GENETIC PARAMETERS FOR ULTRASOUND EYE MUSCLE DEPTH AND AREA IN
HEREFORD AND POLL HEREFORD CATTLE

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SUMMARY
Real-time ultrasound measurements on 2352 Hereford and Poll Hereford seedstock animals were used to estimate variance and covariance components for eye muscle depth and eye muscle area. The heritabilities were 0.32 and 0.28 for muscle depth and area, respectively. The genetic correlation between muscle depth and area was 0.91 which was significantly different from one. These results suggest it is possible to select for eye muscle depth in beef cattle and a correlated change in eye muscle area would be expected. The non-unity genetic correlation indicates a limited opportunity exists to select for increased depth without changing area and thus making small changes in the shape of the muscle.

Keywords: Beef cattle, ultrasound, muscle depth, heritability, genetic correlation

INTRODUCTION
The use of real-time ultrasound to measure carcase attributes on the live animal is widely used in Australian beef herds. Scan measurements of longissimus dorsi muscle area (eye muscle area) and fat depth at the 12/13th rib and P8 sites are incorporated into the multiple-trait GROUP BREEDPLAN evaluations of several breeds. However research in other species suggests eye muscle depth can also be obtained accurately from ultrasound scans (Gilmour et al. 1994; Hermesch 1996). Muscle depth may be easier and cheaper to measure due to the cost associated with tracing muscle area and the possibility to automatically measure depth (Glashey et al. 1996). However for a trait to be useful in a genetic evaluation system the heritability of the trait needs to be determined. Also it is important to estimate the correlation with other traits, particularly eye muscle area. This is because it may be possible to replace area with depth in the current evaluations. Furthermore, the magnitude of the correlation will have implications for changing muscle shape.

The aim of this study was to estimate genetic parameters for eye muscle depth in beef cattle measured using real-time ultrasound. Secondly, the genetic correlation between eye muscle depth and eye muscle area is also estimated.

MATERIALS AND METHODS
Animals. A total of 2352 animals were used to obtain real-time ultrasound images of eye muscle depth (EMD) and area (EMA). Animals were from seedstock Hereford and Poll Hereford herds throughout Eastern Australia.

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Measurements. Real-time ultrasound measurements of the *longissimus dorsi* muscle were taken between the 12th and 13th ribs by two trained sonographers using Aloka 500V machines. Images were stored on a computer and processed at a later time by the technician. Eye muscle depth was measured at the widest part of the *longissimus dorsi* muscle image. Eye muscle area was obtained by tracing the outline of the *longissimus dorsi* muscle and the area within computed. The animal’s sex, weight, age and management group were also recorded at the time of scanning. The mean age at scanning was 535 days (range 300-800) and data for this analysis were predominantly from yearling bulls.

Statistical Analyses. Data were edited to remove missing records and any data recording errors. The final dataset used in this study consisted of 2352 animals with both eye muscle depth and area records. Both traits were then analysed using the GLM procedure in SAS (SAS 1988) to identify significant fixed effects. The full model for both traits included contemporary group, age of the animal at scanning, age of the dam (at calf birth) and sire (included as a random effect). Contemporary group was defined as herd+season+scan date+management group+sex. Season of birth was simply defined as autumn (January - June) and spring (July - December). Management group is a code designated by the breeder to identify animals treated alike e.g. from the same paddock. Age of the animal’s dam was specified in years. Due to low subclass numbers all cows greater than 9 years of age were grouped into the 9 year old class. Age of the animal at scanning was included as linear and quadratic covariates. All first order interactions were included and non-significant effects (P>0.05) were sequentially removed to yield the final models.

The significant effects identified in the SAS analysis for each trait were then included, along with complete pedigree information, in an animal model REML analysis using univariate DFREML (Meyer 1993). A bivariate analysis of EMD and EMA was used to estimate covariance components between eye muscle depth and area.

RESULTS AND DISCUSSION
The mean scan EMD in this study was 7.2 cm and the mean scan EMA was 70.9 cm². The final model for both EMD and EMA included the following significant independent variables: contemporary group, age of animal and age of dam.

Fixed effects. The effect of age of animal on EMD was 0.0038 cm/day and for EMA 0.063 cm²/day. Thus older animals had greater muscle depth and larger areas. Best linear unbiased estimates (BLUE’s) of the age of dam effect are presented in Table 1. Large differences were observed between the traits measured on animals from 2 year old dams compared to those from older cows (0.24 cm for EMD and 3.2 cm² for EMA). A secondary analysis found this difference was largely explained by differences in live weight.

Table 1. Solutions for the age of dam effect, relative to 2 year olds, for eye muscle depth (EMD) and eye muscle area (EMA)
Genetic effects. Variance component estimates are presented in Table 2. The heritability for EMD was 0.32. No literature estimate of scanned EMD was found for beef cattle. However, in sheep studies, Gilmour et al. (1994) reported a heritability of 0.15 for scanned eye muscle depth and Bishop (1993) a higher heritability of 0.36. The heritability of scanned EMA was 0.28 and is similar to estimates reported for Herefords and Poll Herefords by Robinson et al. (1994).

Table 2. Estimated variance components for eye muscle depth (EMD) and eye muscle area (EMA)

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<tr>
<th>Trait</th>
<th>Age of dam (years)</th>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
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<tr>
<td>EMD (cm)</td>
<td>0.0</td>
<td>0.20</td>
<td>0.19</td>
<td>0.24</td>
<td>0.23</td>
<td>0.21</td>
<td>0.21</td>
<td>0.21</td>
<td>0.22</td>
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<tr>
<td>EMA (cm^2)</td>
<td>0.0</td>
<td>2.5</td>
<td>2.8</td>
<td>3.2</td>
<td>3.2</td>
<td>3.0</td>
<td>2.5</td>
<td>2.7</td>
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</table>

The genetic correlation between EMD and EMA was 0.91 and is significantly different from unity (based on a log likelihood ratio test). This estimate is similar to that reported in sheep by Gilmour et al. (1994). Once again no literature estimates of the correlation between these traits were found for cattle. The less than unity correlation suggests depth and area are not completely controlled by the same genes. Therefore a small possibility exists to select animals with different shaped eye muscles.

CONCLUSIONS

Based on its heritability, scanned eye muscle depth could be used in genetic improvement and selecting for increased muscle depth would result in a correlated increase in eye muscle area. The
relative cost of measuring EMD versus EMA may make it a more suitable trait for the beef
industry. However further work is required to determine the repeatability of measuring EMD and
to estimate the relationship between eye muscle depth and meat yield traits. This would be
important if scanned eye muscle depth was to replace the measurement of area in any genetic
prediction of meat yield.

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REFERENCES