MEAT AND CARCASS QUALITY TRAITS OF LAMBS FROM TERMINAL SIRES

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INTRODUCTION

Data obtained from a progeny testing program conducted between 1991 and 1994 (Banks *et al.* 1995) indicated that some rams from a Poll Dorset stud produced progeny with a large positive deviation for eye muscle area. Given recent findings in the USA where Dorset sheep carrying the *callipyge* gene have significantly larger eye muscle areas, but tougher meat (Koohmaraie *et al.* 1995), further investigation of Australian sires was considered important. This was reinforced when a subsequent study (Barendse 1995) found evidence that one of the four DNA markers for the callipyge gene, TGLA 122 on chromosome 18, was present in Australian animals exhibiting increased muscling. In this latter report several small data sets showed that progeny from heterozygote rams had an increased eye muscle area. However no study of tenderness was undertaken. The work reported here comes from a much larger study of diverse genotypes (Fogarty *et al.* 1995) in which one of the Poll Dorset rams used previously has been identified as a possible carrier of a putative gene for extreme muscling. This paper focuses on the carcass and meat quality measures of progeny from selected sires.

EXPERIMENTAL METHODS

Animals

Female progeny (n=88) of 6 sires were used for the study. The sires were Texel (n =3) and Poll Dorset (n =3) and all progeny were born to Merino ewes. The lambs were slaughtered as part of a large group (n=292) at a commercial abattoir when they had reached a fasted liveweight of 36 kg. All lambs were yarded at 1630 pm (Day 1) and fasted overnight without access to water. Subsequent to weighing on Day 2 the lambs were given access to pasture and water for 3.5 h, then trucked to the abattoir (100km) where they were held in covered pens with access to water. On Day 3 the lambs were slaughtered at approximately 0800 am. Hot carcass weight and GR (total tissue depth over the 12th rib 110mm from the midline) were obtained and all carcasses given a conformation score by one assessor using the EUROP system (de Boer 1992) where E is 'best' conformation (herein coded 1) and P is 'worst' (coded 5). Temperature decline of 5 randomly selected carcasses was determined for 24 hours post-mortem using Cox recorders (Belmont, NC, USA). Probes were inserted into *M.semimembranosus* (SM) (to the depth of the femur) and centre of *M.longissimus thoracis et lumborum* (LL). The chiller was set to run at approximately 5^{0}C and the carcasses were held at this temperature until removal of the muscle samples. After 3 days of chilling the LL (including overlaying) subcutaneous fat was removed from the loin cut of 60 carcasses selected across the 6 sires. Fat depth was measured with vernier calipers at the 12th rib over the LL at the deepest part of the muscle (Fat C). The cross-sectional area of the LL was determined by measuring the length and width of the muscle and multiplying this value by 0.008. The cut surface of the LL cut across the fibres was exposed to air at room temperature for at least 30 min. pH of the LL was measured using a Jenco 6009 meter with temperature compensation and an Ionode IJ42 spear electrode. Meat colour was measured on the cut surface using a Minolta Model CR-300 chromameter set on the L^*, a^*, b^* system (where L^* measured relative lightness, a^* relative redness, b^* relative yellowness).

Before sealing in plastic wrap (Cling Wrap, Castaway Australia) the overlaying subcutaneous fat and the silver skin were removed from the muscle. Wrapped muscles were placed in plastic bags and held at approximately 5 ^{0}C until the following day. The same procedures were adopted for the remaining 28 samples measured on the second day. All samples were frozen on the second day and held at -25 ^{0}C. Prior to shear testing the LL were thawed at 5^{0}C for 24 h. Five samples of 1cm ^{2} cross-section were cut parallel to the muscle fibres and the tenderness measured using a Warner-Bratzler (WB) shear blade fitted to an Instron Universal Testing Machine, Model 4301. Cooking loss for each sample was determined by subtracting post-cooking from precooking weight and expressing the difference as a percentage of the raw meat sample. Least square means were determined for each variable, according to sire group and compared using a Bonferroni pairwise procedure. Hot carcass weight was used as a covariate for carcass measures and comparisons were based on adjusted means.

RESULTS

Carcass characteristics

Data are presented according to sire group (n=6) with identification of genotype (n=2), where sire 6 was believed to carry a gene for muscling. Carcasses used in the study ranged from 15.8 to 22.4 kg and from 5 to 15 mm at the GR site, with sire data presented in Table 1. There was no evidence of a significant difference in LL area or EUROP score between sire groups. Sire 4 consistently produced significantly ($P < 0.05$) fatter progeny.

