GROWTH AND CARCASS CHARACTERISTICS OF FIRST AND SECOND CROSS LAMBS
LOT-FED TO HEAVY WEIGHTS

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SUMMARY

The growth, carcass characteristics and meat quality of 75 cryptorchid lambs lot-fed for 43 days was examined. The lambs were sired by Texel and Poll Dorset rams and born to Merino or Border Leicester x Merino ewes giving 4 genotypes (TM, TBM, PDM, PDBM). The PDBM lambs grew significantly ($P < 0.05$) faster than the TM and PDM lambs with TBM lambs not significantly different from the other groups. A linear model ($P < 0.001$) best explained changes in ultrasonically measured fat and eye muscle depth over the feeding period. There was a significant difference ($P < 0.05$) between genotypes for fat depth measured over the eye muscle (Fat C) and at the GR site. Both the TM and PDM lambs produced significantly ($P < 0.05$) leaner carcasses than their second cross equivalents when adjusted to a carcass weight of 28.5 kg. The dimensions or area of the eye muscle were not affected by genotype, but the TBM lambs had the lowest EUROP score (or best conformation) and the PDM the highest, the difference being significant ($P < 0.05$).

Genotype had no significant effect on $L^*$ (relative lightness) or $a^*$ (relative redness) values of the eye muscle. TM and PDM carcasses had significantly higher $b_2^*$ (relative yellowness) values (tail fat) than TBM carcasses and at the 12th/13th rib site the TBM carcasses also had significantly ($P < 0.05$) lower $b_2^*$ values. First cross (TM and PDM) lambs will be leaner at heavier weights, providing a saleable meat yield advantage over second cross lambs, but from the limited sample of sires used no advantage of Texel sired lambs over Poll Dorset sired lambs was evident.

Keywords: lamb, growth, carcass, genotype

INTRODUCTION

Export markets to the USA and elsewhere for lamb are expected to expand (Gray and Clark 1995) as is the domestic food service market (Anon. 1994). Large lean carcasses are required to satisfy these markets and overseas reports (Cameron and Drury 1985; Clarke et al. 1988) indicate that Texel sired lambs could provide ideal carcasses for these expanding markets although these studies were based on lighter carcasses (< 20 kg). Leymaster and Jenkins (1993), however, reported greater subcutaneous fat depths in heavy carcasses from Texel sired lambs than those from Suffolks. Merino ewes also produce leaner lambs than Border Leicester x Merino ewes.

An experiment was undertaken in which the growth, carcass characteristics and meat quality of Texel and Poll Dorset sired lambs from Merino and Border Leicester x Merino ewes fed intensively to heavy weights was examined.

MATERIALS AND METHODS

The 75 cryptorchid lambs were selected from a larger experiment (Fogarty et al. 1995) at 6 months of age. The lambs were ranked on liveweight and selected lambs were within 2 standard deviations of the mean liveweight for each genotype group. Twenty-one Texel x Merino lambs (TM), 15 Poll Dorset x Merino (PDM), 20 Texel x Border Leicester x Merino (TBM) and 21 Poll Dorset x Border Leicester x Merino (PDBM) lambs were selected. The lambs were sired by 3 Texel (T) and 5 Poll Dorset (PD) rams. Three of the PD and 2 of the T sires have been used in central progeny tests providing genetic links to other sires. Within each genotype group the lambs were allocated randomly on ranked liveweight to three pens.

After a seven day introductory period the lambs were fed ad lib on a pelleted ration (15% lupins; 40% wheat; 45% oats with 0.5% salt, 1% ground limestone and 1% bentonite added; 11.8 MJ ME/kg; 15% crude protein). Chaffed lucerne hay (200 g/h.day) was provided daily and the entire feeding period was 43 days. The lambs were scanned with a real-time ultrasonic scanner (Aloka SSD-500) at the deepest part of the eye muscle (M. longissimus thoracis et lumbarum (LL)) between me 12th and 13th ribs where fat depth (US Fat C) and LL depth (USLL) were measured. GR which is the tissue depth over the 12th rib 110 mm from the midline was also measured (USGR). Measurements were taken at the start, mid point and end of the feeding period.
Hot carcass weight (including kidney and internal fat) and GR (using a GR knife) were recorded as well as the EUROPE conformation score (de Boer 1992) following commercial slaughter. Following chilling overnight at about 4°C the carcasses were cut between the 12th and 13th ribs. Fat depth over the LL (Fat C) and the dimensions of the LL were measured. Area of the LL (EMA) was estimated by 0.8 \times \text{width} \times \text{length} of the LL.

Meat colour of the LL was measured using a Minolta Model CR-300 chroma meter set on the \(L^*, a^*, b^*\) system (where \(L^*\) measures relative lightness, \(a^*\) relative redness and \(b^*\) relative yellowness). Colour of the subcutaneous fat was measured at the base of the tail (\(b^*\)) using the chromatometer and at the 12th/13th rib by peeling away the top layer of subcutaneous fat (\(b^*\)).

