

BRIEF COMMUNICATION: Does castration status have an effect on the quality of lamb meat?

JI Kerslake^{a*}, FS Hely^a, G MacLennan^b, S Lindsay^b, MR Behrent^b and AW Campbell^a

^aAbacusBio, PO Box 5585, Dunedin 9058, New Zealand; ^bAlliance Group Limited, PO Box 845, Invercargill 9840, New Zealand

*Corresponding author. Email: jkerslake@abacusbio.co.nz

Keywords: lamb; castration; sex; meat yield; meat quality

Introduction

Consumer demand for leaner lamb meat all-year-round and price incentives to produce heavier carcasses means that in New Zealand ram lambs are often being left entire in an attempt to improve lamb growth rates (Fisher et al. 2010). While this offers potential improvements in on-farm returns, there are still perceived concerns in the market place that meat from entire ram lambs of a certain age may be unsatisfactory. Based on the latest scientific evidence (Young et al. 2006; Young et al. 2003) New Zealand processors make no distinction between carcasses from lambs of different genders. However, due to continual perceived concerns from consumers, an experiment investigating the effects of castration on the quality of lamb meat from five to 13 months of age was investigated.

Materials and methods

Experimental design

Two-hundred male lambs, born as a singleton between the 6 and 30 of September 2008, were sourced from a commercial farm located near Tuatapere, Southland. Lambs were tagged and docked at six to eight weeks of age and randomly allocated to one of three treatments (Entire (n = 77), Cryptorchid (n = 79) and Wethered (n = 38)). Ewes and lambs were grazed as one mob from docking to weaning. Lambs were weaned at 13 to 14 weeks of age and grazed as one mob until slaughter. Lambs were drafted at a target live weight of 40 to 42 kg to provide a 17 to 19 kg carcass weight at five different ages. Namely 5-6 months; 7-8 months; 9-10 months; 10-11 months; 12-13 months and sent for slaughter. Lambs were slaughtered at Alliance Group Limited, Lorneville processing plant up to 11 months of age, and at Matura processing plant at after 12 months of age. Carcass weight, meat yield and GR (tissue depth 11cm from the midline on the 12 rib) was measured using Alliance Group ViaScan® system.

Meat quality measurements

Two short loins with fat cap on, were collected from each carcass. Twenty-four hours after slaughter each loin was cut in half, providing four sub-samples which were individually vacuum packed. Two sub-samples were chilled at -1°C for eight weeks and the other two sub-samples were frozen at -20°C 24 hours

post-slaughter. The frozen-samples were used for tenderness and eating quality assessments and the chilled-samples were used for colour stability and pH assessments. Details of the materials and methods for tenderness, ultimate pH and colour measurements can be found in Campbell et al. (2011).

To measure eating quality, a frozen-loin sample was thawed overnight and grilled on a hot plate until it had an internal temperature of 70°C. Slices of meat were presented to panellists as a “triangle test”, with each test consisting of one slice of meat from entire, cryptorchid or wether and two pieces of meat from one of the two remaining groups. The taste panel was conducted over five days. Each day, eight mixed-sex experienced panellists received 12 triangle tests presented as three coded samples from each slaughter. They were told that two of the samples were the same and that one was different and they were asked to identify the piece of meat that was most different in flavour.

Statistical analysis

Hot carcass weight, GR, total meat yield, pH, tenderness and brightness at 24 hours after packaging were analysed using a general linear model (SAS 2002). Colour measurements taken over time were analysed using a repeated measure analysis (SAS 2002). For all models, fixed effects included castration and age at slaughter. Linear effects of carcass weight were fitted as a covariate in GR, total meat yield, pH, tenderness and brightness models. The linear effect of pH was fitted as a covariate in the tenderness, brightness and taste panel trait models. The quadratic effect of pH was fitted as a covariate in the tenderness and brightness models. First order interactions were tested for significance and non-significant interactions were removed from the final analysis. Triangle test data were analysed testing for a difference from a binomial distribution with three outcomes. A significant result was one where the panellists were able to pick the odd sample out more times than the one in three (Roessler et al. 1978).

Results and discussion

Performance

There was a significant interaction between castration status and age at slaughter for carcass weight and GR (Table 1). Carcass weights for lambs slaughtered at

Table 1 Effect of castration status at five to 13 months of age on carcass weight, GR, total meat yield, ultimate pH, tenderness and brightness of lamb meat 24 hours post-retail pack (Brightness). P values in bold indicate significance ($P < 0.05$), P values in italics indicate a value approaching significance between 0.05 and 0.10.

