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# Ultrasonic selection for divergence in loin fat depth in Southdowns and Suffolks

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## ABSTRACT

Suffolk and Southdown rams were selected on the basis of high (H) and low (L) ultrasonic fat depths over the loin, adjusted for live weight. Rams were mated to Romney ewes and progeny were slaughtered at 2 ages. Loin fat depth (C) adjusted for carcass weight by  $0.31 \pm 0.09$  mm between progeny from H and L sires. Differences in fat depth over the rib (GR) and kidney fat weight were small but favourable. Southdown crossbreds responded more favourably at C and Suffolk crossbreds more favourably for kidney fat weight and at GR; however, these differences were not significant. Average differences between H and L sired progeny in gains between slaughter ages indicated that fat differences were established by 20 weeks of age and maintained through to at least 30 weeks of age. Differences between breeds in favour of Suffolk crossbreds for growth and carcass leanness were similar to previous reports.

**Keywords** Ultrasonic; fat; selection; sheep; carcass

## INTRODUCTION

Selection for and against live animal loin fat depth has resulted in favourable changes in carcass fat in pigs (Hetzer and Harvey, 1967) and sheep (Fennessy *et al.*, 1982). Success in changing carcass fat depots by selecting on live animal loin fat depth depends on the accuracy of the live animal measurement, the heritability of loin fat depth and its genetic correlation with other fat depots.

This experiment reports on sire selection for increased or decreased ultrasonic loin fat depth in 2 sheep breeds differing in mature size and fatness. Progeny were slaughtered at 2 ages to observe whether fat deposition patterns were altered by selection.

## METHODS

Suffolk and Southdown rams in self-replacing flocks were measured for ultrasonic fat depth over the loin several times between 7 and 18 months of age. Rams born in 1978 were measured in April and November 1979 with a Danscan machine and those born in 1979 were measured in September and November 1980 and January 1981 with a Body Composition Meter. Ultrasonic fat thickness was measured over the loin at the last rib as determined by palpation. Rams born in 1978 were graphically selected for high (H) and low (L) deviations from the live-weight regression line. For each measurement on rams born in 1979, fat depth was expressed as a deviation from the regression on live weight and divided by its standard deviation. The sum of 3 standardised deviations was used to select high and low fat depth rams within each breed.

Fourteen rams were selected in 1980 and 20 rams were selected in 1981. Rams were mated to about 30 Romney ewes each at the Waikeria Youth Centre. Progeny were randomly assigned to early and late slaughter groups and were killed at average ages of 20 and 30 weeks of age. Hot carcass weight (HCW), kidney fat weight (KFW), linear fat depth over the loin (C) and depth over the rib (GR) were measured on each carcass.

The statistical model treated year-breed-fat-selection group (YBF), sex, birth-rearing rank, slaughter group and appropriate 2-way interactions as fixed effects and sires within YBF as random. Covariance was used to adjust weight and carcass data for birthday variation and to adjust carcass traits for HCW variation. Separate HCW and birthday regressions were fitted for different breed, sex, and slaughter groups.

Linear contrasts among YBF constants compared breed, fat-selection, their interaction and the interaction of fat-selection and year. Standard deviations of these contrasts were computed from mean squares for sires within YBF. Linear contrasts among YBF  $\times$  slaughter group constants tested whether breed, fat-selection and their interaction effects changed with age. Residual mean squares were used to compute standard deviations of these contrasts.

## RESULTS

Means of birthday adjusted breed and fat-selection groups averaged over 2 years and both slaughter groups are shown in Table 1 along with breed, fat-selection and interaction contrasts.

**TABLE 1** Age-adjusted means and contrasts for Southdown (SD) and Suffolk (SF) progeny from high (H) and low (L) fat sires.

	Group means				Linear contrasts		
	SD H	SD L	SF H	SF L	SD-SF	H-L	((SD,H)-(SD,L)) -((SF,H)-(SF,L))
Lwt.	30.86	31.29	35.10	34.87	-3.91 ± 0.34*	-0.10 ± 0.34	-0.66 ± 0.68
HCW	13.33	13.53	15.10	15.04	-1.64 ± 0.17*	-0.07 ± 0.17	-0.28 ± 0.34
C	3.03	2.66	3.01	2.82	-0.07 ± 0.13	0.28 ± 0.13*	0.18 ± 0.26
GR	8.81	9.06	9.21	8.92	-0.13 ± 0.30	0.02 ± 0.30	-0.54 ± 0.60
KFW	226.6	246.4	272.7	249.2	-24.6 ± 9.4*	1.8 ± 9.4	-43.1 ± 18.8*

Table 2 presents the same means and contrasts adjusted for differences in HCW.

At the same age, Suffolk sired lambs had 12.6% more live weight and 12.2% more carcass weight than Southdown sired lambs. Fat depths at C and GR were not significantly different between breeds,

trait most closely associated with the live animal criterion. Correlated changes in GR and KFW were small (1 to 2%) but favourable. Live and carcass weights were not appreciably different between lambs from H and L sires. This is to be expected if the between-animal phenotypic regression of ultra-

**TABLE 2** Carcass weight-adjusted means and contrasts for Southdown (SD) and Suffolk (SF) progeny from high (H) and low (L) fat sires.

