EFFECT OF GENOTYPE AND SEX ON RELATIONSHIP BETWEEN GR AND C MEASUREMENTS OF FATNESS IN SECOND CROSS LAMBS

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SUMMARY

Second cross lambs (287 ewes and 288 cryptorchids) from 27 different terminals sires (18 Poll Dorset and 1 or 2 each from 7 other breeds) were slaughtered at 6 months of age at mean carcass weights of 17.3 kg for ewes and 20.5 kg for cryptorchids. GR tissue depth was measured on the carcass and C fat depth measured from photos taken of the cross section of carcasses cut at the 12th(12- 13) rib. The relationship between GR and C for ewe lambs from Poll Dorset sires was GR $= 4.8 + 1.2C$ ($R^2 = 0.59$) and this was improved when carcass weight (CW) was added (GR $= -1.9 + 0.8C + 0.5CW$; $R^2 = 0.67$). These equations varied with sex and genotype although inclusion of carcass weight in the relationship reduced this variation. The leaner groups (the cryptorchids compared to ewes and the Romney, Corriedale and Wiltshire Horn compared to Poll Dorsets) had GRs lower than estimated using the above equations.

Keywords: breed, lambs, carcass measurements, fatness

INTRODUCTION

Measurements of GR tissue depth (Frazer 1976) and C fat depth (Palsson 1939) provided good estimates of carcass fat (Kirton and Johnson 1979) and can be used in estimating lean meat in commercial cuts from carcasses (Hopkins *et al.* 1995). The correlation coefficient for these 2 measurements is between 0.5 and 0.7 (0.56 recorded by Waldron *et al.* (1992) and 0.68 by Kenney *et al.* (1995)). For consistency with carcass feedback on lambs in AUS-MEAT accredited abattoirs, LAMBPLAN (Banks 1990) publishes estimated breeding values (EBVs) for GR rather than C. However, since GR cannot be accurately measured objectively on live animals using current ultrasound equipment, the C is measured and converted to GR. LAMBPLAN calculates EBVs for C (adjusted for live weight) and converts them to GR using the equation GR = 3C. Hopkins (1990) showed that even with a narrow range of carcass weights there were significant differences between genotype (Poll Dorsets and Suffolks) in the relationship between GR and C. LAMBPLAN is used extensively for a wide range of breeds and, at measurement, lamb weights vary greatly. Thus we need to know more about the relationship between GR and C for the different breeds over a considerable weight range. Further, as a result of selection, the GR-C relationship is likely to change and a regular check is needed to assure breeders that selection of sires is leading in the desired direction. It is possible other factors such as sex and management of lambs may affect the GR-C relationship. This paper considers effects of genotypes and sex when C measurements are used to estimate GR for selecting breeding sheep to be used in prime lamb production.

MATERIALS AND METHODS

This study examines lamb carcasses from the Central Progeny Test in 1993 at Rutherglen, Victoria. Lambs used 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), 1 Coolalee (Cl), 1 Corriedale (Cr), 1 Jonesdale (Jo), 1 Romney (Ro), 1 White Suffolk (WS) and 1 Wiltshire Horn (WH) studs. Each sire was submitted from an individual stud as 1 of their top sires for growth and leanness. For the purpose of this report, as single rams cannot fairly represent a whole breed, "genotype" will be used in preference to "breed". Lambs were born in May 1993. All male lambs were marked as cryptorchids. Target weights for slaughter were a 45 kg mean for ewes and a 50 kg mean for cryptorchids. Mean hot carcass weights were 17.4 kg for ewes and 20.5 for cryptorchids. Ewes were slaughtered on October 26 and cryptorchids on November 3. Carcasses were sectioned at the 12th (12-13) rib and coloured photographs taken of the cut surface with a grid of 10 mm squares on the same plane. Measurements of C fat depth and a side of the grid (representing 10 mm) were made on photographs. The grid measurement was used to adjust C mm measurements to be equivalent to those made on the carcass. Measurements of GR were made directly on the hot carcass using a GR knife, an adaptation of the Toland probe (Thatcher 1984).

The statistical package Genstat 5 (Payne and Lane 1987) was used to analyse the results using the following models in multiple regression analysis.

$$y = k + sex + sire + genotype \quad (1)$$

where y represents carcass weight (CW), GR and C in separate equations.

$$y = k + sex + sire + genotype + CW \quad (2)$$

where y represents GR and C in separate equations.

$$GR = k + sex + sire + genotype + C \quad (3)$$

$$GR = k + sex + sire + genotype + C + CW \quad (4)$$

The possibility of heteroscedasticity was tested by using log(GR) in models 3 and 4 instead of GR. Models do not include factors (eg birth status) which had no significant effect on the GR-C relationship.

RESULTS

The log transformation of data did not improve relationships.

