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Growth and carcass traits of purebred Texel and Suffolk sheep

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ABSTRACT

Purebred Texel and Suffolk sheep have been grazed together at Belclare in Ireland since 1977. The Texel sheep originated from the Netherlands and are of similar origin to those imported into New Zealand. A series of studies have been undertaken to examine the growth and carcass composition of the 2 breeds.

Relative to the Suffolk the Texel has an altered growth pattern; Texel lambs were 19% heavier at birth than Suffolk lambs after adjustment for non-genetic effects, but by weaning were 8% lighter (29.08 *v* 31.76 kg) and the difference increased to 11% at 2.4 years of age. The difference between the Purebred Texel and Suffolk weaning weights is approximately double the value that has been reported in large scale crossbreeding trials. Wool production in the Texel was 12 to 22% higher than the Suffolk breed depending on age.

Carcass composition data from 2 separate slaughter trials, using ram lambs, show that the purebred Texel has less subcutaneous fat as a proportion of the carcass than the Suffolk with 75 *v* 112 g/kg for 18.6 kg carcasses in the first trial and 34 *v* 80 g/kg and 83 *v* 125 g/kg when killed at 17.3 and 26.1 kg carcass weight in the second trial. When expressed as a percentage these breed differences are approximately double the values observed in crossbreeding trials.

The Texel carcasses also had larger *L. dorsi* areas and less fat in the internal depots. The food efficiency in the Texel breed was better in the 2 experiments where it was measured, with the differences being significant in 1 trial. Breed differences in composition persisted to maturity with adult Texels having only 78, 81 and 90% of the weight of subcutaneous, kidney knob, and channel and omental fat deposits relative to the Suffolk.

In vivo ultrasonic measurements distinguished similar changes in carcass composition between the breeds with C, GR and estimated *L. dorsi* in purebred Texels being 85, 78 and 111% of Suffolk ewe and ram lambs. The corresponding figures for adult ewes were 79, 83 and 107%.

The carcass composition of most sheep breeds are very similar when expressed as a proportion of mature live weight. The data presented suggests that the Texel is a typical having a modified growth curve and retaining its extreme carcass composition even at maturity.

Keywords Sheep; breeds; Texel; Suffolk; carcass composition; mature size; ultrasonic; *L. dorsi.*

INTRODUCTION

Overseas crossbreeding trials have identified the Texel sheep as the breed with the best ability to produce lean heavy carcasses (Wolf *et al.*, 1980; More O'Ferrall and Timon, 1977; Kempster *et al.*, 1987). The need to reduce the fat content of New Zealand lamb carcasses has resulted in the recent importation of this breed to New Zealand by 2 separate organisations. However in contrast to the wealth of information available on Texel crossbreds, there is a paucity of published information regarding the productive characteristics of purebred Texels particularly in comparison with English derived breeds.

Information from these purebred comparisons would be valuable for 3 reasons; firstly information on the growth and carcass characteristics of the Texel purebreds, in conjunction with the crossbred results, would assist in predicting the outcome of various crosses and interbreds including Texel genes. Secondly, because the Texel purebreds are likely to have the most extreme carcass composition of all known sheep breeds, they are useful for investigating

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possible correlated changes occurring after selection for lean meat proportion or content. Finally Texels provide an important resource to investigate the physiological and biochemical pathways which may be involved in controlling the growth and partitioning of nutrients into the various carcass components.

At Belclare in Ireland purebred Texel and Suffolk flocks are grazed together and the following series of studies were undertaken to investigate the unique characteristics of Texel sheep.

