HERITABILITY ESTIMATES OF CARCASS QUALITY TRAITS IN AUSTRALIAN MERINO RAMS UNDER BEST PRACTICE PRE - SLAUGHTER MANAGEMENT

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INTRODUCTION

Recent increases in meat prices have increased the importance of including meat and carcass quality traits in breeding programs for dual purpose Merino Sheep. There is however little information about the capacity for altering these carcass quality traits through selection. Safari *et al.* (2001) have estimated the heritability of meat and carcass quality traits in Merino rams. They found moderate genetic variation in a range of meat traits and concluded that the heritability estimates in Merinos are very similar to those of other meat breeds.

Pre and post slaughter management can affect carcass quality traits (Gardner *et al*., 1999). There is anecdotal evidence that the Merino carcass is particularly prone to dark cutting meat - possibly related to interactions between muscle glycogen levels (Devine and Chrystall, 1988) and increased sensitivity of the Merino to stressful situations (Jacob, personal communication). Feeding a high-energy diet before slaughter has been shown to reduce the incidence of dark cutting meat and give some guarantee to eating quality (Milton pers. comm.). In addition electrical stimulation is a best practice recommendation for abattoirs and has a small influence on improving meat colour.

High ultimate pH and meat ligthness colour (L) are reasonable indicators that meat will not be of unacceptable eating quality. High ultimate pH (> 6.0) and meat lightness colour (L) of greater than 34 are good quantitative indicators of dark cutting meat (Jacob pers. comm.). In the experiment of Safari *et al.* (2001) carcasses were not electrically stimulated and a large proportion of carcasses were dark cutting (mean L = 34.7 and pH = 6.02).

This study investigates the heritability estimates of carcass and meat quality traits under a high energy feeding regime pre slaughter and electrical stimulation of the carcasses post slaughter. This will provide evidence that best practice protocols may reduce genetic variation of meat colour and ultimate pH. Other meat quality traits related to fat and yield traits are hypothesised to be similar to those of other researchers.

MATERIAL AND METHODS

Animals. The data was collected from the Merino resource flocks run at Katanning in Western Australia. This flock consists of four selection lines i.e. meat, staple strength, wool and a control line. Hogget rams and ewes that were born in 1999 and 2000, were scanned for subcutaneous fat thickness (Scanfat) and eye muscle (*Longissimus dorsi)* depth at the C site (Scanmus) on the 12th rib, 45 mm off the midline using an Aloka 500 ultrasound machine, and weighed (LWT) at 16 months of age. Two thousand and eighty two progeny records from 85 sires were available for LWT, Scanmus and Scanfat.

The animals were shorn the week following scanning. As it is well known that shearing can result in a loss in body weight, the rams were placed on a pre slaughter feeding regime two weeks prior to slaughter. The animals were fed a commercial pelleted diet of 10.8 MJ/kg and 15.5 per cent digestible protein. In spite of this feeding regime, the 2000 born rams lost weight from 65 kg live weight at shearing to 59 kg by slaughter over the 6 weeks period. This loss in body weight includes the weight of the greasy wool removed (4.4 kg) at shearing. A day before slaughter the rams from the 2000 born animals were transported 120 kilometres to a commercial abattoir. The Rams were held in lairage overnight and slaughtered early the next day. Hot carcass weight (HCWT) was measured immediately after slaughter. The carcasses were stored in chillers at 4 degrees Celsius overnight and measured for subcutaneous fat (FatC) and tissue depth at the GR site 110 mm of the midline (FatGR) on the 13th rib approximately 24 hours post slaughter. This deviation from the standard site was a requirement by the abattoir in order not to damage the carcasses and comply with their clients' needs. Eye muscle depth (EMD) and width (EMW) was measured using a ruler and meat pH with a WTW pH 330 Pocket pH mV meter. Muscle colour [relative lightness (L), relative redness (a) and relative yellowness (b)] was measured at the same site with a Minolta Chroma meter CR300. These meat quality measurements were taken on three hundred ninety eight carcass records on rams that were the progeny of 42 sires.