Age at slaughter (months)	Castration status	Number of carcasses	Carcass weight (kg)	GR (mm)	Total meat yield (kg)	Ultimate pH	Tenderness (kgF)	Brightness (L*)
5-6	Entire	20	17.2 ± 0.3	4.6 ± 0.4	9.7 ± 0.1	5.74 ± 0.03	11.4 ± 0.5	39.3 ± 0.4
	Cryptorchid	20	16.8 ± 0.3	4.5 ± 0.4	9.6 ± 0.1	5.73 ± 0.03	10.9 ± 0.5	39.2 ± 0.4
	Wether	10	18.4 ± 0.5	6.7 ± 0.6	9.5 ± 0.1	5.70 ± 0.03	10.9 ± 0.7	39.0 ± 0.5
7-8	Entire	15	17.4 ± 0.4	3.9 ± 0.5	9.6 ± 0.1	5.84 ± 0.04	9.8 ± 0.5	39.7 ± 0.4
	Cryptorchid	15	17.9 ± 0.4	4.3 ± 0.5	9.5 ± 0.1	5.74 ± 0.04	9.6 ± 0.6	40.5 ± 0.4
	Wether	7	17.9 ± 0.6	5.1 ± 0.7	9.6 ± 0.1	5.75 ± 0.06	8.3 ± 0.8	40.2 ± 0.6
9-10	Entire	17	17.4 ± 0.4	2.9 ± 0.5	9.6 ± 0.1	5.86 ± 0.04	10.0 ± 0.5	40.7 ± 0.4
	Cryptorchid	15	17.1 ± 0.4	5.2 ± 0.5	9.6 ± 0.1	5.99 ± 0.04	10.0 ± 0.6	40.0 ± 0.4
	Wether	7	18.1 ± 0.6	5.2 ± 0.7	9.6 ± 0.1	5.76 ± 0.06	11.4 ± 0.8	40.0 ± 0.6
10-11	Entire	15	16.2 ± 0.4	4.9 ± 0.5	9.5 ± 0.1	5.93 ± 0.04	9.7 ± 0.6	39.7 ± 0.4
	Cryptorchid	16	16.3 ± 0.4	3.4 ± 0.5	9.4 ± 0.1	5.84 ± 0.04	10.3 ± 0.5	39.9 ± 0.4
	Wether	6	17.4 ± 0.5	5.4 ± 0.8	9.5 ± 0.1	5.72 ± 0.06	11.1 ± 0.8	38.9 ± 0.6
12-13	Entire	10	17.3 ± 0.5	2.2 ± 0.6	9.8 ± 0.1	5.82 ± 0.05	7.8 ± 0.6	41.0 ± 0.5
	Cryptorchid	13	19.7 ± 0.4	2.6 ± 0.6	9.6 ± 0.1	5.77 ± 0.04	9.0 ± 0.6	39.8 ± 0.5
	Wether	8	18.6 ± 0.5	4.7 ± 0.8	9.1 ± 0.1	5.78 ± 0.05	8.8 ± 0.7	39.6 ± 0.6
P value	Castration		0.01	<0.001	0.005	<0.001	0.62	0.22
	Age at slaughter		<0.001	<0.001	0.18	<0.001	0.001	0.02
	Interaction		0.03	0.02	0.22	<i>0.06</i>	0.33	0.39

five to six months of age were lighter for entire and cryptorchid lambs than for wether lambs (Table 1). At 12 to 13 months of age, entire lambs had lighter carcass weights than cryptorchid lambs, and wether lambs were intermediate. Castration status had no effect on carcass weight at seven to eight months of age, nine to ten months of age or 10 to 11 months of age. GR measurements for entire and cryptorchid lambs were lower than wether lambs at five to six months and 12 to 13 months of age. At seven to eight months of age, castration status had no effect on GR measurements but at nine to ten months of age, entire lambs had lower GR measurements than wether and cryptorchid lambs. At 10 to 11 months of age, entire and wether lambs had greater GR measurements than cryptorchid lambs. Castration status had an effect on total saleable meat yield (Table 1), with carcasses from entire rams yielding a greater total amount of saleable meat than wether lamb carcasses (Table 1). Cryptorchid carcasses were not significantly different to entire or wether carcasses. Age at slaughter had no impact on total saleable meat yield. Overall these performance measures are in general agreement with other literature, where results have shown that entire and cryptorchid lambs have similar carcass weights as wether lambs when finished to similar live weights, and entire lambs have leaner carcasses with greater yields of retail cuts than wether lambs (Fisher et al. 2010; Seideman et al. 1982).

