
VOLUME 62 2002

Evaluation of muscling using Texel and Oxford cross Romney and Hight Romney lambs

A.H. KIRTON, G.J.K. MERCER, J.N. CLARKE, J.L. DOBBIE, D.M. DUGANZICH AND J.A. WILSON

AgResearch, Ruakura Agricultural Centre, Private Bag 3123, Hamilton.

ABSTRACT

Muscling is considered important by the New Zealand meat industry. As Texel cross lambs contain more muscle than most other sheep genotypes, a muscling trial was undertaken using Texel and Oxford cross and Hight Romney mixed sex lambs. Eighteen lambs were slaughtered from each breed. The muscle, bone, subcutaneous and intermuscular fat were separated from the leg and shoulder of the 54 right sides. The leg comprised on average 64.4% lean in the Hight Romneys, 66.2% in the Oxford cross lambs and 67.4% in the Texel cross lambs ($p<0.05$). The corresponding figure for shoulder lean 58.8% (Romney), 59.9% (Oxford) and 62.1% (Texel)($p<0.05$). The eye muscle area (cm^2) for these lambs was 9.8 (Romney), 11.0 (Oxford) and 11.7 (Texel). The muscle:bone ratio (weights) for 4 leg muscles to the femur were 7.0 for the Romneys, 7.6 for the Oxford and 8.3 for the Texel cross lambs ($p<0.10$). Only 2 non Texel lambs were classed E under the European classification system.

Keywords: lamb; muscling; carcass muscle; fat; bone.

INTRODUCTION

Muscling has always been considered of importance by the meat industry but has lacked clarity of definition. The same word has been used to describe different things. Muscling has been associated with conformation, muscularity and fleshiness which have been separately defined in Europe (Kempster *et al.*, 1982). Purchas *et al.*(1991) using a European definition for muscling of average muscle depth per unit bone length, proposed an objective method of measuring it. Ratios of some muscles to total muscle mass have been used to separate normal cattle from those defined as double muscled (Shahin *et al.*, 1991). Muscle:bone ratios have also been used as indicators of desirable carcass muscle characteristics as has relative muscle longissimus thoracis et lumborum cross sectional area (eye muscle area - EMA).

Overseas trials indicate that the Texel and Texel cross lambs have a higher proportion of carcass muscle and lower proportion of fat than other breeds (Kirton and Morris, 1989). The present trial was aimed at comparing different indicators of carcass muscle over Texel and Oxford cross Romney and Hight (yearling weight growth selection) Romney lambs.

METHODS

Animals

A sample of Texel Romney, Oxford Romney and Hight Romney (Johnson *et al.*, 1995) mixed-sex (ewe and short scrotum ram) lambs representing the progeny of 3 rams per genotype were selected for dissection studies from a trial which also involved larger numbers of other lambs. The carcasses of three lambs/sire/genotype (9 per genotype) were chosen at 3 months of age and the same number at 7 months old (18/genotype). In addition, right sides from carcasses of all lambs of these genotypes as well as Wiremu and Romney weaning weight selection strains were minced and sampled for proximal chemical analyses.

Muscling

A European conformation grade (E,U,R,O, and P) was placed on all carcasses by the senior author and the Meat Board E and export carcass classes were allotted by an export grader.

Dissection

For detailed shoulder dissection, weights of supraspinatus, infraspinatus, total muscle, subcutaneous fat, intermuscular fat, bone and waste were recorded. For the leg, weights of rump, biceps femoris, semitendinosus, quadriceps femoris (knuckle), semimembranosus plus cap (topside), gastrocnemius, subcutaneous fat, intermuscular fat and kidney/pelvic fat, and bone were taken, together with a separate weight and length of the femur. The total longissimus and psoas major muscle weights were recorded as well as the length of the former muscle. The longissimus cross sectional area (EMA) was measured from a tracing taken where sectioned between the loin and rack.

Statistical analysis

The residual maximum likelihood (REML) procedure within Genstat 5 statistical package (Genstat 1990) was used to analyse the data; the fixed model comprised genotype, sex, age group, birth/rearing rank and the genotype by age group interaction. Sire variation was fitted as a random effect except when its variance component was set to zero by the REML procedure. When making adjustments to the same hot carcass weight, hot carcass weight and its interaction with age group were added as fixed effects.

Means presented in table 1 are averaged over sex, birth/rearing rank and age group. The average standard error for differences between genotypes is given with the significance of genotype effect. This was obtained using the F test to compare the residual variation from the model before and after genotype had been dropped from the fixed model.

RESULTS AND DISCUSSION

Neither subjective method for assessing carcass shape (MLC or NZ Meat Producers Board) suggested any differences between genotypes in the proportion of E type carcasses, a result in line with British observations (Kempster *et al.*, 1982). There were 22% Romney, 71% Oxford cross and 61% Texel cross E+U MLC type carcasses, a result partly influenced by carcass weight which was higher for the latter two groups.

TABLE 1: Mean measurements taken on 18 lambs from each of 3 genotypes averaged over 2 slaughter ages.

