INFLUENCE OF SIRE ON CARCASS MEASUREMENTS OF PROGENY CAPTURED USING VIDEO IMAGE ANALYSIS

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SUMMARY
Dorsal images of 780 whole lamb carcasses (mean weight 19.7 kg, s.d. 3.49 kg) were obtained on a slaughter chain using a video camera. The lambs were ewes or cryptorchids, of one genotype (Poll Dorset sires over Border Leicester/Merino ewes) and were slaughtered on three separate occasions. A series of dimensional measurements and selected area measurements were obtained from the video images. Carcass weight was found to be significantly \((P < 0.001)\) related to each VIA measurement examined, as was GR tissue depth, with the exception being W3 which is a measurement of forequarter width. Carcass length (L) and area (A) were also significantly \((P < 0.001)\) influenced by lamb age. The factor, “treatment” which was a combination of lamb gender, growth rate (high or low nutrition) and day of measurement also significantly \((P < 0.001)\) influenced the VIA measurements. A large proportion of the variation \((R^2 = 0.87\) to \(0.91\)) in L and A could be explained by the independent variables examined with much lower proportions for measurements such as LW3 (width of hindlegs at a specified position from the gambrel). Genetic variation caused by sire had no significant effect on the models.

Keywords: Muscularity, image analysis, lamb, carcass

INTRODUCTION
Various measurements have been used to indicate shape or “conformation” of lamb carcasses. Some of the earliest measurements were described by Palsson (1939) and included the length of the tibia and tarsus, leg length and length of carcass. Some refinements of the measurements has occurred including simpler measurement of carcass length (Moxham and Brownlie 1976). Use of such measurements has been restricted to scientific studies. Although there is evidence that processors and wholesalers use “conformation” for describing or categorising carcasses (Hopkins 1993) there has been much debate about the value of describing carcasses in this way, due to factors such as confounding with fatness.

An objective measurement of muscularity as proposed by Purchas et al. (1991) based on femur length and the weight of surrounding muscles, provides the opportunity to describe “muscling” without the effect of fatness but is based on dissection precluding its use in extensive experiments or as a means of describing carcasses commercially. Hopkins (1996) showed however, that particular dimensional measurements obtained from whole carcass video images under commercial conditions could be used to predict muscularity. Enormous potential exists to utilise video image analysis (VIA) as a means of describing carcass characteristics on the slaughter chain, but the measurements taken must be able to withstand the biological variation that exists with lambs.
The effect of sire on a number of carcass measures obtained from VIA, which could be used as indicators of shape, is examined in this paper with particular focus on measurements identified by Hopkins (1996) as useful for predicting muscularity.

MATERIALS AND METHODS
Carcass data were obtained for 780 lambs representing two sexes (ewes, cryptorchids). The lambs were sired by 20 Poll Dorset rams all from one stud selected on LAMBPLAN EBV's for a range of growth, fat and eye muscle depth and were born to Border Leicester x Merino ewes. The ewe lambs were split into two groups at weaning and one group (n = 239) grown at a fast rate to an average age of 174 days (39.9 kg) and the other group (n = 265) at a slower rate by restricting intake to an average age of 245 days (41.0 kg). The cryptorchids (n = 276) were grown at a fast rate to an average age of 223 days (47.9 kg). Lambs were slaughtered commercially at the three different times and the hot carcass weight (HCW) and GR (the depth of tissue from the surface of the carcass to the lateral surface of the 12th rib 110 mm from the midline, measured using a GR knife) obtained.

While on the moving slaughter chain, following exit from the final carcass wash, an image of each carcass from the dorsal view was obtained using the VIASCAN® video image analysis system with the camera in a fixed position perpendicular to the carcass. From the images approximately 85 variables were recorded including areas, length and widths. The system recognised the bottom of the gambrel where it passes through the Achilles tendon. This was used as the reference position for all linear dimensions as was the most distal junction of the hindlegs where the M. semimembranosus muscles meet (groin) and the distal end of the neck equivalent to the atlanto-occipital articulation. A schematic representation of the dimensions examined in detail is outlined in Figure 1.

Figure 1. The combined width across the hind legs at five equally spaced intervals from the groin to the gambrel reference (LWO to LW4) and carcass widths (W1 to W5) at five evenly spaced locations between F1 and F2.

VIASCAN® is the registered trade name of Video Image Analysis developed by the Meat Research Corporation, Australia
All the measurements W1 to W5 and LW0 to LW4 and carcass length (L) as measured from the groin to the neck were treated as the dependent variables. Carcass area (A) was calculated as were the areas of the hindlegs from the reference lines LW0 and LW1 to the gambrel (La0 and La1).

