VARIATION BETWEEN SIRES AND GENOTYPES IN DIMENSIONS OF CROSS SECTION OF EYE MUSCLE OF MEAT SHEEP

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SUMMARY

This study reports on an investigation of the importance of measurement of depth and width of eye muscle in selecting the most valuable breeding sires in relation to eye muscle area and thus lean meat production.

Second cross lambs (n=575) from 27 sires from different studs and 8 breeds types/genotypes (single sires from each of 18 Poll Dorset (PD), 2 Hampshire Down (HD) , 2 Coolalee (Cl), 1 Corriedale (Cr), 1 Jonesdale (Jo), 1 Romney (Ro), 1 White Suffolk (WS) and 1 Wiltshire Horn (WH) studs) were slaughtered at 6 months of age at a mean carcass weight of 17.3 kg for ewes and 20.6 kg for cryptorchids. Eye muscle depth (EMD), width (EMW) and area (EMA) were measured from photographs taken from the cross section of carcasses cut at the 12th (12-13) rib and EMD/EMW (D/W) calculated and expressed as a percentage.

D/W differed significantly ($p<0.05$) between genotypes (PD 49.4±0.44, Ro 49.0±0.89, Jo 48.2±1.01, Cr 47.2±0.91, HD 46.8±1.00, Cl 46.6±0.68, WS 46.0±1.07 and WH 45.5±1.20). The variation of D/W between sires within genotypes was large (46-52). Other traits were not different between genotypes. Difference between rankings of sires on the basis of EMD and EMW was very large, the mean difference in rankings being 10.1. It is recommended that some effort be made to include more accurate EMW measurements in order to improve selection for EMA.
Keywords: Breed, lambs, carcass measurements, eye muscle

INTRODUCTION

Eye muscle dimensions are considered important when selecting terminal sires for prime lamb production and eye muscle depth (EMD) is included among the measurements offered by the national meat sheep breeding plan, LAMBPLAN (Banks 1990). Eye muscle measurements give an indication of the size of the loin muscle (*M. longissimus thoracis et lumborum*). The size of this expensive cut gives an indication of the quality of the carcass for sale as prime lamb and its yield of lean meat (Kenney *et al. 1995)*. Eye muscle area gives a better indication of the size of the loin compared to one dimension measurement (depth or width) and has better genetic and phenotypic correlations with the main product, lean meat, compared to depth or width measurements alone (Kenney *et al.* 1995). However, a single measurement of depth is preferred because of the ease of measurement on the live carcass. The other dimension of area, eye muscle width, is currently more difficult to measure on live animals and measurements are more variable and inaccurate (Luff *et al.* 1992; Hopkins *et al.* 1993). When there is a consistent ratio between depth and width there should be little problem in measuring only depth. However, width is an important factor in the area of eye muscle and its genetic correlation with eye muscle depth is poor (Kenney *et al.* 1995) and selection of breeding sires for large eye muscle area, size of loin or lean meat production on the basis of eye muscle depth has some limitations.

This study examined the effect of depth, width and area of eye muscle on carcasses on the ranking of sires used in a central progeny test of terminal sires used for prime lamb production.

MATERIALS AND METHODS

Lambs used in this study were male (n= 288) and female (n=287) progeny of Border Leicester x Merino ewes joined to 27 sires from different studs and 8 breed types: single sires from each of 18 Poll Dorset (PD), 2 Hampshire Down (HD) , 2 Coolalee (Cl), 1 Corriedale (Cr), 1 Jonesdale (Jo), 1 Romney (Ro), 1 White Suffolk (WS) and 1 Wiltshire Horn (WH) studs. As a single rams cannot be expected to fairly represent a breed they are referred to as sires from a genotype rather than a breed for the purposes of this report. Lambs were born in May 1993. All male lambs were marked as cryptorchids. Target weights for slaughter were means of 45 kg for ewes and 50 kg for cryptorchids. Ewes were slaughtered on 26 October and cryptorchids on 3 November. Carcasses were cut at the 12th (12-13) rib and colour photographs taken of the cut surface with a grid of 10 mm squares in the same plane as the cut surface. Linear measurements of EMD and EMW were taken using the side of the photographed grid (representing 10 mm). Eye muscle area (EMA) measurements were made using a planimeter, 10 squares of the photographed grids representing 10 cm^2. The ratio of EMD/EMW (D/W) was calculated and expressed as a percentage.