METHOD

Experiment 1

Purebred Texel and Suffolk sheep have been grazed together since spring 1977 at Belclare in Ireland. The ewes are single sire mated with most of the rams originating from industry sources. The flocks are fully recorded at lambing and live weights and fleece weights are recorded regularly. The animals are first shorn at 1.2 years of age. The Texel sheep in Ireland are derived from imports from the Netherlands in 1964 and 1972 and as such are likely to be similar to recent imports into New Zealand. The data which consisted of all the ewe and lamb records from the 1977 to 1984 years, were analysed in 2 groups; for the lambs born in 1977 to 1984, the birth to 14 weeks of age information was analysed by fitting a least squares model (Harvey, 1977) which included fixed effects terms for year of birth, breed, age of dam, birth and rearing rank and birthday. In contrast, adult ewe and hogget records from 1979 to 1984 were analysed by least squares, which included fixed effects for breed, year of record, ewe age and parity. The sums of squares of the individual ewe effect was estimated by absorption and used to test for breed differences. While it is recognised that some of the individuals included in the ewe analysis were not born when the flocks were grazed together, it was felt that similar previous management and subsequent compensation since the flocks have been run together would not invalidate comparisons.

Experiment 2

As part of a larger experiment, (Fitzsimons *et al.*, 1984) the Texel and Suffolk ram lambs born in 1984 were randomly allocated to either a treatment involving immunisation with a somatostatin-human serum albumin conjugate (supplied by Glaxo UK PLC) or a placebo. Treatments commenced at 3 weeks of age, lambs were weaned at 5 weeks, individually penned at 6 weeks and subsequently fed a concentrate diet. Individual intakes were recorded over a 10 week period and lambs were slaughtered and carcasses dissected when they reached approximately 38 kg.

The data obtained were analysed by least squares methods. Fixed effects fitted included breed and treatment, with carcass weight a covariate in the carcass composition data. The somatostatin treatment had little or no effect, only significantly reducing carcass length, so the mean values of the 2 treatments are presented in Table 2 as the breed differences.

Experiment 3

As part of a larger experiment (Hanrahan *et al.*, 1986), the Texel and Suffolk ram lambs born in 1985 were randomly allocated to 1 of 3 treatments; (i) an initial slaughter group at 5 months of age, (ii) treated with the β-agonist, Cimaterol® (supplied by Boehringer Ingelheim VetMedica), (iii) a placebo treated group. The placebo and Cimaterol® groups were individually fed a concentrate ration indoors for 40 or 47 d prior to slaughter. The Cimaterol® (0.1 mg/kg live weight/d) was administered to the treated group in a molasses supplement mixed with the feed each morning with drug treatment being withdrawn 5 d prior to slaughter. Feed intakes were recorded daily during the trial period.

The information obtained was analysed by least squares methods. Fixed effects included breed and treatment, while day of birth was used as a covariate. Carcass traits were also adjusted for the effect of carcass weight and where necessary first order interactions were also included in the tabulated data. The Cimaterol® treatment had marked effects on growth and carcass traits so the data presented here are adjusted to the untreated group estimates.

Experiment 4

Adult Texel and Suffolk sheep of both sexes (5 per breed by sex subclass) were slaughtered to investigate differences in carcass composition in mature animals. The animals were mainly 4 years of age or older but some 2.5-year-old animals were also included. The ewes had been grazed together throughout their life and the rams had either been grazed together or managed under similar conditions. Several months prior to slaughter the animals were housed and fed 1.5 kg whole barley/head/d plus silage *ad libitum*. The data collected were analysed using least squares methods, fitting effects of breed, sex and the breed by sex interaction. Where appropriate carcass weight was also included as a covariate.

Experiment 5

The purebred Suffolk and Texel flocks maintained at Belclare were measured in July and September with real-time β-mode ultrasonic scanners. A Seimens machine (loaned by Seimens Ltd; Dublin) was used in July and a Vetscan (loaned by Farm Relief Services, Roscrea) in September, both machines using 11.5 cm length transducer heads operating at approximately 3 MHz. The animals were clipped closely and vegetable oil applied in the region of the last rib. Offsets (water filled bags) were used to prevent the ultrasonic head distorting the region of interest. When a suitable display was obtained, the picture was frozen, distances being measured with in-screen calipers.

The data collected were analysed by least squares methods. Due to culling, deaths and flock replacement policies a proportion of the animals present in September were not present in July and vice versa.