Univariate and multivariate repeated measures analyses of variance were used to assess the significance of changes in US Fat C, USGR and USLL depth as the lambs grew. Growth, carcass and meat quality data were analysed using the Restricted Maximum Likelihood (REML) procedure in Genstat 5.3.1. (Genstat 5 Committee, 1993) to estimate means and standard errors of the differences with adjustments for pen being tested. Genotype was considered a fixed effect and pen a random effect and the interaction between genotype and pen was also tested. Growth differences between genotypes were established using the starting mean liveweight of each group as a covariate. Hot carcass weight (HCW) was used as a covariate for fatness measurements and eye muscle dimensions.

**RESULTS**

The PDBM lambs grew significantly (\(P < 0.05\)) faster than the TM and PDM lambs even when the difference in initial liveweights was accounted for, with TBM lambs not significantly different from the other groups (Table 1). There was no significant effect of pen.

Table 1. Mean and SED for growth rate over the period of ad libitum feeding, dressing percentage based on a fasted weight (Dress) and ultrasonic measures of fatness (US Fat C, USGR) and eye muscle depth (USLL depth) for four genotypes measured at day 42

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Growth rate</th>
<th>Dress</th>
<th>USFat C</th>
<th>USGR</th>
<th>USLL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDBM</td>
<td>349*a</td>
<td>50.5</td>
<td>3.7*a</td>
<td>11.5*a</td>
<td>30.1</td>
</tr>
<tr>
<td>TBM</td>
<td>391*b</td>
<td>50.6</td>
<td>4.1*b</td>
<td>14.8*b</td>
<td>30.4</td>
</tr>
<tr>
<td>PDM</td>
<td>778*c</td>
<td>50.1</td>
<td>3.1*c</td>
<td>11.0*c</td>
<td>29.7</td>
</tr>
<tr>
<td>TM</td>
<td>256*d</td>
<td>50.1</td>
<td>4.3*d</td>
<td>13.0*d</td>
<td>30.9</td>
</tr>
<tr>
<td>SED</td>
<td>27</td>
<td>1.1</td>
<td>0.3</td>
<td>0.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Significant differences (\(P < 0.05\)) between genotypes are indicated by different superscripts.

Changes in fat depth (US Fat C) were explained by a linear model (\(P < 0.001\)) with the largest increases by TBM and TM lambs. There were significant differences (\(P < 0.05\)) between genotypes with PDM lambs having lower values than TBM and TM lambs. There was no significant interaction between measurement time and genotype.

Table 2. Least square means for measures of fatness (GR, Fat C) and eye muscle characteristics (Depth, Length, EMA) adjusted to a carcass weight of 28.5 kg and EUROPE conformation score according to genotype

<table>
<thead>
<tr>
<th>Genotype</th>
<th>GR</th>
<th>Fat C</th>
<th>Depth</th>
<th>Length</th>
<th>EMA</th>
<th>EUROPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDBM</td>
<td>18.1*a</td>
<td>3.9*a</td>
<td>30.9</td>
<td>65.2</td>
<td>16.2</td>
<td>2.5*a</td>
</tr>
<tr>
<td>TBM</td>
<td>17.1*a</td>
<td>4.0*a</td>
<td>32.0</td>
<td>65.0</td>
<td>16.6</td>
<td>2.2*a</td>
</tr>
<tr>
<td>PDM</td>
<td>15.6*d</td>
<td>2.4*d</td>
<td>32.8</td>
<td>68.0</td>
<td>17.9</td>
<td>2.9*d</td>
</tr>
<tr>
<td>TM</td>
<td>15.8*d</td>
<td>2.7*d</td>
<td>32.0</td>
<td>67.0</td>
<td>17.1</td>
<td>2.6*d</td>
</tr>
<tr>
<td>SED</td>
<td>0.1</td>
<td>0.4</td>
<td>1.0</td>
<td>1.4</td>
<td>0.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Significant differences (\(P < 0.05\)) between genotypes are indicated by different superscripts.

Significant (\(P < 0.001\)) genotype differences were found for USGR and there was a significant (\(P < 0.001\)) interaction between genotype and measurement time, evidenced by a decrease in values for TBM and TM lambs at day 22. Despite the pattern of change a linear model best (\(P < 0.001\)) explained the changes in...
USGR over time. A linear model ($P < 0.001$) best explained changes in eye muscle depth and there was no difference ($P > 0.05$) between genotypes or any interaction between genotype or measurement time. *In vivo* measurements at day 42 are shown in Table 1.

There was no significant difference ($P > 0.05$) between groups for dressing percentage based on a 15 hour fast (Table 1). Both the TM and PDM lambs produced significantly ($P < 0.05$) leaner carcasses than their second cross equivalents (Table 2), and there was no significant effect of pen on the mean values. The dimensions of the LL were not affected by genotype, although there was a trend ($P = 0.06$) for PDM lambs to have a smaller LL area than PDM lambs. The TBM had the lowest EUROP score (or best conformation) and the PDM the highest, the difference being significant ($P < 0.05$). This difference was no longer significant ($P = 0.07$) if HCW was used as a covariate and there was no difference between genotypes within the first and second cross carcasses.