Genotypes and sires were compared using the following model where dependent variable (Y) was EMA, EMD, EMW and the ratio of eye muscle depth:width (D/W) in separate analyses. A mixed model analysis was carried out using Harvey's mixed model least-squares and maximum likelihood computer program PC-1 (1987) and the following model:

$Y = \mu$ (overall mean) + Ge + Si + Lb + Lr + Mg + K_1La+ K_2Cw + residual;

where Ge refers to genotype, Si to sires within genotype, Lb to lambs born , Lr to lambs reared, Mg to management groups (includes sex), La to lamb age, Cw to hot carcass weight and K_1 and K_2 are constants. A similar model omitting hot carcass weight effects was used to estimate genetic parameters for EMA, EMD and EMW. Sires were considered random and nested within genotype.

RESULTS

Mean carcass weights were 17.3 kg for ewes and 20.6 kg for cryptorchids.

The variance of all characters considered were high between sires within genotype and differences between sires were significant ($P<0.01$). Differences between genotypes were significant only with D/W ($P<0.05$). D/W for the different genotypes, in descending order, were: PD 49.4±0.44, Ro 49.0±0.89, Jo 48.2±1.01, Cr 47.2±0.91, HD 46.8±1.00, Cl 46.6±0.68, WS 46.0±1.07 and WH 45.5±1.20.

Sires are placed in order of least mean squares for D/W from highest to lowest in table 1. D/W percentages vary from 52.4 to 45.3. There was considerable difference in rankings of sires on the basis of least mean squares for EMD and EMW. These measurements are listed with rankings (1 - highest and 27 lowest) and differences in rankings to illustrate the differences (Table 1). The mean of the difference between these rankings is 10.1 (*cf* range possible 0-13.5). Rankings for EMA fall between those for EMD and EMW.

Genetic parameters of EMA, EMD, and EMW are shown in Table 2. Of particular note was that h^2 for was low for EMD and high for EMW.

DISCUSSION

The variation between sires within genotype (mainly the PD) was so large that any apparent difference between sires from different genotypes was of little importance. Even in the case of D/W, where genotype differences were significant, the importance of the observation must be questioned in view of the large variation within the largest represented single genotype (PD). This large variation in D/W between sires and genotypes is the source of the problem in selecting for large EMA on the basis of EMD alone.

Our estimates of heritability for EMD and EMW are not very accurate because of the small population used for estimation. However, they do reinforce the suggestion of Kenney *et al.* (1995), made on the basis of genetic parameters estimated from carcass measurements, that EMD was less than ideal for selection of EMA. Our estimates exaggerated the differences between h^2 for EMD and EMW. Compared to the estimates of Kenney *et al.* (1995) which were 0.17 for EMD and 0.36 for EMW, ours were 0.07 and 0.60 respectively.

From these results we may conclude that when EMD is used to select for high EMA there is likely to be a bias towards sires or breeds with high D/W. The importance of such a bias depends of the purpose of selecting for EMD. If it is for increased size of loin or of lean meat, it would be preferable to select the measurement of area by using both depth and width. Currently, the measurement of width for selection purposes is not favoured because the measurement of width on the live animals is more difficult than measuring depth, resulting in less accuracy and higher variability than depth measurements (Luff *et al.* 1992). However, if shape of the loin is important to customers, as distinct from its size and total meat yield, then depth could remain the more important measurement.

Muscle depth has been shown to add little benefit in estimation of commercial cuts if carcass and GR are already available (Hopkins *et al.* 1993). However, it is not clear whether the phenotypic relationships used for these conclusions can be extended to genetic correlations. In such phenotypic relationships EMD may be the better measurement as the estimations in the current work, and those of Kenney *et al.* (1995), show phenotypic correlation between EMA and EMD is higher than between EMA and EMW.

Table 1. Least means squares of eye muscle area (EMA), depth (EMD) and width (EMW) and EMD/EMW (D/W) for different sires. Sires are listed in order of D/W and rankings of sires for each measurement are shown in italics. Differences between rank for EMD and EMW are shown for each sire. Representative standard errors between sires for sires with 7, 20 and 31 progeny are shown at the bottom of the table.

