GENETIC PARAMETERS FOR DAIRY AND GROWTH TRAITS IN DUAL-PURPOSE SHEEP

N. Carolino[1], A.S. Lopes[2] and L.T. Gama[1,3]

[1] Estação Zootécnica Nacional, 2000-763 Vale de Santarém, Portugal
[2] D.R.Ag. Trás-os-Montes, R. República, 5370 Mirandela, Portugal
[3] Instituto Superior de Agronomia, Tapada da Ajuda, 1300 Lisboa, Portugal

INTRODUCTION

In Portugal, as in many other Mediterranean countries, sheep are frequently used for both meat and milk production. In most production systems, ewes are milked after a suckling period of at least 30-45 days, with lambing taking place in late Fall-early Winter, and lactation/milking proceeding until early summer.

The production level observed in many of the dual-purpose sheep breeds found in Mediterranean countries is often low (Astruc and Barillet, 2000), but these breeds play a major role in rural development, and their conservation has been recognized as a major priority. Improvement by selection of these breeds could contribute to their better competitiveness, but selection should consider their particular abilities and the limitations imposed by the production systems under which they are raised.

The Badana breed is a dual-purpose sheep breed raised in Northern Portugal, characterized by coarse-wool and a small mature size. Production abilities of this breed have been reported elsewhere (Lopes *et al*., 1996).

Genetic parameters for meat and dairy traits in sheep have been well documented (e.g. reviews by Banks, 1997 and Barillet, 1997), but the possible correlations between growth and milk traits are an essential part of a breeding program aimed at the genetic improvement of a dual purpose breed (McLintock and Cunningham, 1974).

The objectives of this work were to study the genetic variability of dairy and meat traits in the Badana sheep breed, considering both direct and maternal influences on lamb's weight.

MATERIALS AND METHODS

Animals and data. Data consisted of milk recording information and lamb weights collected in the Badana flock raised in the Valongo research station (Mirandela, Portugal) between 1984 and 2001. The flock is kept on pasture most of the time, and supplemented as needed. Single-sire mating is praticed and two lambing seasons are defined, i.e. September-October and January-February. Lambs are raised with their dams until an average age of 43 days, and ewes are milked afterwards, up to an average lactation length of 165 days.
Lamb information considered in this study consisted of birth weight (BW), and adjusted weights at 45 (W45) and 70 (W70) days of age. Corresponding number of records was 2395, 2164 and 1247, respectively. Milk recording took place according to ICAR recommendations

(ICAR, 1992) and the traits analysed were milk yield after weaning (MY), fat content (FC), protein content (PC), fat yield (FY), protein yield (PY) and usefull yield (UY=FY+PY). All dairy traits were calculated acording to a standard lactation length of 120 days. Dairy production information was between 1990 and 2001, and included 1107 lactations of 403 ewes.

Statistical analyses. Genetic parameters were first estimated with a univariate animal model by Restricted Maximum Likelihood, using the MTDFREML package (Boldman *et al*., 1993), and a convergence criterion of 10^{-9}. For lamb weights, the model included the fixed effects of year of birth, month of birth, sex of the lamb, litter size and age of dam, and the random influence of direct genetic effect, maternal genetic effect, litter effect and permanent environmental effect associated with the ewe, plus a residual effect. Dairy traits were analysed with a model including the fixed effects of year of lambing, month of lambing, age of the ewe, type of lambing and days in milk at first milk recording (linear covariate) ; random factors considered were the direct genetic effect, permanent environmental effect and residual. All known pedigrees were considered, such that the relationship matrix included 2443 and 518 animals for the analysis of growth and dairy traits respectively.

In order to study possible relationships between maternal ability and dairy performance, a bivariate analysis was then conducted between W45, MY and UY, with models for each trait as defined for the univariate analyses.

RESULTS AND DISCUSSION

Results from univariate analyses are summarized in Table 1. Even though mean production levels were low for both growth and milk, the phenotypic variation observed was very high, especially for MY and UY.