Table 3. Least square means for measures of meat colour ($L^*\, a^*$) and fat colour at the tail ($b_1^*$) and rib sites ($b_2^*$) according to genotype

<table>
<thead>
<tr>
<th>Genotype</th>
<th>$L^*$</th>
<th>$a^*$</th>
<th>$b_1^*$</th>
<th>$b_2^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDBM</td>
<td>38.1</td>
<td>17.6</td>
<td>10.3*</td>
<td>7.5*</td>
</tr>
<tr>
<td>TBM</td>
<td>31.1</td>
<td>11.3*</td>
<td>9.6*</td>
<td>6.0*</td>
</tr>
<tr>
<td>PDM</td>
<td>37.7</td>
<td>18.6</td>
<td>10.7*</td>
<td>7.8*</td>
</tr>
<tr>
<td>TM</td>
<td>37.3</td>
<td>17.7</td>
<td>11.1*</td>
<td>7.9*</td>
</tr>
<tr>
<td>SED</td>
<td>0.7</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Significant differences ($P < 0.05$) between genotypes are indicated by different superscripts.

Genotype or pen had no significant effect ($P < 0.05$) on $L^*\, a^*$ values of the LL. TM and PDM carcasses had significantly higher $b_1^*$ values (tail fat) than TBM carcasses. For the rib site the TBM carcasses again had significantly ($P < 0.05$) lower $b_2^*$ values. There was no pen effect on the results. The correlation between $b_1^*$ and $b_2^*$ values was 0.28 ($P < 0.05$).

**DISCUSSION**

In accordance with previous work (Atkins and Thompson 1979) the first cross lambs (from Merino ewes) grew slower than the second cross lambs. However at the same carcass weight the first cross lambs were leaner irrespective of where carcass fat depth was measured, whereas equivalent measurements of fat depth taken in *viva* did not show clear differences between first and second cross lambs. This may reflect the difficulty of measuring carcass characteristics with real-time ultrasound which is discussed in some detail by Hopkins et al. (1993). Carcass measures of LL dimensions and area showed no difference between first and second cross lambs but there was a trend for second cross lambs to have a better conformation.

Although the absolute growth rates of the lambs during feeding were much higher than for the larger mob of grazing lambs (Fogarty et al. 1995), the ranking between genotypes was the same. The slower growth (8 to 14%) of the Texel sired lambs relative to the Poll Dorset sired lambs was expected (Cameron and Drury 1985; McEwan et al. 1988). Although the ultrasonic data for GR suggest that Texel sired lambs had a different rate of fat deposition, the carcass measurements of fat depth showed that there was no difference in carcass leanness between Texel and Poll Dorset sired lambs when fed to heavy weights. Even though a limited number of sires are represented they are linked to other studies and, based on the data of Leymaster and Jenkins (1993) for Texel and Suffolk sired lambs, it seems the leanness advantage reported for Texel sired lambs at lighter carcass weights (eg. Cameron and Drury 1985) does not hold at heavier weights. Measurement of eye muscle also showed that Texel sired lambs did not have a larger cross-sectional area whereas Leymaster and Jenkins (1993) found a slightly larger area for Texel sired lambs compared with Suffolks.

The tendency of Texel sired lambs to have a superior conformation was evident in this study, which probably reflects a shorter carcass (Clarke et al. 1988). This did not translate to a difference in the dimensions or area of the LL nor a significant difference between genotypes within crosses. Further studies will examine these results in relation to muscularity, muscle to bone ratio and yield of hindquarter cuts.

Little information has been published on the meat quality of different crosses or genotypes, particularly with respect to fat colour. There was no difference between first and second cross lambs in mean $L'$ and $a^*$ values for the loin muscle with the majority of muscles having $L^*$ values above 32 indicating an acceptable
colour (Hopkins et al. 1995a). There was also no evidence of a genotype effect. Channon et al. (1994) found that different genotypes did not have different \( L^* \) values for the loin. The \( b^* \) values for the subcutaneous fat from the tail were similar to those reported by Hopkins et al. (1995b) for cryptorchid lambs grazing pasture. The values for subcutaneous fat from the rib region were much less, but the TBM lambs consistently produced the whitest fat (lowest \( b^* \) values) regardless of the measurement site. The magnitude of the difference is unlikely to be advantageous however in terms of selling the meat.

First cross lambs produced heavy carcasses with lower fat levels than second cross lambs with no difference in meat or fat colour. Hence they would offer the advantage of less waste (trim), although the growth rate of the first cross lamb is lower and the conformation poorer. From our limited sample of sires the Texel sired lambs were slower growing than Poll Dorset sired lambs and there was no advantage of the Texels for other carcass and meat characteristics except for a slightly better conformation.

ACKNOWLEDGEMENTS

The lambs used in this study were produced with NSW Agriculture funds at the Cowra Research Station. The technical support of staff at the station is acknowledged as is the support of Mr A.F. Luff who scanned the lambs and the breeders who supported the larger project. The cooperation of the management of the Cowra Abattoir Ltd. is acknowledged as is the statistical advice of Ms H.I. Nicol.

REFERENCES