EARLY RESULTS OF THE GENETIC RELATIONSHIP BETWEEN POSTWEANING GROWTH AND CARCASE INTRAMUSCULAR FAT IN STEERS

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SUMMARY

British breed steers grown out for the Korean and Japanese markets were used to estimate the genetic relationship between postweaning growth and intramuscular fat percent (IMF) in the *m. longissimus dorsi* muscle. The results showed postweaning average daily gain was moderately heritable, and positively correlated genetically with IMF. The study also highlighted problems in estimating genetic parameters for average daily gain traits measured over short periods.

Keywords: Postweaning growth, intramuscular fat, genetic correlation

INTRODUCTION

The level of marbling in beef carcases is an important specification for some domestic and export markets. With the availability of marbling estimated breeding values (EBVs), Australian beef producers can consider genetic and non-genetic methods to improve marbling. The aim of this study was to better understand the genetic and phenotypic relationship between marbling and early postweaning growth.

MATERIALS AND METHODS

Data from the Cooperative Research Centre for the Cattle and Beef Industry (CRC) straightbreeding project was used, the design and management of the project were outlined by Robinson (1995). In brief, the project entailed a designed progeny test for carcase and meat quality traits from four temperate breeds (Angus, Hereford, Shorthorn, and Murray Grey) and three tropically adapted breeds (Brahman, Belmont Red and Santa Gertrudis). The data in this study were on temperate breed steers that were backgrounded to an average liveweight of 400 kg prior to finishing for the Korean or Japanese export markets.

Within a year and season (autumn and spring), animals were assembled at Glen Innes, in northern NSW, for grow-out. Liveweights were taken at several stages throughout the grow-out with three weights being used in this study. These weights were at the start, the middle, and at the end of the grow-out. The middle weight coincided with the moving of the domestic market groups to finishing at an average liveweight of 300 kg. The end of the grow-out weight was taken when the average of the intake group was 400 kg.

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After grow-out the steers were finished on pasture or grain to either the Korean (280 kg carcase) or Japanese market (320 kg carcase) endpoints. At slaughter, a sample of the *m. longissimus dorsi* muscle was taken between the 12/13th ribs. Samples were freeze dried and intramuscular fat percent predicted by near infra-red (NIR) spectroscopy. Growth traits considered were: initial grow-out weight (IWT), average daily gain from start to the mid-weight (ADG12), average daily gain from mid-weight to final weight (ADG23), and average daily gain from initial to final (ADG13).

Variance components were estimated by REML using VCE4.0 (Groeneveld and García Cortés 1998). The first analysis included IWT, ADG13 and IMF run in a three trait model. For the growth traits, the model included a fixed effect for herd of origin||background nutrition level||year||season. A covariate of age at the start of grow-out was included for IWT and ADG13. The model for IMF included two fixed effects, the first modelled the pre-finishing backgrounding regimes: herd of origin||background nutrition level||year||season and a second defined a comparable group of animals: herd of origin||kill code, where kill code grouped all animals from same CRC intake, finish-market destination, killed on the same day at the same abattoir. A covariate of carcase weight was included.

The second analysis was performed where the grow-out period was considered as two separate traits (ADG12 and ADG23) and were included with IWT and IMF in a four trait model. For growth traits, the model included a fixed effect for herd of origin||background nutrition level||year||season. A covariate of age was included for IWT and ADG12. A covariate of mid-weight was included for ADG23. IMF was modelled as above.

For both analyses, additive genetic and residuals were modelled as random effects. The analysis included a relationship matrix using up to five generations of pedigree. A total of 193 sires had progeny recorded.

RESULTS AND DISCUSSION

Trait statistics are presented in Table 1. The steers had an average initial weight (IWT) of 270 kg at 324 days of age. On average, the steers were backgrounded for 186 days (days13) and grew at 0.66 kg/day. When the grow-out period was partitioned, the first period was on average 69 days (days12) and the second period 119 days (days23).

Heritabilities and correlations are presented in Table 2. IWT and IMF were moderately heritable, with a lower estimate for ADG13. Genetic correlations were positive between the three traits, with IMF and ADG13 being moderately correlated (r_g=0.32). The results were in general agreement with estimates reviewed by Koots *et al* (1994a,b), who reported a heritability of 0.32 for yearling gain and a weak positive genetic relationship between post weaning gain and marbling score. Phenotypic correlations were close to zero. This was due to negative residual correlations between the traits. This has ramifications for the grow-out management of feeder cattle, particularly those destined for markets requiring marbling.

Table 1. Raw trait statistics

Variable	Number	Mean	Std	Min.	Max.
Initial wt (kg)	1593	270.3	45.0	128	415
age (d)	1839	324	29.0	227	417
days12 (d)	1427	68.7	39.9	9	110
adg12 (kg/d)	1427	0.71	0.39	0.02	1.95
mid wt (kg)	1839	308.5	40.9	172	428
days23 (d)	1749	118.9	31.2	85	200
adg23 (kg/d)	1749	0.70	0.29	0.01	1.63
days13 (d)	1510	186.2	54.9	104	252
adg13 (kg/d)	1510	0.66	0.22	0.01	1.37
imf (%)	1332	5.47	2.01	1.48	16.26
carcase wt (kg)	1830	302.6	34.4	195.5	445.5

Table 2. Heritabilities (on diagonal) and correlations (genetic above, phenotypic below diagonal) for IWT, ADG13 and IMF

	IWT (kg)	ADG13 (kg/d)	IMF (%)
IWT	**0.44**	0.12	0.12
ADG13	0.05	**0.28**	0.32
IMF	-0.03	-0.01	**0.42**

When grow-out was split into two periods, the genetic parameters estimated were quite different (Table 3). Gain in the first period (ADG12) had an inflated heritability, was negatively correlated with initial weight (IWT) and was slightly negatively correlated with gain in the second period and IMF. However, gain in the second period was positively correlated with initial weight and with IMF. Mukai *et al* (1995) reported a genetic correlation of 0.24 between mid-end test gain for bulls on test and steer marbling score.

These results showed that gain over a short period was an unreliable genetic measure of growth. In this study the animals were recently weaned and relocated from their property of origin. Therefore it is likely that the genetic parameters estimated from the early gain over a relatively short period were confounded with carry over maternal effects and possibly compensatory gain effects during the first few weeks postweaning.

Table 3. Heritabilities (diagonals) and correlations (genetic above, phenotypic below) for IWT, ADG12, ADG23 and IMF

	IWT (kg)	ADG12 (kg/d)	ADG23 (kg/d)	IMF (%)
IWT	0.44	-0.32	0.34	0.12
ADG12	-0.01	0.48	-0.12	-0.09
ADG23	0.22	-0.06	0.27	0.44
IMF	-0.03	0.02	-0.04	0.41

These early results showed the genetic relationship between postweaning gain and marbling was positive and could be considered in selection programs. However, the phenotypic correlation was zero between gain and marbling. Further work will be done to investigate the effect of gain during the finishing period and any interactions with regime (pasture vs. grain) on the relationship with intramuscular fat.

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