Measurement	Genotype			SED	Significance
	Hight Romney	Oxford x Romney	Texel x Romney		
Hot carcass (kg)	15.0	17.6	18.3	1.18	+
Eye muscle area (cm^2)	9.8	11.0	11.9	0.99	ns
% shoulder lean	58.8	59.9	62.1	1.11	*
% shoulder fat	22.8	21.9	20.8	1.43	ns
% shoulder bone	15.9	15.6	15.0	0.59	ns
% leg lean	64.4	66.2	67.4	0.99	*
% leg fat	18.3	16.6	15.9	1.17	+
% leg bone	14.5	14.3	13.6	0.52	ns
Longissimus muscle (g)	372	434	481	30.0	*
% muscles 1 to total muscle[1]	30.9	30.6	31.3	0.43	ns
% muscles 2 to total muscle[2]	6.8	7.3	6.5	0.18	*
Infraspin. % shoulder lean	8.9	10.1	8.7	0.42	*
Leg & shoulder musc./bone	4.1	4.3	4.6	0.16	+
Purchas muscularity coef.	0.47	0.49	0.49	0.016	ns
Muscularity coef. 2	7.00	7.60	8.34	0.447	+
% carcass ether-extract	22.9	23.0	21.4	1.15	ns

+ = p<0.10

muscles 1 = Longissimus muscle + biceps femoris + semitendinosus + topside

muscles 2 = Infraspinatus + gastrocnemius

muscularity coefficient 2 = (semitendinosis + topside + biceps femoris + quadriceps femoris)/femur weight

Table 1 provides information on the lambs of the different genotypes when slaughtered at the same age. Crossbred lambs sired by the larger mature sized breeds (Oxford and Texel) had heavier carcasses than the straight Romneys. Despite carcass weight differences, the Texel cross lambs had a higher proportion of lean in the legs and shoulders than the Romneys with the Oxford cross lambs intermediate. This advantage was enhanced by the indications of the lower fat and bone (ns) content of the Texel joints. This muscle advantage of the Texel cross lambs followed through to heavier longissimus muscles and larger EMA (ns).

Four muscles shown to be hypertrophied in double muscled cattle (Shahin *et al.*, 1991: muscles 1) were related to the total muscle weight recorded (from leg, shoulder plus remaining longissimus and psoas major) and showed no indication of increased proportions in any of the genotypes studied. However 2 muscles showing an indication of being reduced in proportion in the same double muscled cattle (muscles 2) formed a lower proportion of total muscle weight in the Texel cross than the Oxford cross. The infraspinatus formed a lower proportion of shoulder muscle lean in the Texel cross than the Romney with the highest proportion in the Oxford Romney cross.

When the leg + shoulder muscle weights were related to bone weights in these same joints the ratios for the Texel cross were higher than for the Romney with the Oxford cross intermediate (p<0.10). Similarly, the weights of 4 discrete muscle groups to femur weight (muscularity coefficient 2) showed that the Oxford cross lambs had higher ratios than the Romney lambs with the Texel cross lambs having highest ratios. The weights of the topside, biceps femoris, semitendinosus and quadriceps femoris together with femur length were used to calculate a Purchas muscularity coefficient (average muscle depth per unit length). There were no differences between genotypes in this index.

Because it is known that weight has an important influence on carcass composition (heavier carcasses of any genotype tend to be fatter and better muscled), comparisons were also made after adjusting for differences in hot carcass weight. Breed then had no effect on longissimus muscle weight or cross sectional area. However, leg and shoulder differences in composition increased following weight adjustment with the Texel cross having most muscle and least fat (p<0.05) and the adjustment increasing the fat content of the Romney joints when compared with the Texel cross. The leg + shoulder muscle to bone ratios gave slightly higher values for the Texel cross lambs compared with the Romney lambs and the muscularity 2 coefficient was no longer significant (p>0.10).

One of the changes resulting from the carcass weight adjustment on the 54 dissenters was the confirmation of a genotype effect on carcass ether-extract (p<0.05) although the effect on water (indicator of muscle) was not significant (p>0.12). However, when the carcass weight adjusted proximal analyses of all 224 lambs in the trial (from which the 54 dissenters were selected) were analysed, the genotype effect on water difference became significant (p>0.05) with the Texel cross lambs averaging 56.6% and the Hight Romneys 53.5% water.

SUMMARY

This trial confirms overseas (review - Kirton and Morris, 1989) and New Zealand (Clarke et al., 1988) results showing that Texel cross lambs have a higher proportion of muscle and is in agreement with trials (Kempster et al., 1981; Ward et al., 1992) showing better conformation and muscularity and higher muscle:bone ratios for Texel crosses compared with Oxford cross lambs. Results provide no indication that carcass conformation criteria will select Texel cross carcasses in line with overseas experience (Kempster et al., 1982). In the current comparison the Texel cross had the highest muscle:bone ratios. While muscles shown to be hypertrophied in double muscled cattle were not shown to be increased in the Texel cross lambs in this trial, muscles shown to be hypotrophied in double muscled cattle formed a lower (p<0.05) proportion in the Texel cross than the Oxford cross. The muscularity coefficients used in this trial did not differ between genotypes.

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