An evaluation of the association between prion-protein genotype and Lean Meat Index of pedigree Suffolk, Texel and Charollais sheep.

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Introduction

Polymorphisms in the amino acid sequence of prion protein (PrP) play a major role in determining whether individual sheep are susceptible or resistant to scrapie following exposure to infectivity. Three particular polymorphisms are strongly associated with the occurrence of both experimental and natural scrapie. Only 5 of the 12 possible combinations of these polymorphic positions have been found in sheep populations. These alleles are denoted as ARQ, ARR, ARH, AHQ and VRQ. The effect of these alleles on resistance is in the order ARR > AHQ > ARH > ARQ > VRQ. Homozygous ARR animals are generally considered to be resistant to scrapie. The VRQ allele is rare in most breeds and the most frequent susceptible allele in Irish sheep populations are ARQ and ARH. The European Commission have decided that breeding programmes for increased resistance to scrapie must be established in all member states in 2004; the ultimate objective is to eliminate the susceptible alleles. Any implication of this breeding programme for all important production traits need to be examined. In particular information is required on any associations between PrP genotype and the growth and carcass traits that comprise the Lean Meat Index (LMI) which represents the breeding objective of the Pedigree Sheep Breed Improvement Programme (PSBIP) operated by the Department of Agriculture and Food in conjunction with pedigree breeders. The present study involved an evaluation of the relationship between PrP genotype and performance of lambs recorded under the PSBIP in flocks representing the principal terminal sire breeds in this country.

Materials and Methods

Pedigree flocks of the Suffolk, Texel and Charollais breeds that were participating in the PSBIP in 2002 were identified and the largest flocks were invited to participate in the study. A random sample of lambs (~40) born within a 3-week interval in 2002 was identified within each participating flock, subject to constraints on representation of sires and dams. Blood samples were collected for DNA extraction and subsequent genotyping for the PrP locus. A supplementary set of genotype information for PrP locus for the period prior to 2002 was extracted from records on PrP genotyping at UCD (T. Sweeney, unpublished) and matched with PSBIP data files. Performance data collected in 2002 under PSBIP and the estimated breeding values from the 2003-analysis of PSBIP data were matched with genotype data. Data were analysed by least squares procedures using PROC GLM of SAS to fit a model with effects for flock, sex, rearing type, age of dam, birth date and regression on the number of ARR alleles carried. Similar analyses were done for the pre-2002 animals in the supplementary data set.

Results and Discussion

The number of animals with PSBIP information and PrP genotype are shown in Table 1 for both the main and supplementary datasets. The regression coefficients for performance traits and the Lean Meat Index on number of ARR alleles carried are given in Table 2. These show that there was no significant relationship between liveweight at 120 days of age (LWT), ultrasonic fat depth (UFD) or ultrasonic muscle depth (UMD) and number of ARR alleles. There was a significant ($P<0.01$) positive relationship with the LMI in both the Suffolk and Charollais breeds. This reflected significant positive relationships with breeding values for LWT and UMD, respectively. The significant association with

Table 1 Details on number of animals used.

Breed	Data set	
	Born 2002	Born pre-2002
Suffolk	429 (11)[§]	402 (60)
Texel	519 (16)	174 (75)
Charollais	383 (9)	106 (34)

[§]No. of flocks represented

LMI in Suffolk sheep was not confirmed in the analyses of the supplementary dataset but the Charollais data again yielded a significant ($P<0.05$) positive regression coefficient. The supplementary data for the Texel breed again yielded a non-significant relationship. The overall pattern of results is consistent with the absence of any significant effect of substituting an ARR allele for an ARQ allele in crossbred progeny sired by purebred rams from each of these breeds (Casey et al. 2004).

Table 2 Regression coefficients (±s.e.) for various traits on number of ARR alleles carried

Trait	Breed		
	Suffolk	Texel	Charollais
LWT (kg)	-0.4 ± 0.52	0.2 ± 0.47	-0.0 ± 0.45
UFD (mm)	-0.1 ± 0.08	0.0 ± 0.05	0.0 ± 0.05
UMD (mm)	-0.2 ± 0.22	0.0 ± 0.24	0.1 ± 0.23
LMI (units)	8.0 ± 2.87	0.6 ± 2.34	6.1 ± 2.02

Conclusions

The significant relationships detected were all relatively small relative to the variation in the traits in question and are of little consequence for the aims of the PSBIP. The corollary is that implementing the EU programme to increase scrapie resistance in the national flock does not appear to have any negative implications for the performance of either pedigree of commercial sheep producers, in terms of growth rate or carcass composition.

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References

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