BRIEF COMMUNICATION: Exploring the effects of growth rate and meat yield on lamb meat quality

AW Campbell[a]*, G Maclennan[b], S Lindsay[b], MR Behrent[b], I Cheong[a] and JI Kerslake[a]

[a]*AbacusBio Limited, PO Box 5585, Dunedin 9058, New Zealand;* [b]*Alliance Group Limited, PO Box 845, Invercargill 9840, New Zealand*
**Corresponding author. Email: acampbell@abacusbio.co.nz*

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Introduction

New Zealand sheep breeding programs currently place high emphases on selection for growth and yield. High growth rates and high meat yield have both been reported as having negative effects on meat quality in pig, beef and poultry (Dransfield & Sosnicki 1999), probably due to changes in muscle structure and metabolism. In contrast, organic pork has shown to be less tender than conventional pork, which is thought to be due to organic pigs growing more slowly (Therkildsen et al. 2012). It is of importance to evaluate these relationships in lamb.

Some relationships between meat quality traits and yield and growth have been observed in the Beef + Lamb New Zealand Central Progeny Test (Payne et al. 2009). However, the Central Progeny Test was not specifically designed to evaluate these relationships so these results need to be viewed with some caution.

The aim of this study was to investigate the influence of growth rate and meat yield on the quality of lamb meat.

Materials and methods

Lamb resource

One hundred and seventy Coopworth, Poll Dorset and Texel lambs; born on the 15 September 2008 to Coopworth ewes, were sourced from a commercial Southland farm. Lamb sex (female and wethers) and birth rank (single and twin) were recorded. Single-born lambs were weaned on 1 December 2008 and twin-born lambs were weaned on 15 December 2008. All lambs were weighed on the 9 February 2009 before slaughter at the Alliance Group Mataura plant on the 10 February 2009. Lambs were grazed on ryegrass and white clover pasture until slaughter.

Meat quality measurement

Measurements and procedures for yield, colour stability, tenderness and eating quality assessments are described in Campbell et al. (2011). The exception to this was in the way the samples were presented to the panellists. The methodology followed for the taste panel was paired descriptive tests, where each panellist was presented with ten pairs of meat samples, each from a different treatment (Low growth vs. High growth or Low yield vs. High yield). Each panellist quantitatively assessed for aroma, flavour, texture, succulence and overall liking. Panellists assessed each sample using a sliding nine-point scale with 0.25 increments which results in a score from one (Poor) to three (Excellent). The taste panel was conducted over seven sessions, where Sessions one to six had eight panellists of mixed sex and Session seven had six panellists of mixed sex.

Statistical analysis

The birth to slaughter growth rate was calculated for each of the 170 lambs born on the 15 of September 2008. The Low growth rate lambs were taken to be those with a growth rate between 190 and 250 g/day and the High growth rate lambs being those with a growth rate between 280 and 350 g/day. Data were analysed using the statistical software SAS. Performance measures and meat quality characteristics of meat colour measurements, pH values and shear force tenderness were analysed using general linear models. The eating quality traits were analysed using mixed linear models. The growth rate and yield classes, along with sex, breed and birth rank, were fitted as fixed effects for all models. Linear and/or quadratic effects of pH were fitted as covariates in the tenderness and taste analyses. Panellist and pair were also fitted as random variables in all taste panel analyses. First order interactions were tested for significance and non-significant interactions were removed from the final analysis of each trait.

Results and discussion

Lambs were divided into Low and High growth rates groups and Low and High yielding groups by analysing data from the tail ends of the normal distribution curve. Low growth rate lambs grew, on average, 70 g less per day than lambs from the High growth rate group (Table 1). Low yielding lambs had 9% less saleable meat yield, on average, than High yielding lambs (Table 1).

Different lamb growth rates and different yields had no effect on the redness, colour deterioration or brightness of the lamb loins (Table 2). On average, lambs with lower growth rates had greater pH levels than lambs with higher growth rates ($P < 0.05$; Table 2). Thirty one of 69 lambs within the Low growth rate group and 15 of 48 lambs within the High growth rate group had a pH over a desirable value of 5.8.

Table 1 Summary statistics (means ± standard errors) of live weight at weaning and slaughter, hot carcass weight (HCW), growth rates and VIAScan® GR (tissue depth 11 cm from the midline on the 12th rib) and yield data for lambs of Low (LGR) and High (HGR) growth rates or Low (LYLD) and High (HYLD) meat yields.

