

## GENETIC PARAMETERS FOR MEAT QUALITY AND CARCASS TRAITS IN AUSTRALIAN MERINO SHEEP

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### SUMMARY

Data from 1048 rams of three strains of Merino were used to obtain heritability estimates for carcass and meat quality traits fitting an animal model using a REML procedure. Traits analysed were eye muscle depth (EMD), eye muscle width (EMW), tissue depth at GR site (FATGR), fat depth at C site (FATC), pH and colour of the *m. longissimus lumborum* ( $L^*$ ,  $a^*$ ,  $b^*$ ). Estimates of heritability were 0.33 ( $\pm$  0.09), 0.20 ( $\pm$  0.08), 0.27 ( $\pm$  0.08) and 0.15 ( $\pm$  0.07) for FATGR, FATC, EMD and EMW respectively. Estimates of heritability for pH,  $L^*$ ,  $a^*$  and  $b^*$  were 0.27 ( $\pm$  0.09), 0.14 ( $\pm$  0.07), 0.02 ( $\pm$  0.06) and 0.04 ( $\pm$  0.06) respectively. The heritability estimates reported here for carcass traits in Merino sheep are reasonably similar to those previously reported for other sheep breeds. This would indicate there is little need to change the parameters currently used for calculating EBVs for meat breeds when Merino data are being processed. It also indicates that there is moderate genetic variation with scope for selection for improvement in meat quality through pH and possibly meat colour.

**Keywords:** Merino, sheep, meat quality, carcass, heritability.

### INTRODUCTION

There has been a growing demand from consumers and industry for the production of meat with high and consistent quality. Due to low wool prices in recent years, Merino wool producers have shown a growing interest in improving meat production from the breed. In Australia, the national sheep breeding program LAMBPLAN (Banks 1994) provides estimated breeding values (EBVs) for a range of production traits, such as weight, fat and muscle, using breed specific parameters when they are appropriate and available. Further development of genetic improvement programs for both production and meat quality traits requires information on both genetic variance and covariance among these traits, estimated in specific populations. This study presents estimates of heritability for carcass and meat quality traits in Merino sheep.

### MATERIALS AND METHODS

**Animals.** Data were collected from the QPLU\$ Merino selection lines maintained at the Trangie Agricultural Research Centre (Taylor and Atkins 1997). The data were from 1048 17-month old rams from three different strains (fine, medium and broad) born in 1997 and 1998. The animals were the progeny of 125 sires and 748 dams. The animals were randomly allocated to slaughter over three days in 1999 and two days in 2000. The rams were transported 250 km, held in lairage overnight and slaughtered at a commercial abattoir. Hot carcass weight (HCW) and tissue depth (FATGR) at the GR site (total tissue depth to the 12<sup>th</sup> rib, 110mm from the midline, using a GR knife) were measured

immediately after slaughter. In addition, eye muscle (*m. longissimus lumborum*) depth (EMD), width (EMW) and fat depth over the eye muscle (FATC) at the 12<sup>th</sup> rib and the meat quality traits, pH and colour of the eye muscle, were recorded 24 h after slaughter. Muscle temperature and pH were measured using a Jenco pH meter Model 6009. A Minolta chromameter Model CR-300 set on the  $L^*$ ,  $a^*$ ,  $b^*$  system was used to measure meat colour.

**Statistical analysis.** Analyses of traits were based on mixed linear models. Fixed effects in the model were strain, year and slaughter day, nested within year. Linear covariates included in the models were HCW for all traits and temperature for meat quality traits. The interaction, strain x HCW was included in the model. Strain was significant for GR and FATC, but not for EMD and EMW. FATC was the only trait for which the strain x HCW interaction was significant. Strain was significant for pH and  $b^*$ , but not for  $a^*$  colour. HCW was significant for both pH and  $a^*$ . Muscle temperature had a significant effect on both  $a^*$  and pH. The variance components were estimated from an animal model applying a Restricted Maximum Likelihood procedure using ASREML (Gilmour *et al.* 1999).

## RESULTS AND DISCUSSION

Estimates of heritability for carcass and meat quality traits are presented in Table 1. The estimated heritability for GR tissue depth (adjusted for carcass weight) of  $0.33 \pm 0.09$  was similar to the average of 10 estimates for carcass fat depth of 0.28 in the studies reviewed by Fogarty (1995). The heritability estimate for FATC ( $0.20 \pm 0.08$ ) was somewhat lower than that for FATGR, although it was within the range reviewed (Fogarty 1995) and consistent with Bennett *et al.* (1991) for Southdown x Romney sheep. The Merino rams in the current study were very lean with a mean FATC of only 2.0mm and a very high coefficient of variation, with the magnitude of the error in the measurement relative to the low mean no doubt contributing to the higher coefficient of variation and lower heritability estimate.

**Table 1. Number of records, mean, standard deviation (SD), coefficient of variation (CV), estimate of heritability ( $h^2$ ) and standard error (SE) for carcass and meat quality traits**

Trait	Number of records	Mean	SD	CV (%)	$h^2$	SE
FATGR (mm)	1045	8.3	3.9	47.0	0.33	0.09
FATC (mm)	1045	2.0	1.5	74.0	0.20	0.08
EMD (mm)	1045	30.3	3.8	12.5	0.27	0.08
EMW (mm)	1045	62.5	5.1	8.2	0.15	0.07
pH	957	6.02	0.29	4.8	0.27	0.09
$L^*$	1035	33.5	3.5	10.4	0.14	0.07
$a^*$	1011	18.4	3.0	16.2	0.02	0.06
$b^*$	1005	8.4	1.7	20.3	0.04	0.06
HCW (kg)	1045	25.2	3.9	15.4	-	-
Temperature (°C)	956	3.8	2.0	53.7	-	-

The heritability estimate for EMD ( $0.27 \pm 0.08$ ) was similar to the average of 22 previous studies (0.29) reviewed by Fogarty (1995). The estimated heritability for EMW ( $0.15 \pm 0.07$ ) was lower than

EMD, which contrasted with other reports in which they were similar (Bennett *et al.* 1991), or in which the heritability of EMW was greater than that of EMD (Thorsteinsson & Bjornsson 1982; Pollott *et al.* 1994). The coefficients of variation for EMD and EMW were similar to other reports (Fogarty 1995).

Heritability estimates for meat quality traits were moderate for pH ( $0.27 \pm 0.09$ ) and lower for the colour traits ( $L^*$ ,  $a^*$ ,  $b^*$ ). There was some genetic variation for  $L^*$  colour ( $h^2=0.14 \pm 0.07$ ), which measures the relative lightness of the muscle. However there was no genetic variation expressed for the  $a^*$  and  $b^*$  colour measurements, which measure relative redness and yellowness respectively. We are not aware of any other studies that have reported heritability estimates for these meat quality traits in sheep. However in Australian pigs, Hermesch *et al.* (2000) reported lower heritability (0.14) for pH and higher heritability (0.29) for  $L^*$ . On the other hand, Aass (1996) estimated heritabilities of 0.1 and 0.27 for ultimate pH and  $L^*$ , respectively. In addition, the author reported estimates of redness and yellowness of  $0.17 \pm 0.14$  and  $0.08 \pm 0.12$ , respectively which indicates a rather low genetic variation in these traits.

The heritability estimates reported here for carcass traits in Merino sheep are reasonably similar to those previously reported for other sheep breeds. This would indicate there is little need to change the parameters currently used for calculating EBVs for meat breeds when Merino data are being processed. The study provides the first parameter estimates of meat quality traits in sheep, which indicates there is moderate genetic variation with scope for selection for improvement in meat quality through pH and possibly meat colour.

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