RESULTS AND DISCUSSION

Experiment 1 (Table 1)

The results from the analysis of the flock live weight data are consistent with the hypothesis that Texel sheep have an altered pattern of growth compared to the Suffolk breed. The Texels were 19% heavier at birth than the Suffolk but grew more slowly subsequently, being 8% lighter at weaning and 11% lighter at 2.4 years of age. The 17% difference in older ewes should be viewed with caution due to possible disparities in survivial and culling practices between the breeds.

Wool production is higher in the Texel breed than the Suffolk with estimates ranging from 12 to 22% depending on age.

While in the present experiment the maternal and milk producing ability of the breeds are confounded with their progeny's genetic propensity for growth, the 8 (SE = 2.3)% lower weaning weight in the Texel relative to the Suffolk is approximately double the crossbred differences of 3.4 % reported by More O'Ferrall and Timon (1977) and 6.1 (0.88)% reported by Wolf *et al.* (1980).

The altered pattern of growth in the Texel is consistent with changes occurring in *double muscled* cattle (Menissier, 1982) and after selection for less fat content using ultrasonics in sheep (Owens *et al.*, 1986). This alteration in the growth pattern may be a characteristic of all lean sheep and cattle strains or breeds. The estimate of 11 to 17% lower live weights at maturity in the Texel breed relative to the Suffolk from this study is considerably larger than the 4%

TABLE 1 Mean live weights and greasy fleece weight (kg) of Texel and Suffolk sheep from birth to maturity (Experiment 1[1])

Parameter	Breed: Texel	Breed: Suffolk	Av SEM	Texel/Suffolk (%)
Live weight				
Number of ewe and ram lambs	149	263		
Age (weeks)				
0	5.05	4.26	0.08	119
5	14.39	14.30	0.24	101
10	23.44	24.77	0.41	94
14	29.08	31.76	0.50	92
Number of ewes[2]	115	146		
Age (years)				
0.4	45.4	48.0	1.1	95
1.4	60.4	68.3	1.0	88
2.4	65.3	73.1	1.0	89
3.4 to 7.4[3]	67.7	81.8	0.8	83
Fleece weight				
Number of ewes[2]	107	127		
Age (years)				
1.2	3.64	3.12	0.10	117
2.2	2.75	2.25	0.12	122
3.2	2.87	2.39	0.13	120
4.2 to 8.2[3]	2.68	2.39	0.95	112

[1] Lamb data adjusted for effects of year of birth, age of dam, birth/rearing rank and birthday with adult ewe data adjusted for year of record, ewe age and parity.

[2] Total number of animals; numbers in age sub-groups may differ slightly.

[3] Due to differences in culling and survival these estimates should be viewed with caution.

obtained from flock survey data (Cameron and Drury, 1985).

Experiments 2 and 3 (Tables 2, 3, 4)

In Experiment 2 there was little difference in growth rates between the breeds and the Texel lambs were heavier at the finish of the growth measurement phase of the trial. In contrast, in Experiment 3 the Texel sheep were lighter than the Suffolks and grew more slowly, but in both cases the animal numbers were too small to detect differences of the magnitude estimated in Experiment 1.

As it is more energetically efficient to deposit lean meat rather than fat (Van Es, 1977), the Texel breed should be more efficient than the Suffolk when compared under conditions of rapid growth. The feed efficiency results from Experiments 2 and 3 *support* this hypothesis; with the differences being significant in Experiment 2. However these observations should be extended to a wider range of growth rates and stages of maturity.

The Texels had consistently lower carcass fat contents and fat depths in both experiments; Texels had 33 (SE = 9.7)%, 57 (13.7)% and 34 (7.60)% less subcutaneous fat than Suffolks in Experiment 2 and the initial and final slaughter of Experiment 3 respectively. Comparable figures for total dissected fat from crossbred lambs are approximately one half the purebred difference at 12 (1.8)% by Kempster *et al.*, (1987), and 15 (1.8)% by Wolf *et al.* (1980), while More O'Ferrall and Timon (1977) had 17% less chemical fat in the 6th rib cut. The Texels also had lower fat contents in the internal depots (omental and kidney knob and channel fat) than the Suffolks,

TABLE 2 Mean Texel and Suffolk growth rate, feed efficiency and carcass traits in entire male lambs (Experiment 2[1])

