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RELATIONSHIPS OF SIRE BREEDING VALUES FOR MERINO PRODUCTION TRAITS WITH EATING QUALITY OF LAMB

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SUMMARY

Regression coefficients were estimated of sensory and objective eating quality (EQ) traits on sire Australian Sheep Breeding Values (ASBVs) for a range of Merino production traits to identify if genetic relationships were likely to exist between these traits. The sire ASBVs were not associated with either overall liking scores of loin, knuckle and topside cuts, or intramuscular fat and shear force of the loin. This preliminary study has shown that it is likely that selection on sire ASBVs to improve Merino production traits would yield negligible responses in EQ traits.

INTRODUCTION

For the current MERINOSELECT indexes where the breeding objective includes improvement of carcass traits (Dual Purpose+ and Dohne+), it is predicted that small unfavourable responses in eating quality (EQ) traits would occur (A.A. Swan, personal communication). With around 30% of Merino breeding ewes being mated for crossbred lamb production (MLA and AWI 2021), considering EQ traits in these Merino breeding objectives is warranted. Like the lamb EQ indexes for Terminal sires (Swan *et al*. 2015), refinement of these indexes would contribute to ensuring that lamb produced by Merino dual purpose production systems are of acceptable quality, when eaten by consumers. For those Merino ewes mated to Terminal sires to produce crossbred lambs, it would be prudent to know if the MERINOSELECT objectives used to generate those ewes are consistent with the EQ objectives of the LAMBPLAN Terminal sire indexes. Based on low to negligible genetic correlations, Mortimer *et al.* (2017) had concluded that Merino breeding programs emphasising wool production would have little or no effect on the objectively measured EQ traits of intramuscular fat and shear force. The genetic relationships of wool production traits with sensory scores for EQ traits have not yet been reported.

The diversity of the sires selected to generate progeny of Australian Wool Innovation's Merino Lifetime Productivity (MLP) project (Ramsay *et al.* 2019) and the availability of data from consumer testing of sensory EQ traits of meat samples from MLP wether carcasses provide a means to detect if genetic relationships exist between EQ traits and sire Australian Sheep Breeding Values (ASBVs) for production traits. This preliminary study estimated relationships between ASBVs for a range of MERINOSELECT breeding objective traits and EQ traits, sensory and objective, assessed on 3 cuts of Merino lamb sampled from carcasses produced at 2 MLP sites.

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MATERIALS AND METHODS

The design of the MLP project (Ramsay *et al.* 2019) and the pre-slaughter procedures (Mortimer *et al.* 2021) that produced the carcasses for this study have been described elsewhere. Sensory EQ data were recorded on loin, knuckle and topside samples aged for 5 days taken from carcasses of 2018-born F1 wethers at the Macquarie (fine/medium ewe base) and New England (ultrafine ewe base) MLP sites. Sample collection and preparation, cooking procedures and sensory testing protocols applied to the grilled samples and tasted by panels of untrained consumers have been described by Pannier *et al.* (2014). Briefly, for each consumer tasting session (57 sessions), 10 sub-samples were prepared from each meat sample following grilling under standardised conditions and provided to 10 consumers. The EQ traits were assessed by the consumers using a 0-100 scale (100 being most preferred) and included tenderness, juiciness, liking of flavour and overall liking of loin, topside and knuckle cuts, respectively. The EQ record for each sample was then based on the mean of the 10 consumer responses. For this study, the overall liking scores for the loin (llike), knuckle (klike) and topside (tlike) samples only were analysed; 408, 409 and 403 records respectively were available from the Macquarie carcasses, while 152, 156 and 157 records were available from the New England carcasses. Objective EQ data were recorded on samples taken from the other loin of each carcass. Intramuscular fat (imf, %) was measured using procedures described by Hopkins *et al.* (2014), while shear force (sf5, N) was tested as described by Hopkins and Thompson (2001).

The ASBVs were available for 14 (extracted from MERINOSELECT analyses 21 September 2017) and 12 (extracted from MERINOSELECT analyses 21 January 2018) of the sires used to generate progeny at the Macquarie and New England sites (Table 1), respectively. The ASBVs for the production traits included: yearling (ycfw) and adult (acfw) clean fleece weight (%); yearling (yfd) and adult (afd) fibre diameter (micron); yearling (yfdcv) and adult (afdcv) coefficient of variation of fibre diameter (%); yearling (yss) and adult (ass) staple strength (N/ktex); yearling (ysl) and adult (asl) staple length (mm); yearling (ywt) and adult (awt) live weight (kg); yearling ultrasound fat depth (yfat, mm); and yearling ultrasound eye muscle depth (yemd, mm).