The mean carcass weights for genotype groups (Table 1, equation 1 a) of the Coolalee, Hampshire Down and Jonesdale were similar (16.7 - 17.5 kg) ($P>0.05$) and Corriedale, Romney and Wiltshire Horn were low (12.8-15.1 kg) ($P<0.01$) when compared to the Poll Dorset (17.4 kg).

Positive correlation between carcass weight and'either GR or C was indicated by the increase in R^2 when carcass weight was included in equations with GR or C as dependent variables (equation lb *vs* 2a and lc *vs* 2b, Table 1). Similarly there was a positive correlation between GR and C with R^2 increasing from 0.39 to 0.59 when C was included as a independent variable (GR(1b) *cf* GR(3), Table 1).

Table 1. Coefficients ± standard errors for different genotypes and sex when genotype (Ge) and sex (Sx) has been included as an independent variable in the 6 regression models listed below. The equations listed are for ewe lambs from Poll Dorset sires. Figures in parentheses indicate equations as listed below

Genotype[B]	CW(1a)[C] (kg)	GR(1b) (mm)	C(1c) (mm)	GR(2a) (mm)	C(2b) (mm)	GR(3) (mm)	GR(4) (mm)
	Dependent variables for different equations						
HD	-0.2±0.53	-1.1±0.65*[A]	-0.5±0.32	-1.0±0.52	-0.5±0.28	-0.5±0.54	-0.6±0.48
Ro	-3.0±0.49**	-3.2±0.59**	-0.8±0.29**	-1.1±0.49*	0.1±0.27	-2.4±0.49**	-1.1±0.45*
Cr	-2.3±0.52**	-2.7±0.64**	-1.2±0.31**	-1.1±0.52*	-0.5±0.28	-1.4±0.53**	-0.6±0.48
WS	-1.5±0.65*	-1.4±0.79	-0.4±0.39	-0.4±0.64	0.0±0.35	-1.0±0.66	-0.4±0.59
Jo	0.1±0.62	-0.7±0.76**	-1.1±0.37**	-0.8±0.61	-1.1±0.33**	0.5±0.63	0.0±0.56
Cl	-0.7±0.39	-2.1±0.48**	-1.2±0.23**	-1.6±0.38**	-1.0±0.21**	-0.8±0.40	-0.9±0.36*
WH	-4.6±0.70**	-6.8±0.86**	-2.3±0.42**	-3.5±0.72**	-1.0±0.39**	-4.2±0.72**	-2.7±0.66*
Crypt	3.2±0.25**	0.8±0.19**	0.3±0.13*	-1.8±0.24**	-0.7±0.13**	0.4±0.22	-1.3±0.22**

CW	= 17.3±1.14 + Ge + Sr + Sx	R^2 = 0.55	(1a)
GR	= 11.1±1.39 + Ge + Sr + Sx	R^2 = 0.39	(1b)
C	= 5.5±0.69 + Ge + Sr + Sx	R^2 = 0.26	(1c)
GR	= -1.4±1.34 + Ge + Sr + Sx + 0.72±0.04CW	R^2 = 0.60	(2a)
C	= 0.7±0.72 + Ge + Sr + Sx + 0.28±0.02CW	R^2 = 0.42	(2b)
GR	= 4.8±1.24 + Ge + Sr + Sx + 1.15±0.07C	R^2 = 0.59	(3)
GR	= -1.9±1.22 + Ge + Sr + Sx + 0.7 5±0.04C + 0.51±0.04CW	R^2 = 0.67	(4)

[A] * = P<0.05, ** = P<0.01 for differences either from PD in genotype group or between sexes.
[B] HD = Hampshire Down, Ro = Romney, Cr = Corriedale, WS = White Suffolk, Jo = Jonesdale, Cl = Coolalee, WH = Wiltshire Horn, Crypt = cryptorchids.
[C] Numbers in parentheses refer to models and link to listed equations.

However, the increase in R^2 when C was included in equation lb was no more than when carcass weight was added (equation lb *cf* equation 2a and 3, Table 1). Equation 4 where both C and carcass weight were included provided the best estimate of GR (R^2 = 0.67).

The equations in Table 1 relate to ewe lambs from Poll Dorset sires and the coefficients listed are the adjustments to be made to these equations if other genotypes or sex are involved. The relationship between GR and C was affected by genotype (equations 3, Table 1) and significant negative adjustments ($P<0.01$)

had to be made to the equation for estimation of GR from C for Romney, Corriedale and Wiltshire Horn genotypes (equation 3, Table 1). It is noteworthy that these 3 genotypes also had the lowest mean carcass weights. Inclusion of carcass weight in the regression (equation 4, Table 1) reduced the size of these adjustments (Table 1, equation 4).

The cryptorchids were 3.2 kg heavier than the ewes but GR was only 0.8 mm deeper ($P<0.01$, equations la and lb, Table 1) and when adjustment was made for carcass weight the estimate for GR was 1.8 mm less for cryptorchids than ewes ($P<0.01$, equation 2a, Table 1). Sex did not significantly affect the relationship between GR and C unless carcass weight was included in the relationship (P,0.0 1, equation 4, Table 1).