Parameter	Breed		Av SEM	Slope[2]	SEM
	Texel	Suffolk			
Number of lambs	12(11)[3]	16(15)	—	—	—
Growth rate (g/d)	240	240	9	—	—
Geed efficiency[4]	0.27	0.23	0.01	—	—
Live weight (kg)	35.5	34.2	1.3	—	—
Subcutaneous fat (g/kg)[5]	75	112	8	3.9	1.9

[1] Animals killed when reached approximately 38kg. Carcass traits adjusted to 18.6kg hot carcass weight.
[2] Regression slope:units/kg carcass weight.
[3] Number of lambs for carcass traits in parenthesis.
[4] kg gain/kg food.
[5] g/kg in the half carcass.

TABLE 3 mean Texel and Suffolk live weight and carcass traits in the entire male lambs (Experiment 3, initial slaughter[1])

Parameter	Breed		Av SEM	Slope[2]	SEM
	Texel	Suffolk			
Number of lambs	5	4	-	-	-
Pre-slaughter weight (kg)	35	42	3	-	-
Hot carcass weight (kg)	17.6	19.9	1.8	-	-
Subcutaneous fat (g/kg)[3]	34	80	7	5.0	1.2
Chemical fat (g/kg)[3]	145	200	9	13.4	1.4
Omental fat (kg)	0.15	0.25	0.05	0.044	0.008
KKCF[4] (kg)	0.18	0.25	0.02	0.034	0.004
C (mm)	1.2	2.3	0.5	0.14	0.09
GR (mm)	4.4	7.0	1.4	0.50	0.24
L. dorsi (cm^2)	15.0	10.9	0.9	0.30	0.15

[1] Errors derived from a larger data set; carcass traits adjusted to a mean hot carcass weight of 17.3 kg.
[2] Regression slope:units/kg carcass weight.
[3] g/kg in the half carcass.
[4] Kidney knob and channel fat.

the percentage differences being similar but somewhat smaller than the differences in subcutaneous fat content.

The area of the cut surface of the *L. dorsi* between the 12th and 13th ribs was larger in the Texel than the Suffolk lambs and this may be partly due to the Texel lambs significantly shorter carcasses with longer legs than Suffolks as well as having a higher content of lean meat when compared at the same carcass weight.

The breed regressions with carcass weight were consistently lower in the Texel for the fat

TABLE 4 Mean Texel and Suffolk growth rates, feed efficiency and carcass traits in the entire male lambs (Experiment 3, terminal slaughter[1])

Parameter	Breed		Av SEM	Slope[2]	Approx. SEM
	Texel	Suffolk			
Number of lambs	12(11)[2]	10	-	-	-
Growth rate (g/d)	323	359	23	-	-
Feed efficiency[2]	0.23	0.20	0.01	-	-
Pre-slaughter weight (kg)	52	56	3	-	-
Hot carcass weight (kg)	26.8	28.7	1.7	-	-
Subcutaneous fat (g/kg)[2,3]	83	125	6	5.9	1.0
Chemical fat (g/kg)[2]	195	228	9	3.0	1.1
Omental fat (gk)[3]	0.51	0.74	0.07	0.051	0.011
KKCF (kg)[2,3]	0.60	0.78	0.05	0.056	0.012
C (mm)[3]	3.0	4.6	0.5	0.35	0.08
GR (mm)	12.3	16.4	1.0	1.10	0.15
L. dorsi (cm^2)[3]	19.4	17.8	0.7	0.18	0.10

[1] Errors are derived from a larger data set; data are adjusted for slaughter group and birthday and so as to be untreated with Cimaterol while carcass traits are also adjusted to a mean hot carcass weight of 26.1 kg.
[2] Meaning as in Table 2.
[3] Breed by carcass weight interaction significant; values tabulated from a model including this term.

