

Evaluation of the effects of scrapie (PrP) genotype on lamb growth and carcass traits in commercial production systems

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Introduction

Susceptibility to scrapie in sheep is strongly associated with polymorphisms of the PrP gene. The ARR allele is associated with resistance while the ARQ allele is associated with increased susceptibility (Hunter, 1997). Scrapie susceptibility is generally defined as the ability of an individual animal to develop characteristic, neurological signs of disease, which is ultimately fatal (Goldmann and Hunter, 2003). Selection for the favourable ARR allele is desirable due to the growing concern about the possible relationship between scrapie in sheep, BSE in cattle and CJD/vCJD in humans. The EU Commission requires the initiation of a breeding programme for resistance to scrapie in all member states for the 2004 breeding season. This study is part of a project designed to evaluate the effects of a selective breeding programme for the ARR allele on lamb performance in commercial production systems. The three main terminal sire breeds in Ireland were used.

Materials and Methods

The study was designed to provide direct estimates of the effects of substituting an ARQ allele with an ARR allele on lamb growth and carcass traits. Pedigree rams (14 Suffolk, 8 Charollais and 8 Texels) were obtained for mating in autumn 2002. The rams were purchased in pairs from pedigree breeders, with one member being ARR homozygous and the other being ARQ homozygous. The members of a pair were by the same sire, where possible, so as to minimise any confounding of PrP genotype and genetic merit for performance traits. Six flocks were used for progeny testing, four of which were commercial flocks. A minimum of 4 rams (2 pairs) were tested per flock. In each flock ewes were assigned at random to individual mating groups (at least 40 ewes per group) and rams were randomly assigned to these groups. For the commercial flocks the individual sire groups were maintained for at least 21 days to ensure that sufficient ewes were mated to yield at least 45 lambs with growth data for each sire.

All progeny were tagged and weighed at birth, weighed again at ca. 35, 98 and 130 days of age and fat and muscle depth over the loin was measured using ultrasonography on the latter 2 dates. These two measurements were used to estimate live-weight (LWT), ultrasonic muscle depth (UMD) and ultrasonic fat depth (UFD) at 120 days of age for each lamb. These are the traits used in the Pedigree Sheep Breed Improvement Programme (PSBIP) operated by the Department of Agriculture and Food to calculate the Lean Meat Index. Flock managers selected lambs for slaughter when judged suitable for the export market and sent for slaughter at a single export plant. The abattoir provided individual carcass weight and classification data (EUROP system). Carcass

conformation classes (E,U,R,O,P) were mapped to numerical values (5,4,3,2,1) for statistical analysis. The PSBIP traits, carcass traits and growth rate to weaning (G_014) were analysed by least squares procedures using a model with effects for flock, flock×breed-of-sire, individual sire within flock×breed, sex, rearing type and dam age. The differences between ARR/ARR and ARQ/ARQ sires were obtained by appropriate linear contrasts within each breed of sire and sire within breed was the experimental unit.

Results and Discussions

The estimates of the effects of substituting an ARR allele for an ARQ on growth rate to 98 days (G_014), and LWT, UMD and UFD are shown in Table 1.

Table 1. Effect of genotype of sire (ARR/ARR minus ARQ/ARQ) on growth traits

Trait	Breed of sire		
	Suffolk	Charollais	Texel
G_014 (g/day)	-3.3±5.19	-16.4±9.36	0.7±6.60
LWT (kg)	-0.8±0.88	-1.9±1.58	0.3±1.12
UFD (mm)	0.0±0.04	0.1±0.08	0.0±0.05
UMD (mm)	-0.5±0.30	0.1±0.55	0.2±0.38

The results in Table 1 show that substituting an ARR allele for an ARQ allele had no effect on the traits measured, for any of the three breeds. The rather large estimate for the effect on growth rate (-1.9 kg for LWT) for the Charollais breed reflects an exceptionally large difference (3.6 kg) for one of the pairs of sires. This difference had a considerable effect on the overall results for the breed.

The results for carcass traits, based on data for most of the flocks involved, yielded a mean carcass weight of 19.2 kg with >70% in conformation class R and >90% with a fat score of 3. There was no evidence for any effect of PrP genotype on carcass weight, conformation or fatness.

Conclusions

The data support the hypothesis that substituting an ARR allele for an ARQ allele has no important negative effect on lamb growth or carcass traits in any of the breeds examined. Consequently it is concluded that the planned breeding programme based on the selection for the ARR allele will not affect any of the traits used in the PSBIP. The current experiment is being repeated in 2004 and a further 32 rams have been selected and used for mating.

References

- Hunter, N (1997) In 'The Genetics of Sheep', p 225-240 (eds L. Piper and A Ruvinsky)
- Goldmann, W and Hunter N. (2003) Conference on methods for control of scrapie, 15 & 16 May 2003, Oslo, Norway