Table 1. Summary statistics for eating quality and ASBV (minimum and maximum in brackets) traits for Macquarie and New England samples

	Macquarie samples		New England samples	
Eating quality trait				
	Mean (SD)	Range	Mean (SD)	Range
llike	68.7 (8.20)	42.3 - 88.8	69.5 (8.16)	49.0 - 87.6
klike	65.0 (7.10)	40.4 - 84.2	65.6 (6.97)	43.3 - 88.0
tlike	53.7 (9.08)	26.6 - 73.8	52.2 (8.99)	28.1 - 74.3
imf	4.7 (1.39)	2.2 - 10.8	4.5 (1.34)	2.2 - 8.2
sf5	24.5 (5.28)	14.1 - 41.4	24.1 (4.91)	13.4 - 41.4
Australian Sheep Breeding Value				
	Yearling	Adult	Yearling	Adult
cfw	22.98 (10.35, 41.63)	17.95 (5.35, 37.67)	13.37 (-34.96, 30.95)	8.29 (-34.94, 21.23)
fd	-1.21 (-2.71, 0.05)	-1.13 (-2.79, 0.05)	-2.29 (-4.19, -0.78)	-2.55 (-4.78, -1.02)
fdcv	-0.14 (-1.95, 1.65)	-0.08 (-1.73, 1.52)	-0.69 (-2.17, 1.63)	-0.60 (-2.04, 1.36)
ss	-0.80 (-5.9, 5.35)	-0.88 (-5.96, 3.27)	-1.06 (-5.58, 2.57)	-1.33 (-6.46, 2.45)
sl	5.96 (0.62, 13.31)	5.75 (-1.4, 12.54)	3.82 (-12.62, 17.31)	2.96 (-18, 14.8)
wt	6.33 (1.94, 13.55)	5.20 (0.66, 12.42)	3.36 (-5.81, 6.62)	2.04 (-6.50, 5.59)
fat	-0.03 (-1.06, 2.15)	-	-0.08 (-0.96, 1.70)	-
emd	0.17 (-1.72, 2.39)	-	-0.11 (-1.30, 2.72)	-

Separate analyses for each site's data were performed to estimate the regression coefficients of each EQ trait on sire ASBV for each production trait using ASReml (Gilmour *et al.* 2021). The model fitted to the data included a fixed effect of contemporary group (accounting for management and slaughter group effects) and a random effect of sire. Although fixed effects of birth type, rearing type, dam age and their interactions were also tested, these effects were found to be not significant and were excluded from the model.

RESULTS AND DISCUSSION

Average scores tended to be similar for overall liking for each of the 3 cuts across the sites (Table 1). The average scores for overall liking of topside samples were lower than scores for loin samples from both sites, with differences of 10 units for Macquarie samples and 17 units for the New England samples. Average overall liking scores for knuckle samples were 4 units lower than the average scores for loin samples at both sites.

For both data sets, significant ($P < 0.05$) regression coefficients were not detected for any of the EQ traits with the sire ASBVs for wool traits (Table 2). Nonetheless across the 3 cuts from the

Table 2. Regression coefficients for eating quality traits of Macquarie and New England samples on sire ASBVs