TABLE 5 Mean live weights, carcass weight, and carcass traits of mature Texel and Suffolk sheep (Experiment 4[1])

Parameter	Sex	Breed		Av SEM	Slope[2]	SEM
		Texel	Suffolk			
Number of sheep	M	5	5			
	F	5	5			
Live weight (kg)	M	78	94			
	F	83	76	5	-	-
Hot carcass weight (kg)	M	37	46	3	-	-
	F	42	35			
Subcutaneous fat[3] (g/kg)	M	77	119	13	3.5	1.0
	F	161	184			
KKCF (kg)[4]	M	0.70	0.85	0.27	0.067	0.022
	F	1.66	2.08			
Omental fat (kg)	M	0.91	0.95	0.28	0.062	0.023
	F	1.87	2.15			
C (mm)	M	1.8	5.0	1.4	0.18	0.12
	F	7.8	9.0			
GR (mm)	M	8.7	14.4	1.7	0.45	0.14
	F	18.9	19.4			
L. dorsi (cm^2)	M	22.2	20.2	1.3	0.41	0.11
	F	18.6	17.4			

[1] Carcass traits are adjusted to the mean carcass weight of 40.9 kg.
[2] Regression slope:units/kg carcass weight.
[3] g/kg in the half carcass.
[4] Kidney knob and channel fat.

measurements, the differences being significant for several traits in the terminal slaughter of Experiment 3. The differences in the regression slopes were of a size that they only changed the magnitude but not the sign of the breed differences over the range of carcass weights present in the trial. As an example the regression slope for subcutaneous carcass fat proportion was lower in the Texels than the Suffolk breed, in the terminal slaughter of Experiment 3, at 2.65 *v* 7.88 (SED = 1.83) g/kg per kg carcass weight in the Suffolk breed.

Experiment 4 (Table 5)

There was a signifcant sex by breed interaction for live weight and carcass weight in this experiment with the Suffolk breed showing the expected 30% sex difference in favour of the males. However, Texel males had slightly lower live weights and carcass weights than ewes of the same breed. This finding is at variance to the results of Experiment 1 and is likely to be the result of a random sampling variation rather than a real effect. After adjustment for carcass weight sex had a significantl effect on the fat measurements, with males having only 57, 41 and 46% of the females subcutaneous, kidney knob and channel and omental fat depots respectively. In contrast the breed effects were smaller, with the Texels having 22 (8.4)% less subcutaneous fat than the Suffolks being the only significant difference. The breed differences in subcutaneous fat content,

TABLE 6 Mean live weight and ultrasonic measurements of fat depth and *L. dorsi* area in adult ewes (Experiment 5[1])

Parameter	Breed: Texel	Breed: Suffolk	Av SEM	Slope[2]	SEM
No. ewes — July	41	44	-	-	-
No. ewes — Sept.	49	47	-	-	-
Live weight (kg) — July	66	68	1	-	-
Live weight (kg) — Sept	68	74	1	-	-
C fat depth (mm) — July	3.7	4.9	0.4	0.08	0.03
C fat depth (mm) — Sept	4.0	4.8	0.4	0.13	0.04
GR thickness (mm) — July	10.2	12.9	1.1	0.26	0.08
GR thickness (mm) — Sept	10.9	12.4	0.9	0.43	0.08
L. dorsi area[3] (cm^2) — July	16.6	15.7	0.7	0.10	0.05
L. dorsi area[3] (cm^2) — Sept	16.1	14.9	0.6	0.16	0.05

[1] Live weights have been adjusted for age and previous lactation status while ultrasonic measurements have been adjusted to a mean live weight of 65.2 kg in July and 69.3 kg in September.
[2] Regression slope: units/kg live weight.
[3] Estimated as 0.77* length* width (P.F. Fennessy, unpublished).