**Statistical analysis.** The following model was used to examine the effect of the main factors and sire (fitted as a fixed effect) on the carcass measurements (Y), where Y = W1 to W5, LW0 to LW4, L, A, La0 and La1 and T = treatment

\[ Y_{ijkl} = u + T_i + b_1HCW + b_2GR + a_{age}i + sire_k + e_{ijkl} \]

Interactions between the main factors were also tested. Treatment was the nutrition by sex groupings which was equivalent to the three slaughter times as sex and nutrition were confounded with slaughter times. Of the dependent variables in the groupings, W1 to W5 and LW0 to LW4 only results for LW3 and W3 are reported as these two measurements were shown to be useful for prediction of muscularity by Hopkins (1996). The other variables were not found to be significantly different between sires. All analysis was undertaken using Genstat 5 release 3.1.

**RESULTS**

The means (s.d.) of the carcass and VIA measurements were as follows; hot carcass weight 19.7kg (3.49), GR 10.9mm (3.29), LW3 86.2mm (8.60), W3 191.6mm (19.21), L 941.7mm (53.41), A 2124.7cm² (218.88), La0 215.1mm (23.99) and La1 141.2mm (16.99). The significance of the main factors on each of the dependent variables is shown in Table 1, as is the % variance explained ($R^2$). The significance of adding sire as an independent variable and the effect on the $R^2$ is also shown.

**Table 1. Relationship between the main factors and VIA measurements**

<table>
<thead>
<tr>
<th>Variable</th>
<th>LW3</th>
<th>W3</th>
<th>La0</th>
<th>La1</th>
<th>L</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Treatment</td>
<td>**</td>
<td>**</td>
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<td>**</td>
<td>**</td>
</tr>
<tr>
<td>HCW</td>
<td>**</td>
<td>NS</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>GR</td>
<td>**</td>
<td>NS</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>86.6</td>
<td>90.7</td>
</tr>
<tr>
<td>$R^2$</td>
<td>28.7</td>
<td>40.2</td>
<td>24.2</td>
<td>24.3</td>
<td>86.6</td>
<td>90.7</td>
</tr>
<tr>
<td>Sire</td>
<td>P=0.06</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>P=0.09</td>
<td>NS</td>
</tr>
<tr>
<td>$R^2$</td>
<td>29.6</td>
<td>40.7</td>
<td>24.9</td>
<td>24.9</td>
<td>86.7</td>
<td>90.7</td>
</tr>
</tbody>
</table>

**P < 0.001, NS not significant at P > 0.05**

Only for carcass length and area was the age of the lamb a significant factor (Table 1). All measurements were significantly influenced by 'treatment', carcass weight and GR, with the exception being W3 upon which GR had no effect. Sire tended to affect LW3 ($P = 0.06$), however for each VIA variable the effect of sire was not significant.

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DISCUSSION
Hopkins (1996) reported that the measurements LW3 and W3 showed some potential as predictors of muscularity as determined by dissection. Data presented here reveals that sire does not have a significant effect on the measurements LW3 and W3 provided weight and fatness (GR) are accounted for, even though the sires ranged in EBV's for EMD from -0.7 to +0.7mm. The analysis indicates that both measurements are liable to be influenced by lamb gender although this is confounded with growth rate in the present data set. Hopkins (1996) found that lamb gender did not significantly influence the prediction of muscularity using either LW3 or W3 measurements. Although VIA could be used to predict yield (Horgan et al. 1995) and measures of subcutaneous fatness, it also has the potential to provide some measurement of 'conformation' or muscling. Currently the VIA system can provide estimates of conformation based on the EUROP system. An alternative approach is to predict estimates of muscularity which overcomes the confounding affects of variation in fatness, and also provides the ability to discriminate between carcasses for muscle cross-sectional area. This is because of the correlation between muscularity and the cross-sectional area of both loin and several major hindleg muscles (Hopkins 1996).

Of the models derived from the data set only those for carcass length and area were able to explain a large amount of the variance in these measurements, but for these two measurements, lamb age was found to be significant. However, relative to carcass weight and GR the contribution of lamb age was much less. Given that an index of shape can be developed using carcass length, transformed by a function of weight (Abdullah et al. 1993), this may also be a useful approach to providing an indication of shape or "conformation". The automatic, on line capability of VIA provides unique opportunities for industry to streamline carcass description. Such developments require, however, that biological variation is considered when predictions are made and it remains as to the effect of gender and genotype on predictions from VIA such as for fat levels. This paper shows that genotype variation caused by sires within a breed is unlikely to have significant influence on potential predictors of muscularity such as W3, however although untested here, breed variation could be important.

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REFERENCES

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