VARIABILITY IN GASTROINTESTINAL PARASITE RESISTANCE AND PRODUCTIVITY IN ANGORA GOATS

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SUMMARY

Data were collected from 430 Angora kids over a period of 2 years for estimation of genetic parameters for production traits, and phenotypic correlations between production and gastrointestinal parasite (GIP) resistance. Mohair traits were moderately heritable (0.37 to 0.55), with generally higher heritability estimates than for body weights (0.19 to 0.24). Faecal egg count had negative and low phenotypic correlations with body weight at all ages of measurements (-0.14 to -0.22). The correlation between other potential marker traits for resistance (Ab, EOS & PCV) and productivity were inconsistent and close to 0.
Keywords: Angora goats, phenotypic correlation, heritability, gastrointestinal parasite, Mohair

INTRODUCTION

Knowledge of genetic and phenotypic parameters is essential for implementation of genetic improvement programs in farm animals. The rate of genetic progress, development of selection indices and optimization of selection all depend on these parameters. The desired aim of a selection program for worm resistance would be to increase the animal's resistance to worm infection with minimum adverse effects on the genetic improvement of production traits. Most investigators have reported no strong *phenotypic* association between FEC and productivity in sheep. Reported *genetic* correlations between FEC and growth rate in sheep vary from strongly favourable (Bishop *et al.* 1996), through moderately favourable or neutral (Eady 1998) to moderately unfavourable (McEwan *et al.* 1995), with the majority of correlation estimates being negative. In goats, such relationships have been less intensively studied and the consequences of selecting goats for increased resistance to gastrointestinal parasites on growth and fleece traits are unclear. The aim of this study was to estimate genetic parameters for production traits, and phenotypic correlations between production and traits possibly reflecting parasite resistance to GIP (FEC, EOS, Ab and PCV) in Angora kids.

MATERIALS AND METHODS

Production and parasite-related data used for the analysis were collected from 430 mixed sex kids of 10 Angora bucks on a commercial property in the Northern Tablelands of New South Wales (NSW) Australia over a 2-year period. Dams were randomly joined in March each year to 6 bucks in 6 separate single sire paddocks, with 2 of the sires in the first year serving as link sires in the second year.

Parasite -related traits. All kids were exposed to natural nematode infection from birth up to an average age of 19 weeks, with anthelmintic treatment at 12 and 19 weeks of age. At 20 weeks of age, that is 1 week after anthelmintic treatment, all kids were challenged with an oral dose of 10,000 infective L_3 larvae of *T. colubriformis*. The traits measured were faecal egg count (FEC) at 12, 19, 25 and 26 weeks of age. The measurement at 25 and 26 weeks represent 28 and 35 days post artificial challenge. Specific antibody (IgG) directed against *T. colubriformis* larval antigens (Ab), blood eosinophil counts (EOS) and packed cell volume (PCV) were measured at 8, 12, 19 and 25 weeks of age.

Production traits. The production variables measured were (a). M*ohair* at first shearing (25 weeks of age). Greasy fleece weight (GFW) was recorded and optical fibre diameter analyser (OFDA 100, BSC Electronics, Perth, WA) was used to determine mean fibre diameter (MFD), coefficient of variation of fibre diameter (CVD), % medullated (%MED) and % Kemp fibres; and (b). *Body weights* (Wt) at birth and average ages of 4, 8, 12, 19 and 25 weeks.

Statistical analyses. Preliminary data analyses were carried out to explore significance of fixed effects using S-PLUS software (MathSoft 1999). The fixed effects investigated were year of birth, type of birth, sex and age. The phenotypic correlations, calculated from the ratio of residual covariance and the product of residual standard deviations of the two traits were estimated from bivariate analyses using ASREML (Gilmour *et al*. 1999) fitting a model with significant fixed effects. Estimates of heritability for all traits were obtained fitting the same fixed effects and sire as a random effect in a univariate analysis using ASREML (Gilmour 1999).

RESULTS AND DISCUSSION

Summary statistics. Table 1 shows the number of records available, the mean and the standard deviation for body weights from birth up to average age of 25 weeks, and for Mohair production and quality traits at first shearing (25 weeks of age) in Angora kids.

Table 1. Number of records, means and standard deviations for production traits in Angora

Traits	N	Mean	Std Dev.	Range
Body weight, kg				
Average Age (weeks)				
Birth	207	3.2	0.5	2.0 – 4.4
4	427	8.5	2.2	3.0 – 14.5
9	222	12.9	2.7	4.6 – 20.8
12	430	13.6	2.7	6.6 – 21.2
19	421	16.5	3.2	7.7 – 24.8
25	412	17.0	3.2	8.7 – 25.2
Mohair at 25 weeks (6 months)				
Greasy Fleece weight (GFW), kg	408	1.0	0.2	0.1 – 1.6
Mean fibre diameter (MFD), µm	416	22.4	1.6	17.9 – 7.5
Coef of variation (CVD), %	416	29.4	2.8	22.2 – 42.0
Medullation (MED), %	416	0.8	0.5	0 – 2.5
Kemp, %	416	0	0.01	0 – 0.02

Test of fixed effects. All the fixed effects investigated were significant (P<0.01) for Wt, except that year of birth had no significant effect (P>0.05) on Wt at 5 and 6 months of age. For Mohair all fixed effects were significant (P<0.05) for GFW, all except sex for MFD, only age for CVD, sire and age for %MED and none for %KEMP.