Treatment group	Weaning live weight (kg)	Slaughter live weight (kg)	Hot carcase weight (kg)	Growth rate birth to slaughter (g/d)	GR (mm)	Leg yield (% of HCW)	Loin yield (% of HCW)	Shoulder yield (% of HCW)	Total yield (% of HCW)
LGR	27.5 ± 0.8[a]	38.7 ± 0.6[a]	14.7 ± 0.4[a]	230 ± 4[a]	3.7 ± 0.7[a]	20.7 ± 1.0	12.7 ± 0.7	15.8 ± 0.8	49.2 ± 2.5
HGR	34.0 ± 0.9[b]	48.5 ± 0.7[b]	19.3 ± 0.5[b]	300 ± 4[b]	7.1 ± 0.9[b]	20.9 ± 1.2	13.6 ± 0.8	16.5 ± 0.9	51.0 ± 2.8
LYLD	31.0 ± 0.8	43.3 ± 0.7	16.6 ± 0.4	260 ± 5	6.0 ± 0.8	18.9 ± 1.1[a]	11.9 ± 0.7[a]	14.8 ± 0.9[a]	45.6 ± 2.7[a]
HYLD	30.4 ± 0.8	43.9 ± 0.7	17.3 ± 0.4	270 ± 4	4.8 ± 0.8	22.7 ± 1.1[b]	14.4 ± 0.7[b]	17.53 ± 0.9[b]	54.7 ± 2.6[b]

Table 2 Summary statistics (means ± standard errors) of brightness, colour deterioration, pH, tenderness measurements and eating quality of meat for lambs of Low (LGR) and High (HGR) growth rates or Low (LYLD) and High (HYLD) meat yields.

Treatment group	Brightness (L*)	Deterioration (days)	pH	Tenderness (kgF)	Aroma (taste panel)	Flavour (taste panel)	Texture (taste panel)	Succulence (taste panel)	Overall (taste panel)
LGR	38.9 ± 0.7	9.5 ± 0.9	5.87 ± 0.05[b]	10.6 ± 0.6	2.56 ± 0.03[b]	2.45 ± 0.03[b]	2.37 ± 0.04[b]	2.36 ± 0.03[b]	2.41 ± 0.03[b]
HGR	39.7 ± 0.8	8.6 ± 1.0	5.77 ± 0.05[a]	10.0 ± 0.6	2.48 ± 0.03[a]	2.37 ± 0.04[a]	2.25 ± 0.05[a]	2.27 ± 0.04[a]	2.30 ± 0.04[a]
LYLD	39.8 ± 0.7	9.3 ± 0.8	5.82 ± 0.05	10.1 ± 0.6	2.53 ± 0.03	2.40 ± 0.04	2.32 ± 0.04	2.31 ± 0.04	2.36 ± 0.03
HYLD	38.8 ± 0.7	8.8 ± 0.8	5.82 ± 0.05	10.5 ± 0.5	2.51 ± 0.03	2.41 ± 0.04	2.30 ± 0.04	2.32 ± 0.04	2.35 ± 0.03

Eating quality results showed that lambs with lower growth rates had significantly better eating quality than lambs with greater growth rates ($P < 0.05$; Table 2). These results were significant for aroma, flavour, texture, succulence and overall acceptability. However, despite this significant effect of growth rate on eating quality, all eating quality scores were within the top third of the assessment scale, so all meat was still considered of a high quality. In this study, the lower growth rate lambs were slaughtered at a lower carcase weight than the higher growth rate lambs (14.7 kg vs. 19.3 kg; Table 1). This was done, in order to evaluate both growth and yield in the same trial. Because of this it is unclear if the significant effects we have observed result from lower growth rates or lower carcase weight. A future study to evaluate the relationship between growth rates and meat quality, which removes the confounding effect of carcase weight, by killing lambs at a chosen slaughter weight, is underway.

There were no significant differences in any of the eating quality traits between Low and High yielding lambs.

Conclusions

Growth rates and yield had no significant effects on most meat quality traits, including colour stability and tenderness. Higher growth rate lambs had poorer eating quality than lower growth rate lambs, although all lambs were assessed to have good eating quality. This relationship is being explored further.

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