GENETICS OF MEAT QUALITY TRAITS IN TWO TROPICALLY ADAPTED GENOTYPES OF BEEF CATTLE 2. INFLUENCE OF TENDERSTRETCHING

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SUMMARY
Tender stretching (TS) is an alternative means of hanging beef carcasses which, when compared to sides conventionally hung by the Achilles tendon (AT), minimises the potential for muscle shortening during rigor in the high priced cuts of the rump and loin. A total of 1,939 tropically adapted steers of two genotypes (889 Brahmans (BRAH) and 1,050 Tropical Composites (TCOMP)) were used to estimate the effect of TS on the genetic parameters of meat quality traits. Measurements of meat quality traits (peak force (PF), cooking loss (CLoss) and compression (CMP)) were performed on feedlot finished steers. Heritabilities of meat quality traits were moderate in both genotypes. For BRAH heritability estimates were 0.33, 0.15 and 0.07 for PF, CMP CLoss, respectively. The heritabilities for TCOMP were 0.30, 0.27 and 0.21, respectively. Use of TS resulted in a proportional reduction in phenotypic and additive variances in comparison to conventionally hung carcases. As a result, the heritabilities of TS meat quality traits are similar to those measured on conventionally hung carcases. Despite this, the response to selection upon TS measurements will be significantly reduced, in comparison to AT, due to the reduction in additive variance. However, the reduced phenotypic variances for TS measurements suggest that commercial use of TS in the abattoir will lessen the need to select for tenderness in beef genetically.

INTRODUCTION
Selection for tenderness in beef is difficult as it is expensive and measured post-slaughter. Traditionally carcases are hung by the achillis tendon (AT) during processing. However, alternative hanging techniques have been examined as a post-slaughter means of improving tenderness. Tender stretching (TS) hangs carcasses by the aitch bone, allowing the hind limb to hang at approximately 90^0 to the rest of the carcase. Ahnstrom *et al*. (2006) reported that this process minimised the potential for shortening in the high value muscles of the rump and loin as the carcase entered rigor; and Taylor and Perry (1995) demonstrated that sarcomere length, and therefore tenderness, was increased in TS sides. It is not known, however, how the use of TS affects the genetic parameters of meat quality traits (including tenderness). The aim of this study was to quantify the effect of TS hanging on the genetic parameters of tenderness and cooking loss in animals of two tropically adapted beef genotypes. This is the second in a series of two papers investigating the genetics of meat quality of tropically adapted beef genotypes (Wolcott *et al.* 2007).

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MATERIALS AND METHODS

This study utilised the same experimental animals described in the companion paper by Wolcott *et al.* (2007). Briefly, the animals used in this study were from the Northern breeding project of the CRC for cattle and beef quality (Burrow *et al.* 2003), and involved steers of two tropically adapted genotypes: Brahman (BRAH) and Tropical Composite (TCOMP). After weaning, steers were allocated to one of 5 CRC managed properties in Central QLD or NSW. Steers were grown out to a target average contemporary group live weight of 400kg before entry into a feedlot. During finishing, animals were lot fed for an average of 119 days and were slaughtered at one of two commercial abattoirs.

At slaughter, the left side of each carcass was tender stretched and the right side was hung conventionally: by the achillis tendon (Wolcott *et al.* 2007). Carcasses were not electrically stimulated, though there may have been some minor electrical inputs through use of the hide puller and other slaughter floor equipment. Methods for obtaining meat samples are described by Wolcott *et al.* (2007). Meat quality measurements included shear force in kg (PF), cooking loss percentage (CL) and compression in kg (CMP) for each animal and each hanging method. All measurements were conducted in accordance with the protocol described by Perry *et al.* (2001).

Initially data editing removed animals with missing kill groups and sires. The traits were then examined to ensure normality, and any outliers (greater than 3 standard deviations from the contemporary group mean) were removed from the analysis. Fixed effects models for each genotype and trait tested the significance of cohort, property of origin, age of dam, birth month, feedlot management groups and kill date. In addition, terms to account for heterosis were tested for Tropical Composites. See Wolcott *et al.* (2007) for a description of the fixed effects tested for this analysis. All fixed effects and first order interactions were included in initial models with sire fitted as random. Terms were removed from the models in order of least significance and terms significant at P=0.05 were retained in final models. Genetic parameters were estimated in ASReml (Gilmour *et al.* 1999) in univariate analyses using an animal model and a 3 generation pedigree, and genetic correlations were estimated in bivariate analyses.