Table 1. Descriptive statistics and genetic parameter estimates from the univariate analyses[A]

Trait	Mean	Phenotypic SD	h^2_a	h^2_m	r_{am}	c^2	l^2
BW	3.20	0.57	0.09	0.35	-0.34	0.01	0.42
W45	12.95	2.23	0.20	0.30	-0.46	0	0.24
W70	16.16	3.31	0.10	0.20	-0.29	0	0.09
MY	37.92	22.32	0.47	-	-	0.18	-
FC	8.32	1.19	0.30	-	-	0.11	-
PC	5.42	0.70	0.26	-	-	0.16	-
FY	3.10	1.78	0.46	-	-	0.17	-
PY	2.02	1.14	0.46	-	-	0.16	-
UY	5.12	2.90	0.47	-	-	0.17	-

[A] h^2_a : heritability of direct effects ; h^2_m : heritability of maternal effect ; r_{am} : correlation between direct and maternal effects ; c^2 : permanent environmental effects in successive lambings ; l^2 : within-litter effect.

Heritability estimates for weights at birth, 45 and 70 days of age indicated a much larger influence of the maternal component, wich was negatively correlated with genetic direct effect in all ages considered, in general agreement with results reported by Maria *et al*. (1993) for Romanov sheep. The within-litter component was quite important, while permanent environmental effect in repeated lambings were negligible.

Estimates of heritability for dairy traits were about 0.45 for quantitative traits, and somewhat lower for fat and protein contents. These results are in disagreement with those reported in the review by Barillet (1997), where contents tend to have a higher heritability than yield. Legarra and Ugarte (2001) also report a low heritability for fat content in Latxa sheep.

Genetic parameter estimates, obtained from bivariate analyses, were in Table 2. Heritability estimates for dairy traits were very close to those obtained from univariate analyses, while for W45 the heritability of direct effect was somewhat lower. As expected, MY and UY showed a very strong genetic correlation. Considering this result and the fact that both traits have similar heritabilities but MY is easier and cheaper to measure, it can be argued that selection for MY alone could be at least as effective in improving UY as direct selection for this trait.

Table 2. Heritabilities (diagonal) and genetic correlations (above diagonal) from bivariate analyses

	MY	UY	$W45_a$	$W45_m$
MY	0.50	0.98	-0.08	0.36
UY		0.52	-0.07	0.38
$W45_a$			0.16	-0.41
$W45_m$				0.30

The genetic correlation between milk production after weaning (MY) and the maternal component involved in weaning weight ($W45_m$) was 0.36. This indicates that the correlation between milk production before and after weaning is not perfect, and factors other than milk yield might be involved in maternal influences on weaning weight. Nevertheless, this positive genetic correlation indicates that both maternal ability and milk yield can be improved simultaneously, a concern of major importance in a dual-purpose breed such as the Badana breed. The fact that there is no strong genetic antagonism between milk yield and genetic direct effect for weaning weight reinforces this idea.

CONCLUSION

The results of this study indicate that genetic variability for dairy traits in the Badana sheep breed is high, and selection for milk yield can be expected to result in an improvement of both usefull yield (fat and protein) and maternal ability for weaning weight, with no negative correlated responses in genetic direct effect for this trait.

REFERENCES

Astruc, J.M. and F. Barillet. (2000) *Proc. 32nd Biennial Session of ICAR* EAAP Publication . **98** : 289-306.

Banks, R.G. (1997) “The genetics of sheep” p 505-522 L. Piper and A. Ruvinsky, Eds., CAB International, Oxford, UK.

Barillet, F. (1997) “The genetics of sheep” p 539-564 L. Piper and A. Ruvinsky, Eds.,. CAB International, Oxford, UK.

Boldman, K.G., Kriese, L.A., Van Vleck, L.D. and Kachman, S.D. (1993) "A manual for use of MTDFREML". USDA, ARS.

ICAR (1992) "International regulations for milk recording in sheep". Institut de l’Elevage, Paris.

Legarra, A. and Ugarte, E. (2001) *Anim. Sci*. **73** : 407.

Lopes, A.S., Gama, L.T. and Carolino, N. (1996) *Colectânea SPOC*. **7.**

Maria, G.A., Boldman, K.G. and Van Vleck, L.D. (1993) *J. Anim. Sci*. **71** : 845.

McClintock, A.E. and Cunningham, E.P. (1974) *Anim. Prod*. **18** : 237.