ID	Breed[AB]	Progeny	D/W (%)		EMD (mm)		EMW (mm)		Diff. in ranking	EMA (cm^2)	
1	PD	21	52.4	*1*	29.9	*1*	56.9	*22*	21	13.0	*6*
2	PD	27	52.0	*2*	29.0	*5*	56.0	*27*	22	12.3	*20*
3	PD	20	51.3	*3*	29.1	*4*	56.9	*23*	19	12.7	*11*
4	PD	7	50.8	*4*	28.9	*7*	57.0	*20*	13	12.4	*18*
5	PD	33	50.8	*5*	28.5	*11*	56.1	*26*	15	12.2	*23*
6	PD	22	50.2	*6*	29.6	*2*	58.9	*9*	7	13.5	*2*
7	PD	28	50.0	*7*	28.4	*12*	56.8	*24*	12	12.5	*17*
8	PD	24	50.0	*8*	28.5	*10*	57.0	*21*	11	12.6	*13*
9	PD	29	49.8	*9*	29.4	*3*	59.0	*8*	5	13.5	*1*
10	PD	21	49.3	*10*	28.7	*8*	58.5	*14*	6	12.5	*16*
11	PD	13	49.1	*11*	28.3	*14*	57.6	*17*	3	12.5	*15*
12	Ro	30	49.0	*12*	28.0	*15*	57.4	*18*	3	12.3	*22*
13	PD	22	48.8	*13*	27.5	*22*	56.5	*25*	3	12.1	*24*
14	PD	19	48.7	*14*	28.6	*9*	58.7	*12*	3	12.8	*9*
15	HD	17	48.3	*15*	28.4	*13*	58.7	*11*	2	13.0	*5*
16	Jo	21	48.2	*16*	27.8	*18*	57.7	*16*	2	12.0	*26*
17	PD	22	47.9	*17*	29.0	*6*	60.4	*3*	3	13.2	*3*
18	PD	15	47.9	*18*	28.0	*16*	58.5	*13*	3	12.3	*19*
19	PD	24	47.9	*19*	27.4	*24*	57.3	*19*	5	12.1	*25*
20	Cr	27	47.2	*20*	27.2	*26*	57.8	*15*	11	12.0	*27*
21	PD	27	47.0	*21*	27.7	*21*	58.9	*10*	11	12.9	*7*
22	Cl	26	46.9	*22*	27.9	*17*	59.6	*4*	13	12.8	*10*
23	Cl	31	46.2	*23*	27.5	*23*	59.6	*5*	18	12.6	*14*
24	PD	7	46.0	*24*	27.7	*20*	60.4	*2*	18	13.1	*4*
25	WS	19	46.0	*25*	27.3	*25*	59.4	*7*	18	12.3	*21*
26	WH	15	45.5	*12*	27.8	*19*	61.2	*1*	18	12.7	*12*
27	HD	8	45.3	*27*	27.0	*27*	59.5	*6*	21	12.8	*8*
SE		(n=7)	1.84		0.93		1.06			0.46	
SE		(n=20)	1.12		0.56		0.64			0.28	
SE		(n=31)	0.90		0.45		0.52			0.22	

[A] PD = Poll Dorset, Ro = Romney, WS = White Suffolk, WH = Wiltshire Horn, Cl = Coolalee, Cr = Corriedale, HD = Hampshire Down, Jo = Jonesdale.
[B] Numbers in italics represent ranking of sires for different characters.

Table 2. Genetic parameters for eye muscle are (EMA), depth ((EMD) and width (EMW). Heritibilities are on the diagonal, phenotypic correlations above and genetic correlations below

	Genetic parameters		
	EMA (cm^2)	EMD (mm)	EMW (mm)
EMA	**0.27**	0.81	0.47
EMD	0.72	**0.07**	0.16
EMW	1.03	0.70	**0.60**

In practice measurement of depth is the preferred measure of eye muscle on the live animal. However, we should continue to encourage the use of width measurements and endeavour to improve the accuracy and facility for measurement of width on the live animal. The results indicate that this would result in a greater increase in EMA and thus lean meat production than by continuing to select on the basis of EMD alone.

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