RESULTS AND DISCUSSION

The results presented in Table 1 show that PF and CMP measured in TS sides were moderately heritable for both genotypes. Heritabilities for PF and CMP were 0.30 and 0.15 for BRAH and 0.30 and 0.27 for TCOMP respectively. CLoss measurements were moderately heritable for TCOMP (0.21) but the same measure was lowly heritable for BRAH (0.07).

For most traits, the use of TS decreased the additive and phenotypic variances when compared to the results presented by Wolcott *et al.* (2007) for measurements collected in AT sides, where the phenotypic variance for ATPF in BRAH and TCOMP was 1.12 and 1.09 respectively. In comparison, results in Table 1 show that the phenotypic variance for TSPF was 0.27 and 0.23 for BRAH and TCOMP. Similarly, phenotypic variances for ATCMP, and ATCLoss were 0.07 and 5.3 for BRAH and 0.06 and 4.8 for TCOMP. Results from Table 1 show that phenotypic variances for BRAH and TCOMP TSCMP and TSCLoss were 0.05, 3.63, 0.04 and 3.41 respectively. Phenotypic variances were greatly reduced (by 76 – 79%) in comparison to AT results presented by Wolcott *et. al.* (2007). Furthermore, the reduction of additive and phenotypic variances between AT and TS carcases were proportional and the heritability of tenderness traits were similar between the two hanging methods

(Wolcott *et al.* 2007). The reduced additive variances, however, mean that response to selection for improved meat quality based on measurements in TS sides would be greatly reduced, compared to selection based on data from conventionally hung sides. Research by Kadel *et al.* (2006) predicted that single trait selection based on 10 progeny for AT tenderness would result in an improvement of approximately 0.29 kg of shear force per generation. Using the same selection intensity and accuracy of selection as Kadel *et al.* (2006) and the additive standard deviation from Wolcott *et al.* (2007), the predicted response to selection for improved AT tenderness would be 0.43 kg per generation. However, selection upon TS carcase measurements would reduce the response to selection of shear force by 55% to 0.19 kg per generation.

Table 1. Number of records (N), additive (σ_A^2) and phenotypic (σ_P^2) variances and heritability (h^2) estimates for peak force (PF), compression (CMP) and cooking loss (CLoss) in Brahman and Tropical Composite

Trait	Brahman				Tropical Composite			
	N	σ_A^2	σ_P^2	h^2 (SE)	N	σ_A^2	σ_P^2	h^2 (SE)
PF (kg)	880	0.08	0.27	0.30 (0.11)	1049	0.07	0.23	0.30 (0.11)
CMP (kg)	881	0.01	0.05	0.15 (0.08)	1044	0.01	0.04	0.27 (0.12)
CLoss (%)	889	0.24	3.63	0.07 (0.06)	1050	0.72	3.41	0.21 (0.09)

Table 2 presents the genetic correlations between AT and TS measurements of PF and CMP in both genotypes. The genetic relationships were universally high (r_g = 0.67 to 0.93), and suggested that selection for tenderness from measurements collected in TS sides would result in an improvement in AT tenderness, and vice versa. These results also show that, despite the lower variation observed in TS sides (Table 1), measurements of tenderness in TS and AT sides are highly correlated and suggest that selection using either measure will improve tenderness. This is important as it suggests that selection for tenderness can be carried out based on measurements from carcasses subjected to either hanging method. However, as this correlation is not 1, the EBV ranking of sires selected on TS measurements may be considerably different to the ranking of sires selected on AT measurements.

Table 2. Genetic correlations between measurements of peak force, compression and cooking loss in sides hung by the Achillis tendon (AT) or tender stretched (TS) for Brahman and Tropical Composite

Trait	Brahman	Tropical Composite
PF	0.67 (0.22)	0.72 (0.24)
CMP	0.80 (0.44)	0.93 (0.28)
CLoss	1.00* (1.52)	1.00* (0.17)

*estimate exceeded bounds

IMPLICATIONS

Results from this study show that PF and CMP are heritable in tropically adapted beef genotypes and that selection for improved meat tenderness is possible. Additionally, selection to improve PF or

CMP, from measurements on either AT or TS carcasses, will yield improvement in tenderness traits, however, the use of TS hanging methods resulted in a decrease in both the additive and phenotypic variances for tenderness traits in comparison to conventionally hung carcasses and, as such, will greatly reduce the rate of genetic gain from selection based on measurements from TS carcases. However, it is costly and difficult to obtain these meat quality measurements to form the basis of a genetic evaluation for the traits. Consequently, tender stretching may now be used as a means of improving tenderness through the significant reduction of phenotypic variation in tenderness between carcasses.

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