intramuscular fat content, and is more tender than the *semitendinosus* muscle.

Heritability estimates for the carcass traits are shown in table 2. Estimates for hot carcass weight, backfat thickness, *longissimus* muscle area, and marbling are similar to estimates in the literature (Devitt and Wilton, 2001; Reverter *et al*., 2000). The estimates of heritability for percent intramuscular fat were 0.57 and 0.25 for the *longissimus* and *semitendinosus* muscle, and 0.13, and 0.18 for shear force measurements taken on the *longissimus* and *semitendinosus* muscle respectively. Estimate of heritability for percent intramuscular fat (*longissimus* muscle) was higher than literature estimates (0.41, Ferguson *et al*., 1997). For shear force measurements taken on the *longissimus* and *semitendinosus* muscles, estimates fell within literature ranges 0.06-0.40 (0.26, Splan *et al.* 1998; 0.06-0.40, Robinson *et al*. 2001). These estimates of heritability were based on a management system whereby the cattle were fed to a fixed endpoint of approximately 8 mm of backfat, measured by ultrasound technology.

Genetic correlations of marbling with intramuscular fat were high (0.63, and 0.94), but were lower with shear force measurements (0.17, and 0.43). Marbling is an easier trait to measure, and can be used as a good indicator of intramuscular fat, but would be a much less accurate indicator of shear force.

Table 1. Basic statistics on carcass quality traits

Trait	N	Mean	SD
Hot carcass weight (Kg)	610	350	56
Backfat thickness (mm)	610	9.05	2.13
Longissimus muscle area (cm^2)	610	85.4	12.3
Marbling (points)	609	5.10	0.74
Intramuscular fat – *longissimus* muscle (%)	586	4.68	1.54
Intramuscular fat – *semitendinosus* muscle (%)	375	3.08	1.07
Shear force – *longissimus* muscle (kg)	580	4.62	1.28
Shear force – *semitendinosus* muscle (kg)	576	5.42	0.93

Table 2. Estimates of genetic parameters for carcass quality traits [A]

Trait	HCW	Backfat thick-ness	*Longi-ssimus* muscle area	Mar-bling	% Intra-muscular fat (LM)	% Intra-muscular fat (ST)	Shear force (LM)	Shear force (ST)
HCW	**0.30**	0.17	0.62	-0.10	0.01	0.28	-0.01	0.42
Backfat thickness	0.38	**0.17**	-0.22	-0.19	-0.07	0.37	-0.07	-0.55
Longissimus muscle area	0.69	0.13	**0.40**	-0.48	-0.43	-0.27	-0.05	0.13
Marbling	0.33	0.31	0.16	**0.37**	0.94	0.63	0.17	0.43
% Intra-muscular fat (LM)	0.26	0.31	0.03	0.65	**0.57**	0.80	0.28	0.40
% Intra-muscular fat (ST)	0.21	0.29	-0.05	0.28	0.47	**0.25**	0.04	0.04
Shear force (LM)	0.12	0.10	0.15	0.09	0.08	-0.05	**0.13**	0.48
Shear force (ST)	0.14	0.06	0.09	0.07	0.24	0.20	0.29	**0.18**

[A] Heritabilities on the diagonal; genetic correlations above and phenotypic correlations below the diagonal.

CONCLUSION

These results indicate that there is the potential to improve meat quality for tenderness using shear force measurements, and flavour, and juiciness through percent intramuscular fat or marbling measurements, under management programs based on marketing at constant finish.

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