	Group means				Linear contrasts		
	SD H	SD L	SF H	SF L	SD-SF	H-L	((SD,H)-(SD,L)) -((SF,H)-(SF,L))
C	3.32	2.89	2.75	2.57	0.45 ± 0.10*	0.31 ± 0.09*	0.25 ± 0.18
GR	9.68	9.78	8.42	8.13	1.46 ± 0.23*	0.10 ± 0.21	-0.39 ± 0.42
KFW	254.7	263.4	248.9	228.2	20.5 ± 8.8*	6.0 ± 8.0	-29.4 ± 16.0

but Southdown sired lambs had 10.9% less kidney fat. When adjusted to the same carcass weight, Suffolk sired lambs had less fat depth at C and GR and less kidney fat.

Average differences between lambs from H and L sires were about 10% for C fat depth, the carcass

sonic measurement on live weight is similar to the within-animal genetic regression.

The interaction contrast comparing selection in Southdown cross lambs and selection in Suffolk cross lambs indicated a tendency for a more favourable response at C in Southdown cross lambs and

**TABLE 3** Means and contrasts for Southdown (SD) and Suffolk (SF) progeny from high (H) and low (L) fat sires at early (E) and late (T) slaughter ages.

	Age	Group means				Linear contrasts		
		SD H	SD L	SF H	SF L	(SD,T-E) -(SF,T-E)	(H,T-E) -(L,T-E)	Interaction
Lwt.	E	27.81	27.86	31.09	30.59	-1.81 ± 0.42*	-0.65 ± 0.42	-0.22 ± 0.86
	T	33.91	34.72	39.11	39.15			
HCW	E	11.82	11.80	13.18	13.04	-0.67 ± 0.22*	-0.31 ± 0.22	-0.25 ± 0.44
	T	14.85	15.26	17.02	17.04			
C	E	1.95	1.69	1.84	1.59	-0.33 ± 0.15*	0.06 ± 0.15	0.39 ± 0.30
	T	4.13	3.63	4.18	4.05			
GR	E	6.19	5.93	5.93	5.87	-0.58 ± 0.35	-0.28 ± 0.35	-1.48 ± 0.72*
	T	11.43	12.19	12.49	11.97			
KFW	E	145.3	155.5	166.3	150.5	-33.1 ± 10.9*	-2.0 ± 11.0	-34.2 ± 22.2
	T	307.9	337.3	379.2	348.3			

more favourable responses for GR and KFW in Suffolks. This tendency was only significant for KFW adjusted for age.

Interactions of selection with year were small and not significant for weight-adjusted carcass traits. Average differences between progeny from H and L sires were 0.30 and 0.32 mm at C, 0.09 and 0.11 mm at GR and 2 and 11 gm KFW for the first and second year, respectively. This indicated that the 2 selections were similar in their effectiveness.

Means of age-adjusted traits at the 2 slaughter ages are shown in Table 3. Linear contrasts test whether the average differences in Table 1 change with age. Alternatively, they may be interpreted as differences between breeds and sire selection in changes between the 2 slaughter ages.

Suffolk sired lambs gained more live weight, HCW and KFW and increased depths at C and GR more between the 2 slaughter ages than did Southdown sired lambs. Changes between slaughter ages did not significantly differ between lambs from H and L sires. However, selection appeared to have more favourable results for KFW and GR in Suffolk crosses and for C in Southdowns. This interaction of breed and selection on change between slaughter ages was only significant for GR. These differences in selection between breeds on gains between 20 and 30 weeks of age are similar to the interactions of breed and selection averaged over ages.

## DISCUSSION

The overall results show that ultrasonic selection for loin fat depth in 6 to 18 month old sheep resulted in lambs that differed favourably at C. Averaged across breeds, favourable but small and statistically unreliable differences also occurred at GR and for KFW. Fennessy *et al.* (1982) reported differences of 0.38 mm at C and 0.54 mm at GR between high and low fat progeny averaging 13.5 kg. While the difference at C is similar, the change at GR reported by Fennessy *et al.* (1982) was larger, although the difference is probably not statistically significant. Based on genetic correlations calculated from Southdown cross lambs slaughtered at about 14 kg carcass weight (authors' unpublished data), a difference of 0.31 mm at C should result in differences of 0.23 mm at GR and 1 gm KFW. These predictions compare favourably with the correlated responses observed.

Differences between the breeds, showing Suffolks to be heavier at the same age and leaner at the same weight, agree with many previous findings. Carter *et al.* (1974), Coop *et al.* (1979), Kirton *et al.* (1974), Meyer *et al.* (1978) and Walker (1949) have found differences of 8 to 15% in weight and 10 to 20% difference in carcass fatness.

While there were apparent differences at different fat depots and ages between breeds in their response to selection, these were generally statistically unreliable. Geenty *et al.* (1979) reported large but non-significant differences in allometric growth coefficients of chemical or physical carcass components between sires. However, depositional differences resulting from different selection methods have been demonstrated in laboratory animals (see Roberts, 1979).

Selection against loin fat depth on the basis of ultrasonic measurement appeared to be successful in reducing carcass loin fat depth. Its ability to produce changes of practical importance at other fat depots requires further evaluation.

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