	llike	klike	tlike	imf	sf5
Macquarie samples					
ycfw	0.09 ± 0.09	0.13 ± 0.08	0.12 ± 0.10	-0.01 ± 0.02	-0.05 ± 0.74
acfw	0.07 ± 0.08	0.05 ± 0.08	0.09 ± 0.09	0.00 ± 0.02	-0.02 ± 0.07
yfd	-0.17 ± 0.95	0.34 ± 0.94	0.10 ± 1.08	0.10 ± 0.21	-0.56 ± 0.77
afd	-0.10 ± 0.92	-0.07 ± 0.92	0.01 ± 1.05	0.10 ± 0.20	-0.38 ± 0.76
yfdcv	0.62 ± 0.65	0.02 ± 0.67	0.49 ± 0.76	-0.09 ± 0.15	0.03 ± 0.56
afdcv	0.79 ± 0.75	0.30 ± 0.78	0.89 ± 0.87	-0.09 ± 0.17	-0.09 ± 0.65
yss	-0.21 ± 0.21	0.17 ± 0.21	0.00 ± 0.25	-0.01 ± 0.05	-0.05 ± 0.18
ass	-0.35 ± 0.27	0.13 ± 0.28	-0.19 ± 0.32	0.01 ± 0.06	-0.07 ± 0.24
ysl	-0.09 ± 0.18	0.00 ± 0.18	-0.05 ± 0.21	0.03 ± 0.04	-0.03 ± 0.15
asl	-0.02 ± 0.20	-0.07 ± 0.2	0.00 ± 0.23	0.04 ± 0.04	-0.04 ± 0.16
ywt	-0.02 ± 0.22	-0.03 ± 0.22	-0.17 ± 0.24	-0.02 ± 0.05	0.20 ± 0.17
awt	0.02 ± 0.21	-0.11 ± 0.21	-0.16 ± 0.23	-0.02 ± 0.05	0.21 ± 0.16
yfat	-0.40 ± 0.77	0.10 ± 0.78	-0.39 ± 0.89	-0.08 ± 0.17	0.28 ± 0.65
yemd	-0.48 ± 0.56	-0.46 ± 0.56	-0.71 ± 0.63	-0.17 ± 0.12	0.47 ± 0.46
New England samples					
ycfw	0.01 ± 0.05	-0.03 ± 0.04	-0.02 ± 0.05	-0.01 ± 0.01	0.01 ± 0.04
acfw	0.00 ± 0.05	-0.03 ± 0.05	-0.01 ± 0.06	-0.01 ± 0.02	0.00 ± 0.04
yfd	0.84 ± 0.64	0.18 ± 0.62	0.76 ± 0.71	0.00 ± 0.22	-0.21 ± 0.50
afd	0.63 ± 0.50	0.10 ± 0.48	0.65 ± 0.55	0.01 ± 0.17	-0.20 ± 0.39
yfdcv	-0.57 ± 0.53	-0.25 ± 0.51	-0.07 ± 0.26	-0.15 ± 0.18	0.10 ± 0.42
afdcv	-0.67 ± 0.60	-0.22 ± 0.58	0.41 ± 0.68	-0.15 ± 0.20	0.14 ± 0.47
yss	0.46 ± 0.29	0.16 ± 0.28	0.13 ± 0.34	0.06 ± 0.10	-0.06 ± 0.23
ass	0.44 ± 0.28	0.17 ± 0.27	0.20 ± 0.33	0.04 ± 0.09	-0.10 ± 0.22
ysl	0.09 ± 0.09	-0.06 ± 0.08	-0.07 ± 0.10	-0.02 ± 0.03	0.08 ± 0.06
asl	0.09 ± 0.09	-0.07 ± 0.08	-0.07 ± 0.10	-0.02 ± 0.03	0.07 ± 0.07
ywt	0.15 ± 0.23	-0.12 ± 0.21	-0.07 ± 0.26	0.00 ± 0.08	0.09 ± 0.17
awt	0.05 ± 0.22	-0.14 ± 0.20	0.07 ± 0.24	0.01 ± 0.07	0.06 ± 0.16
yfat	0.83 ± 0.92	0.76 ± 0.84	-1.07 ± 0.96	0.29 ± 0.29	-0.07 ± 0.69
yemd	0.98 ± 0.60	0.53 ± 0.58	-0.88 ± 0.65	0.10 ± 0.21	0.17 ± 0.47

Macquarie carcasses, there may be a possibility that improving sire ASBVs for clean fleece weight and fibre diameter variability could lead to slight favourable and unfavourable responses, respectively, in overall liking scores. For the New England cuts, improving sire ASBVs for fibre diameter may lead to slight unfavourable responses, while improving sire ASBVs for fibre diameter variability and staple strength may yield slight favourable responses. In the case of the objective EQ traits (imf, sf5), the lack of associations was consistent with the negligible to low genetic correlations of imf and sf5 with wool production traits reported by Mortimer *et al.* (2017), which were generally less than 0.20 in size.

No significant regression coefficients were detected for any of the EQ traits with the sire ASBVs for the live weight and ultrasound traits (Table 2). The effect of increasing sire ASBVs for yfat and yemd on overall liking scores, though, may vary between data sources: slightly unfavourable effects on the scores on cuts from the Macquarie carcasses versus slightly favourable effects on scores of loin and knuckle cuts and slight unfavourable effects on scores of topside cuts from New England carcases. For imf and sf5, negligible genetic correlations have been estimated for these objective EQ traits with ywt, awt, yfat and yemd (Mortimer *et al.* 2018).

CONCLUSION

This preliminary study suggests that selection on sire ASBVs to improve Merino production traits would yield negligible responses in sensory and objective EQ traits. Estimation of genetic correlations among the traits will verify if at most weak genetic associations do exist between EQ and wool production traits. Based on a combination of data from the Macquarie and New England flocks and data from other resource flocks that have assessed eating quality of Merino lamb cuts, analyses are underway to estimate the accurate genetic parameters needed to include an EQ breeding value in MERINOSELECT indexes.

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