GROWTH AND MEAT QUALITY OF WETHER, SHORT SCROTUM AND IMMUNOCASTRATE LAMBS

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SUMMARY

The growth, carcase fatness and meat quality of wether, short scrotum and immunocastrate lambs (n = 27, 3 x 9) run under grazing conditions was examined. The short scrotum lambs grew faster than the wether and immunocastrate lambs, which had similar growth rates. Although the mean (±s.e.) carcase weight of the short scrotum lambs was heavier (24.3 ± 0.76 kg) than the wether (22.3 ± 1.04 kg) and immunocastrate lambs (22.9 ± 1.24 kg), the difference was not significant (P > 0.05). At an equivalent carcase weight of 23.1 kg all measures of fatness showed the short scrotum lambs to be significantly (P < 0.05) leaner than the immunocastrate lambs and significantly (P < 0.05) leaner than the wether lambs for the GR measurement, which is defined as the tissue depth over the 12th rib 110 mm from the midline. There was no difference in the cross sectional area of the loin, irrespective of how it was measured. There was a significant difference (P < 0.05) between treatments for muscle pH, the short scrotum lambs having a higher ultimate pH than the immunocastrate lambs, with no difference between wether and immunocastrate lambs.

There was no significant difference (P > 0.05) between treatment groups for Warner Bratzler values of the loin muscle or for the a* values which can be used to indicate relative redness. However the loin muscle from the immunocastrate lambs had significantly (P < 0.05) higher b* values than the short scrotum group indicating a relatively more yellow appearance.

Keywords: lamb, growth, meat quality, carcase.

INTRODUCTION

The short scrotum technique (Hudson et al. 1968) where the testicles are retained at marking and the scrotal sac is removed by use of an elastrator ring, is increasingly being adopted by lamb producers because it has been proven a simple way of producing leaner, heavier carcasses (Hopkins et al. 1990). While only a small proportion of such males are potentially fertile (Thwaites et al. 1982) it has been shown that the testicles commonly descend to a subcutaneous position where some grow quite large (Hopkins et al., 1990). This can lead to market prejudice and in some cases increased slaughter and shearing costs. Additionally the processing industry has expressed concern about the tenderness and meat colour of uncastrated lambs (Hopkins 1993). Although collagen concentration has been found to be greater in the muscle of ram lambs than ewe lambs (Nold et al. 1992) it is likely that a difference in ultimate pH of the muscles results in the meat being tougher through a number of different mechanisms (Purchas 1992; Morgan et al. 1993).

A range of techniques have been investigated which are aimed at minimising the expression of masculine characteristics, yet utilise naturally occurring testosterone. These techniques have covered different forms of castration; such as partial (Hopkins et al. 1991), chemical (Cohen et al. 1991) and immunological (Hoskinson et al. 1990). The potential of an immunological approach that blocks the action of gonadotrophin releasing hormone (GnRH) leading to gonadal atrophy has been previously demonstrated in cattle and lambs (Hoskinson et al. 1990), but there are no published studies for lambs run under Australian conditions where carcass fatness and meat quality have been studied. This paper outlines a small study which examined the growth, carcass fatness and meat quality of wether, short scrotum and immunocastrate lambs, run under grazing conditions.

MATERIALS AND METHODS

From a mob of 364 April-born, second cross lambs (Poll Dorset x Border Leicester x Merino), 27 male lambs were randomly selected at marking in May and allocated to 3 groups (3 x 9). At marking 9 of the lambs were rendered wethers by standard open castration (W), 9 were rendered short scrotum (SS) and the remaining 9 were given a vaccine prepared as a GnRH-ovalbumin conjugate (IC). The 9 IC lambs were given a booster injection of the immunogen 7 weeks later. Normal lamb marking practices were used including vaccination for clostridial diseases and tail docking. From birth till weaning the
Ewes and lambs were grazed on lucerne and offered oat grain as a supplement. After weaning, at 20 weeks of age, the lambs were grazed on an oat crop with access to oat grain for 6 weeks and then grazed on a subterranean clover, lucerne pasture until slaughtered at 9 months of age. The lambs were weighed regularly throughout the experiment.