DISCUSSION

Although the rams used in this project were not necessarily typical representatives of their breed they were separated on the basis of breed because in some cases they were outstandingly different from the 18 rams of the Poll Dorset breed.

Estimations of GR from C using the equation appropriate to estimate GR from C for Poll Dorsets generally gave GR estimates too high for other genotypes. This finding was similar to the results of Hopkins (1990) in a comparison of progeny from Poll Dorsets and Suffolks. As the higher fat is considered a disadvantage, these other genotypes would be at a disadvantage if GR was estimated from C measurements rather than using direct measurements of GR. This disadvantage can be reduced, but not totally removed, by including carcass weight in the equation. As fat measurements are normally adjusted to a common live or carcass weight, the effect of any bias against low weight sire groups is reduced. However, in the case of sex differences, adjustment to a common carcass weight is likely to increase a sex bias, making estimates of GR for cryptorchids appear higher than they really are.

The bias may be associated with a practical problem of discrimination of C fat depth on very lean animals in comparison with GR. It has been considered that C fat depths of O-2 mm represent O-6 mm GR. Where the lambs from a particular sire are very lean there is little variation in C fat depth (O-2 mm) and thus little opportunity for selection as compared with GR. Estimates for GR using equation 3 (Table 1) illustrates the difficulty with these thin animals where the minimum estimate, without adjustment, of GR is 4.8 mm. Adjustment factors for sire, genotype or sex would reduce this only a little and some concern is to be expected when C is measured on lean animals. This concern would be greater for cryptorchids (the leaner sex) and will increase if lambs become steadily leaner as a result of selection.

The equation developed from my data ($GR = 4.8 + 1.15C$; equation 3, Table 1) differs from the approximate relationship suggested by Hopkins (1990) ($GR = 3C$) over the expected range of C. Further investigation and monitoring of this relationship is desirable while C and GR relationships are used as an essential part of LAMBPLAN assessments. All estimations of GR from C should include the weight of the animal in the equation to reduces bias. However, it should be noted that doing this reduces the independence of the fat measure from the carcass weight thus making it more difficult to achieve the selection aims to increase carcass weight while decreasing fat. Further, Hopkins et *al.* (1995) suggested that GR provided better information regarding lean meat content of commercial cuts than C.

In the current work, measurements were made either on carcasses or photographs. In practice C measurements are made live with scanners and are likely to be less accurate. Scanners have a low resolution which results in measurements having a relatively large error (McEwan *et al.* 1984; Waldron *et al.* 1992 and Hopkins *et al.* 1993). This, in particular, exacerbates the problem of accurately discriminating between lean animals on the basis of C measurements. Further, the correlation between carcass measurements and ultrasound scanning measurements have been found to be low (Waldron *et al.* 1992; Hopkins *et al.* 1993) leading Waldron *et al.* (1992) to conclude that they should not be considered as the same traits for selection purposes.

I conclude that there are serious limitations in using measurements of C to estimate GR. Errors in comparisons are likely to be large when sheep being measured differ in breed or sex or are very lean. The current selection criteria for lean animals for breeding should be continually monitored with efforts made to improve the measurement of fat on the live animal.

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REFERENCES

BANKS, R.G. (1990). *Proc. 8th Conf. Aust. Ass. Anim. Breed and Genetics 8: 237-40.*

FRAZER, A.E. (1976). N.Z. Meat Producer 4 (10): 1.

HOPKINS, D.L. (1990). *Proc. Aust. Soc. Anim. Prod.* 18: 493.

HOPKINS, D.L., PIRLOT, K.L., ROBERTS, A.H.K. and BEATTIE, A.S. (1993). *Aust. J. Exp. Agric.* **33:**707- 12.

HOPKINS, D.L., WOTTON, J.S.A., GAMBLE, D.J. and ATKINSON, W.R. (1995). *Aust. J. Exp. Agric. 35:* 161-9.

KIRTON , A.H. and JOHNSON, D.L. (1979). *Proc. N.Z. Soc. Anim. Prod. 39:* 194-201.

KENNEY, P.A., GODDARD, M.E. and THATCHER, L.P. *(1995). Aust. J. Agric. Res. 46:* 703-719.

MCEWAN, J.C., CLARKE, J.N., KNOWLER, M.A. and WHEELER, M. *(1989). Proc. N.Z. Soc. Anim. Prod. 49:* 113-9.

PALSSON, H. (1939). *J. Agric. Sci. Camb. 29: 544-625.*

PAYNE, R.W. and LANE, P.W. (1987). Genstat 5 Reference Manual. (Clarendon: Oxford).

THATCHER, L.P. (1984). *Proc. Aust. Soc. Anim. Prod . 15: 624-7.*

WALDRON, D.F., CLARKE, J.N., RAE, A.L., KIRTON, A.H. and BENNETT, G.L. *(1992). N.Z. J. Agric. Res. 35: 287-98.*