Meat quality measurements

Chilling conditions resulted in a mean LL centre temperature of 7.0 ^{0}C 8 hours post-mortem and a mean SM deep butt temperature of 12.8 ^{0}C. Progeny of sires 4 and 6 produced significantly ($P < 0.05$) lighter meat (lower L^* values; Table 2), but there was no significant difference between groups for pH or the colour value a^*. pH was negatively correlated (r = -0.22) with a^* values. No pH value exceeded 5.80, above which meat is often dark with the range in values being 5.43-5.71. Meat from the progeny of sire 1 had the highest cooking loss, losing significantly ($P < 0.05$) more fluid than meat from sire groups 3 and 5. There was a tendency (P=0.08) for the LL muscle from sire groups 3 and 6 to be tougher than other groups, but using carcass weight or GR as covariates had no significant effect. Overall 9% of muscles exceeded 5kg shear force with the distribution for sire 3 being skewed due to two high values. Cooking loss explained 19% of the variation in shear values and sire an additional 12%.

Table 1. **Carcass characteristics (mean; s.e.d.) according to sire group; adjusted to a common hot weight of 19.2 kg**

Sire	n	Genotype	Hot carcass weight (kg)	GR (mm)	Fat (mm)	LL Area (cm^2)	EUROP (1-5)
1	16	T x M	18.6	8.8 a	2.1 a	12.6	3.0
2	10	T x M	19.4	10.4 a	2.7 ab	12.8	2.6
3	11	T x M	19.9	10.2 a	2.9 ab	13.5	2.8
4	16	PD x M	19.8	12.7 b	3.0 b	13.0	2.9
5	13	PD x M	19.1	10.4 a	2.5 ab	13.1	3.1
6	22	PD x M	18.9	9.7 a	2.3 ab	13.0	3.0
s.e.d.			0.52	0.66	0.32	0.46	0.19

Table 2. **Least square means (s.e.d.) for meat quality measurements according to sire groups**

Sire	*L**	*a**	pH	Cooking loss (%)	Shear force (kg)
1	37.9 a	17.8	5.57	38.3 a	3.18
2	37.9 ab	18.2	5.59	37.6 ab	3.94
3	37.4 ab	17.8	5.59	36.7 b	2.97
4	36.2 bc	18.6	5.60	37.1 ab	3.22
5	37.1 abc	18.2	5.54	36.5 b	3.24
6	35.7 c	17.8	5.57	37.5 ab	3.98
s.e.d.	0.54	0.59	0.03	0.43	0.42

Given that the distribution for sire 6 showed two distinct peaks the shear force data were arbitrarily divided into two sub-samples; <4.0 kg and > 4.0 kg and the area of the LL compared. The mean LL area of the 10 muscles with a shear value > 4.0 kg was 13.0 $\pm$ 1.69cm^2 and similar to the 12 muscles with shear values < 4.0 kg at 12.8 $\pm$ 1.69cm^2.

DISCUSSION

There was no evidence of sire 6 producing excessively muscled progeny compared to the other sires in this study with eye muscle area values falling within the range of those for other progeny. If sire 6 was a heterozygote ram however, only half the progeny would be expected to express the gene diminishing the likelihood of detecting significant differences. However given LL area is much greater in callipyge carrying progeny it does not appear that a gene is present which results in the dramatic increase in muscle areas and weights as reported for callipyge animals (Hays *et al.* 1995). Measures of fatness showed between sire variation as previously demonstrated using the genotypes of this study (Fogarty *et al.* 1995), but with no dramatic difference as reported for carriers and non-carriers of the callipyge gene (Hays *et al.* 1995).

Although sire 6 did tend to produce some progeny with tougher muscles, it was not alone and overall muscles with larger LL areas were not necessarily the toughest. Since the temperature decline during chilling indicated a medium to slow chill (Shaw *et al.* 1995) and the samples were effectively aged for 4 days before freezing the number of samples exceeding 5 kg shear force was high when for retail samples, Hopkins *et al.* (1995) showed lower projected levels after 3 days of ageing. The reason for the incidence of tough samples is unlikely to be cold-shortening and not a pH induced effect as no samples exceeded 5.80. Other meat quality differences such as for cooking loss are unlikely to be of practical significance, although meat from sire 1 may have been less juicy given that between pH 5.4 to 5.7 cooking loss relates to juiciness (Bouton *et al.* 1971). No samples had *L** values less than 34, a value suggested by Hopkins (1996) as indicative of dark, unacceptable lamb meat.

CONCLUSION

There is no evidence based on this study, that sire 6 a Poll Dorset ram, carried a gene for muscling that would lead to a detrimental effect on tenderness. Other differences between sires were consistent with normal variation and again emphasise the importance of sire selection.

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