All lambs were slaughtered under commercial conditions. Hot carcase weights including kidney and internal fat were recorded and the GR (tissue depth over the 12th rib 110 mm from the midline) measured on the carcase in the chiller using a GR knife. The carcases were chilled overnight at approximately 4°C. The following day the midloin was removed from the left side of each carcase and held at 10°C until further carcase measurements were made. These measurements included the fat depth over the eye muscle *M. longissimus thoracis et lumborum* (EM) at the deepest part of the muscle between the 12th and 13th rib called the C site (FDC), and the depth and width of the EM. These dimensions were multiplied and the product then multiplied by 0.8 to approximate the area of the muscle (EMA). The area was also calculated using a grid of 1 cm squares (EMAI).

Colour of the subcutaneous fat at the 12th rib was assessed using colour chips and scored on a 3 point scale (0 = white to 2 = yellowish). The EM was removed from the loin cut, wrapped in plastic and placed in plastic bags for storage at -10°C.

The pH of the EM was measured using a Micrometer pH Vision model 6007, with the electrode inserted into the muscle. The end of the EM adjacent to the first lumbar vertebrae was sliced across the fibres and left exposed to the air at room temperature for 30 minutes. Meat colour was measured using a Minolta CR-200 chroma meter set on the *L*, *a*, *b* system (where *L* measures relative lightness, *a* relative redness and *b* relative yellowness). A sample of the EM was placed in a water bath at 80°C for 1 hour, then left under cool running water for 30 minutes and placed in a refrigerator at about 0°C for 24 hours. Five subsamples with a cross section of 1 cm x 1 cm 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.

Analysis of variance was used to examine the effect of treatment on the various carcase and meat quality characters. Measurements of fat depth and EM characteristics were compared between treatments using carcase weight as a covariate and the adjusted means compared using a Bonferroni pairwise procedure. SYSTAT V5.03 (Wilkinson 1990) was used for all analyses.

Table 1. Least square means of short scrotum (SS), wether (W) and immunocastrate (IC) lambs for measures of fatness (GR, FDC) and eye muscle characteristics (Depth, Length, EMA, EMAI) adjusted to a carcase weight of 23.1 kg

<table>
<thead>
<tr>
<th>Treatment</th>
<th>GR (mm)</th>
<th>FDC (mm)</th>
<th>Depth (mm)</th>
<th>Length (mm)</th>
<th>EMA (cm²)</th>
<th>EMAI (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>10.5a</td>
<td>2.1a</td>
<td>27.7a</td>
<td>64.0a</td>
<td>14.9a</td>
<td>14.3a</td>
</tr>
<tr>
<td>W</td>
<td>13.9b</td>
<td>3.4ab</td>
<td>30.8b</td>
<td>58.1b</td>
<td>15.3a</td>
<td>14.4a</td>
</tr>
<tr>
<td>IC</td>
<td>15.1b</td>
<td>3.7b</td>
<td>29.2b</td>
<td>59.8b</td>
<td>15.1a</td>
<td>14.0a</td>
</tr>
</tbody>
</table>

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

**RESULTS**

The growth pattern for each treatment group is presented in Figure 1. This shows the SS lambs grew faster than the W and IC lambs, which grew at similar rates.

Although the mean (±s.e) carcase weight of the SS lambs was heavier (24.3 ± 0.76 kg) than the W (22.3 ± 1.04 kg) and IC lambs (22.9 ± 1.24 kg) the difference was not significant (P > 0.05). At an equivalent carcase weight of 23.1 kg all measures of fatness showed the SS lambs to be significantly (P < 0.05) leaner than the IC lambs (Table 1) and significantly (P < 0.05) leaner than the W lambs as indicated by the GR measurement but not by FDC measurement. There was no difference between the W and IC lambs for either of the fatness measurements.