Heritability estimates. The heritability estimates for mohair traits and body weight are shown on the diagonals of Tables 2 and 3, respectively. The estimates were moderate (0.33 to 0.55) for all the fleece traits except for % kemp (0.03), while the estimates for body weights ranged from 0.15 to 0.26. Our heritability estimates for GFW, MFD and CVD for Angora goats conform well to other estimates, which range from 0.10 – 0.50 (Pattie *et al.* 1990; Gifford *et al.* 1991; Sumner and Bigham 1993; Bishop and Allain 2000). However, all the estimates were lower than estimates for similar traits in Merino sheep (Cloete *et al*. 2002). All estimates had very high standard error (0.06 to 0.26) due to the small size of the data set.

Table 2. Heritability (s. e.) on diagonals and phenotypic correlation estimates of Mohair traits at 6 months

Traits	GFW	MFD	CVD	%MED	%KEMP
GFW	**0.33** (0.19)	0.23	-0.07	0.01	0.02
MFD		**0.55** (0.26)	-0.13	0.07	0.07
CVD			**0.38** (0.19)	0.28	0.05
%MED				**0.37** (0.20)	0.16
%KEMP					**0.03** (0.06)

Phenotypic correlation. The phenotypic correlations amongst the fleece traits and body weights are shown on Tables 2 and 3 respectively. The phenotypic correlations between fleece traits were generally positive (except for the negative correlation between GFW & CVD, and MFD & CVD) and low. The positive relationship between fleece weight and fibre diameter is undesirable when the objective is to increase fleece weight while reducing the fibre diameter. Body weights from 4 weeks of age were highly and positively correlated with later body weights (0.64 to 0.97), but birth weight was poorly correlated with other body weights (0.24 to 0.54). Phenotypic correlations between production and GIP resistance traits are shown in Table 4. The relationships between FEC and body weights were low and negative ranging from -0.14 to – 0.22. This suggests that heavier kids shed fewer worm eggs per gram of faeces than lighter kids. The correlations between body weight and PCV were positive and low (0.08 to 0.23), indicating a higher PCV in heavier kids. Body weights were also, positively but weakly correlated with EOS (0.02 to 0.13).

Table 3. Heritability (s. e.) on diagonals and phenotypic correlation estimates of body weights in Angora kids

Body weight	Birth	4 weeks	9 weeks	12 weeks	19weeks	25 weeks
Birth	**0.24** (0.21)	0.37	0.54	0.30	0.33	0.24
4 weeks		**0.15** (0.12)	0.87	0.79	0.70	0.64
9 weeks			**0.20** (0.18)	0.97	0.87	0.81
12 weeks				**0.26** (0.17)	0.92	0.85
19 weeks					**0.20** (0.11)	0.95
25 weeks						**0.19** (0.12)

There was no consistent relationship between body weight and Ab. The strength of the relationships increased generally with age for all the traits except for Ab. There were no consistent relationships between the mohair and parasite-related traits.

Table 4. Phenotypic correlation between parasite-related and production traits

Body weights and parasite-related traits		Mohair and parasite-related traits	
Wt12: FEC12	-0.14	GFW25: FEC25	-0.05
Wt19: FEC19	-0.17	GFW25: PCV25	-0.07
Wt25: FEC25	-0.22	GFW25: Ab25	0.01
Wt8: PCV8	0.08	GFW25: EOS25	-0.07
Wt12: PCV12	0.16	MFD25: FEC25	-0.13
Wt19: PCV19	0.23	MFD25: PCV25	0.07
Wt25: PCV25	0.23	MFD25: Ab25	-0.08
Wt8: Ab8	-0.15	MFD25: EOS25	0.01
Wt12: Ab12	-0.01	CVD25: FEC25	0.07
Wt19: Ab19	0.01	CVD25: PCV25	-0.11
Wt25: Ab25	0.06	CVD25: Ab25	-0.03
Wt8: EOS8	0.02	CVD25: EOS25	-0.05
Wt12: EOS12	0.06		
Wt19: EOS19	0.12		
Wt25: EOS25	0.13		

This study showed that genetic variation exists for production traits in Angora kids and that the heritability estimates are higher for fleece traits than for body weight and GIP resistance traits (h^2 of 0.10 to 0.24 reported for FEC at different ages in the same goat population; (Olayemi *et al.* 2002). The phenotypic relationships suggest that kids with lower FEC tend to have better growth performance and PCV. Genetic correlations are relevant for the breeding program, and need to be estimated based on more data, which is expected later on in this project. If genetic correlations are also negative, inclusion of FEC in selection indices would be needed to avoid unfavourable genetic trends for resistance when selecting for production traits. Moderate heritability for FEC and weak to moderate correlations with production traits suggest that joint improvement of both is possible within goat breeding programs.

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