Statistical analysis. Analyses were performed with ASREML (Gilmour, 1999) using an animal model. Different models were fitted for the different traits. All models included : selection line, year of birth, birth type, damage, sex and all first order interactions as fixed factors. Linear covariates included in the models were: day of birth for LWT, LWT for HCWT, Scanfat and Scanmus and HCWT for EMD, EMW, FatGR, FatC, pH, L, a and b colour measurements. The final model only included significant factors.

RESULTS AND DISCUSSION

The rams weighed on average 59 kg before being transported to the abattoir. Selection line and birth type had a significant effect ($P < 0.05$) on HCWT, while birth type had a significant effect on Scanmus and Scanfat when LWT at scanning was included as a linear covariate. Birth type also had a significant effect on EMD and FatGR using HCWT as a covariate. Relative redness (a) and pH were not affected by any of the fixed environmental factors or HCWT, but HCWT had a significant ($P < 0.001$) positive relationship with EMD, EMW, FatC and FatGR but a negative relationship with relative lightness (L) and yellowness (b).

The means, standard deviations (SD) and heritability estimates (± se) of the different traits are shown in table 1. It is clear that the carcasses were quite lean at scanning and at slaughter but that they showed quite a large amount of phenotypic variation for the fat traits. The amount of variation shown by the traits is very similar to that of Safari *et al*. (2001). All the traits in this study were heritable. LWT had a high heritability (0.51) while Scanfat and Scanmus had moderate heritabilities (0.23 and 0.28) which agrees with estimates in Fogarty's (1995) review. This is encouraging as it is more difficult to measure these traits on Merino sheep that are relatively lean.

Table 1. Number of records, means and standard deviations of meat and carcass traits of Merino rams

Trait[a]	Number of records	Mean	SD	CV	h^2	SE
LWT [1] (kg)	2082	51.9	6.39	12.3	0.51	0.07
Scanfat [2] (mm)	2082	3.33	0.65	19.5	0.28	0.07
Scanmus [2] (mm)	2082	22.3	2.13	9.5	0.23	0.07
HCWT[2] (kg)	398	24.7	2.65	10.7	0.36	0.18
FATC[3] (mm)	398	1.76	0.83	47.2	0.26	0.14
FatGR[3] (mm)	398	4.12	1.78	43.2	0.70	0.20
pH	398	5.81	0.35	6.0	0.13	0.11
EMD[3] (mm)	398	30.1	3.30	10.9	0.25	0.15
EMW[3]	398	63.2	4.86	7.7	0.45	0.17
L[3]	398	36.4	3.36	9.2	0.20	0.12
A	398	22.4	2.70	12.0	0.22	0.13
b[3]	398	10.3	1.98	19.2	0.14	0.11

[a] LWT, Scanfat and Scanmus were measured on both sexes. Other traits on rams only.
[1] Day of lambing included as a linear covariate
[2] LWT at scanning included as a linear covariate
[3] HCWT included as a linear covariate

In most cases the heritability estimates of the carcass traits were higher than the results of Safari *et al.* (2001) except for EMD that was similar (0.25 vs. 0.27). In general the results agree with the average estimates reported by Fogarty (1995) across a range of sheep breeds, except for FatGR, in spite of the fact that these estimates are based on a relatively small dataset. As FatGR was measured on the 13th rib and not on the 12th rib as is normally done, this could have contributed to the higher heritability estimate for FatGR.

The meat quality traits L, a and b exhibited less variation in this study but they had higher heritability values than that reported by Safari *et al.* (2001). These rams had lower ultimate pH values (pH = 5.81) and lighter meat colour (L = 36.3) than reported by Safari *et al*. This may have been caused by the electrical stimulation of the carcasses. The heritability estimate of pH was lower but higher for L than that of Safari *et al.* (2001). Consequently it appears that best practise techniques do not reduce the heritability estimates for these traits.

CONCLUSION

This study indicates that ultrasonically scanned fat and muscle depth on the live animals shows genetic variation that are independent of live weight. The carcass and meat quality traits, independent of hot carcass weight, were also heritable and agree with most studies. This shows that genetic variation exists for most meat and carcass quality traits in Merino sheep and that genetic improvement through selection should be possible. More work needs to be done to determine the genetic and phenotypic relationships between the wool and meat traits.

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