The SS lambs had wider and shallower EM dimensions than the W and IC lambs, but there was no difference in the area of the EM irrespective of how it was measured. The EMA and EMAI values were significantly correlated (P < 0.001, r = 0.77). Apart from the fat of 1 of the short scrotum lambs all other lambs had fat colour scores of 0 or 1.
There was a significant difference (P < 0.05) between treatments for pH, the SS lambs having a higher ultimate pH than the IC lambs, with no difference between the W and IC lambs (Table 2).

There was no significant difference (P > 0.05) for the WB values between treatment groups or for a* values, but lambs from the IC group had significantly (P < 0.05) higher b* values than the SS group. The loin muscle from the SS lambs tended to be darker than that from the IC lambs (lower L*, P = 0.08). Muscle pH was significantly correlated (P < 0.001, r = -0.60) with the L* value.

![Figure 1. The liveweight change after marking (week 0) for short scrotum (cross), wether (closed square) and immunocastrate (star) lambs](image)

Table 2. Least square means of short scrotum (SS), wether (W) and immunocastrate (IC) lambs for muscle pH, Warner Bratzler (WB) values and colour measurements (L* for lightness, a* for redness, b* for yellowness)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH</th>
<th>WB</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>5.77^a</td>
<td>4.32^a</td>
<td>31.85^a</td>
<td>15.54^a</td>
<td>7.41^a</td>
</tr>
<tr>
<td>W</td>
<td>5.61^ab</td>
<td>4.10^ab</td>
<td>33.95^a</td>
<td>15.16^a</td>
<td>7.47^ab</td>
</tr>
<tr>
<td>IC</td>
<td>5.54^b</td>
<td>3.88^b</td>
<td>34.22^a</td>
<td>16.36^a</td>
<td>8.79^b</td>
</tr>
</tbody>
</table>

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

**DISCUSSION**

Faster growth of short scrotum lambs than their castrated counterparts has been extensively reported (Lee 1986; Hopkins *et al.* 1990). The similar growth of the immunocastrate lambs and the wethers in this experiment is attributed to the effect of GnRH vaccination, blocking the action of GnRH leading to a suppression of testicular development (Hoskinson *et al.* 1990) and testosterone production. Previous studies have found a range of growth responses in animals treated with immunogens and Lobley *et al.* (1992) has discussed in detail the reasons for these responses. Immunological castration offers several practical advantages for manipulating growth since it avoids the problems inherent with growth promotants and market access, and is also unlikely to cause the stress induced growth setback observed in partially castrated lambs (Hopkins *et al.* 1991) or in chemically castrated cattle (Cohen *et al.* 1991). As the effect of the vaccine is reversible it could be used by lamb producers to suppress some of the masculine characteristics in short scrotum lambs for management or marketing reasons, or to increase fat deposition in short scrotum lambs that are underfinished.
It is apparent that for whatever reason (possibly a differential stress response) the loin muscle of the short scrotum lambs had higher pH values which led to a tendency for tougher and darker meat. This relationship between pH and meat colour is well documented (Monin and Quali 1991). At a practical level the differences in mean WB values for loin muscles in this experiment were small, and given that testing was performed on samples aged for only 1 day after slaughter it could be expected that the muscles would be more tender after another day of aging. Other differences between the treatment groups were small apart from the significantly higher $b^*$ values of the immunocastrate lambs, which may be indicative of an increased intramuscular fat content.

Carcasses of short scrotum lambs with an off-white fat colour have been noted previously (S.A. Spiker pers. commun.) but it must be stressed that the colour variation is significantly less than occurs in beef and most retailers place a low importance on this trait when ordering lamb.

At this stage, application of an immunological approach to castration in lambs is unlikely to offer cost effective advantages over use of the short scrotum technique even if faster growth rates could be achieved by treatment with a lower dosage of the vaccine. Should immunisation become more widespread, this small study suggests there should be no concern about the meat quality of vaccinated lambs.

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REFERENCES