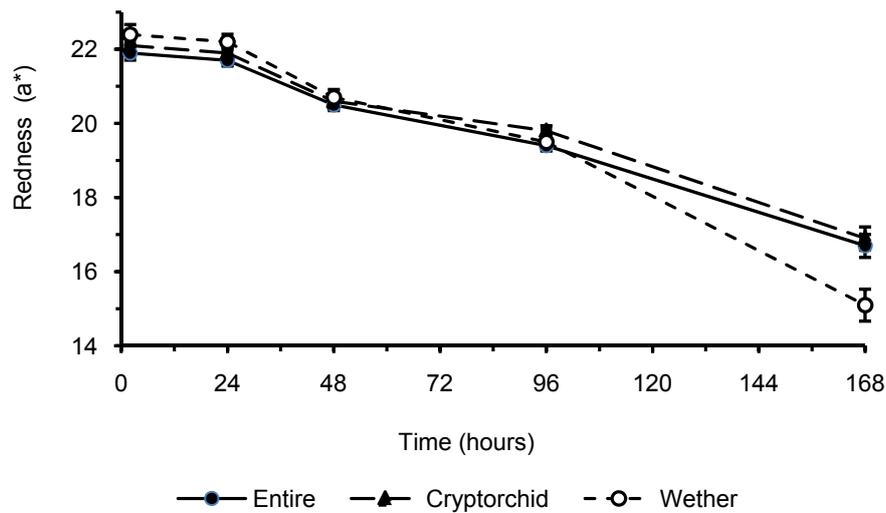
Meat quality traits

After seven days of retail display, meat from wether lambs declined from a red colour to an unacceptable brown colour where $a^* = 16$, faster than lamb meat from entire or crypt-orchid lambs (Fig. 1). The reason for this faster decline is unclear. Previous research has suggested that fatter carcasses may have slower cooling rates and faster pH decline, which could have an impact on meat colour (Priolo et al. 2001). While wether lambs were found to have greater GR values than cryptorchid and entire lambs in this trial, the effect of GR on the colour stability of these lambs is not known. Brightness of lamb meat after 24 hours of retail display was not affected by castration status, but was affected by age of slaughter, with lamb meat being significantly brighter at five to six months of age than all other ages.

Castration status and age at slaughter had a significant impact on ultimate pH (Table 1). At nine to ten months of age, entire and wether lamb meat had lower ultimate pH levels than cryptorchid lamb meat (Table 1). At 10 to 11 months of age, loins from entire rams had greater ultimate pH level than wether lamb meat and meat from the cryptorchid lamb was intermediate. Castration status had no impact on pH or tenderness of lamb meat at five to eight and 12 to 13 months of age.

In terms of eating quality, castration status had no effect on the tenderness of lamb meat. In addition, using the triangle test, panellists were unable to

Figure 1 Effect of castration status at five to 13 months of age on post-retail pack colour stability (a^*) of a sample of chilled loin.



distinguish amongst the different castration groups at any age of slaughter. These results suggest that there is no major detectable difference in the eating quality of meat samples frozen 24 hours post-slaughter, for entire, crypt orchid and castrated lambs from five to 13 months of age ranging in carcass weight from 17 to 19 kg. While the minor differences in colour stability and pH levels are of no large concern, it would be of interest to investigate if these castration effects have any impact on eating quality attributes of chilled meat at eight weeks post-slaughter. Overall these results are in general agreement with other New Zealand literature (Purchas & Schreurs, 2009).

References

- Campbell AW, Maclennan G, Judson HG, Lindsay S, Behrent M, Mackie A, Kerslake JI 2011. Brief communication: The effects of different forage types on lamb performance and meat quality. *New Zealand Society of Animal Production* 71: 208–210.
- Fisher MW, Bray AR, Johnstone PD 2010. Implications of removing or altering the testicles of ram lambs on the financial returns from carcasses. *New Zealand Journal of Agricultural Research* 53: 135–143.
- Priolo A, Micol D, Agabriel J 2001. Effects of grass feeding systems on ruminant meat colour and flavor. A review. *Animal Research* 50: 185–200.
- Purchas RW, Schreurs NM 2009. The quality of meat from ram lambs relative to that from wether or ewe lambs. Research report prepared for Meat & Wool New Zealand, Wellington, New Zealand. 10 p.
- Roessler EB, Pangborn RM, Sidel JL, Stone H 1978. Expanded statistical tables for estimating significance in paired-preference, paired-difference, duo-trio and triangle tests. *Journal of Food Science* 43: 940–944.
- SAS 2002. Statistical analysis system. SAS Institute Inc., Cary, North Carolina, USA.
- Seideman SC, Cross HR, Oltjen RR, Schnanbacher BD 1982. Utilization of the intact male for red meat production: a review. *Journal of Animal Science* 55: 826–840.
- Young OA, Lane GA, Priolo A, Fraser K. 2003: Pastoral and species flavour in lambs raised on pasture, lucerne or maize. *Journal of the Science of Food and Agriculture* 83: 93–104.
- Young, OA, Lane GA, Podmore C, Fraser K, Agnew MJ, Cummings TL, Cox NR 2006: Changes in composition and quality characteristics of ovine meat and fat from castrates and rams aged to 2 years. *New Zealand Journal of Agricultural Research* 49: 419–430.