TABLE 7 Mean live weight and ultrasonic measurements of fat depth and *L. dorsi* area in lambs (Experiment 5[1])

Parameter	Breed: Texel	Breed: Suffolk	Av SEM	Slope[2]	SEM
No. ewes — July	27	33	-	-	-
No. ewes — Sept.	21	22	-	-	-
Live weight (kg) — July	36	38	1.2	-	-
Live weight (kg) — Sept	43	47	1.3	-	-
C fat depth (mm) — July	2.2	2.5	0.1	0.03	0.02
C fat depth (mm) — Sept	3.9	4.7	0.3	0.16	0.05
GR thickness (mm) — July	6.7	7.5	0.4	0.35	0.06
GR thickness (mm) — Sept	10.3	14.4	0.8	0.35	0.12
L. dorsi area[3] (cm^2) — July	12.2	10.9	0.3	0.25	0.05
L. dorsi area[3] (cm^2) — Sept	16.0	14.5	0.6	0.24	0.09

[1] Body weights adjusted for sex, rearing rank and age while scan measurements were also adjusted to the mean body weight of 37.3 kg in July and 45.8 kg in September respectively.
[2] Regression slope: units/kg live weight.
[3] Estimated as 0.77* length* width (P.F. Fennessy, unpublished).

whether expressed as percentages or absolute values, are not significantly different for Experiments 2, 3 and 4, although the breed difference is smallest in the latter experiment.

These results suggest that Texels are still leaner at maturity than Suffolks, with sex having a larger effect on carcass composition than breed. Due to the unexpected breed by sex interaction for body weight and carcass weight, the present results will need to be validated by further studies.

Experiment 5 (Tables 6 and 7)

This experiment was undertaken to confirm the carcass results in Experiments 2, 3 and 4 on a larger sample of animals than were available for slaughter. This was possible due to the non-destructive nature of ultrasonic measurements.

The experiments in this paper have compared breed composition differences on a constant live weight (or carcass weight) basis as it was felt that this was most appropriate given the nature of the data and also because it consistently produced the smallest residual errors. Inspection will show that as the Texels were lighter at maturity (11% from Experiment 1 if the figure at 2.4 years of age is used) comparisons at the same proportion of maturity would accentuate the differences in fat content between the Texel and Suffolk breeds while reducing the differences in *L. dorsi* area. This is obviously at variance with McClelland and Russel's (1972) proposal. The inclusion of the regression coefficients with live weight in the tables will allow other comparisons to be calculated if desired.

Clearly the Texel breed has an altered growth curve when compared to the Suffolk breed, being relatively heavier at birth and lighter at maturity. The Texel also has markedly less fat in the carcass and internal organs than the Suffolk with the differences persisting to maturity. As such the Texel is apparently an exception to the general pattern of carcass composition at a given weight being related to mature size of the sheep breed. Where breed comparisons were available, differences in growth and carcass composition were approximately double in the purebred comparisons relative to the crossbred results.

In the adult ewes the breed differences in live weight were similar to the results of Experiment 1, with the Texels having 6% lower live weights than the Suffolks. The live weight adjusted C, GR and estimated *L. dorsi* measurements in the Texel breed averaged 79, 83 and 107% compared to the Suffolks. Corresponding values in Experiment 4 were 69, 82 and 109%. In the lambs the live weight adjusted C, GR and estimated *L. dorsi* measurements in the Texel breed averaged 85, 78 and 111% of the Suffolk values respectively, corresponding values in the terminal slaughter of Experiment 3 were similar at 65, 75 and 109%. In summary, the breed differences observed with the ultrasonic measurements were broadly similar to the carcass fat measurement results. However, the differences were somewhat smaller for the C measurement and in this case it may have been due to the distances measured being small relative to the intrinsic accuracy of these machines.

CONCLUSIONS

It was proposed by McClelland and Russel (1972) that if breeds and strains of different mature size were slaughtered at the same degree of maturity then the fat proportion would be similar. However due to the cost and long term nature of the experiments needed to define mature size, few experiments have been conducted examining this proposal. In support of this hypothesis Cameron and Drury (1985) reported high correlations between slaughter age, carcass weight and mature size of the sire when the carcasses were compared at the same subcutaneous fat proportion, after pooling the results of 3 crossbreeding trials involving 15 sire breeds. Cameron and Drury (1985) also noted that the Texel crosses were an apparent deviation from this rule. Similarly Thompson *et al.* (1985) compared ewes and rams from strains selected for low and high weaning weight and found that the carcass proportion differences between strains and sexes were reduced, but not eliminated, when compared as a proportion of mature weight, rather than on a constant live weight basis.

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