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Estimates of heritability of and correlations for milk and growth traits in Zaraibi goat

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Abstract

A total of 2363 lactation records obtained from 975 does progeny of 99 sires and 571 dams were collected from October 1995 to October 2003. Milk traits were, total milk yield (TMY), milk yield at 90 days (MY90) and lactation period (LP). Growth traits data were collected from 6755 Zaraibi kids progeny of 110 sires and 1331 dams during the period from 1990-2003. Measured growth traits were weight at birth (WB), 90 days (W90-D), 180 days (W180-D), 365 days (W365-D) of age, pre-weaning daily gain (PRW) and post weaning daily gain (PSW). Mixed model methodology based on a multi-trait animal model was used to estimate genetic and phenotypic parameters.

Heritability estimates for milk production traits showed that the milk yield traits have moderate heritability while, lactation period was low, the same pattern was found for the repeatability estimates for milk yield traits as that for heritability. The estimate of repeatability for total milk yield was 0.43 and was 0.33 for milk yield up to 90 days. Genetic correlation was high for TMY with MY90 and LP being 0.89 and 0.80, respectively, and low between MY90 and LP (0.46). Phenotypic correlations were moderate for the milk production traits except between MY90 and LP which was low (0.14).

The relatively high estimate of heritability for total milk yield indicates that selection for this trait will be effective especially with the high and positive genetic correlation between this trait and other milk production traits.

For growth traits, heritability estimates of body weights showed a decreasing trend from WB to W365-D and for daily gains. Genetic correlations were low between W365-D and each of PRW and PSW being 0.40 and 0.26, respectively and high between PRW and PSW being 0.99. Phenotypic correlation was generally low for all studied growth traits except between pre and post weaning traits which was high.

The substantially higher genetic correlation (0.99) between PRW and PSW indicate that selection for the PRW trait will improve the PSW trait as well and selection can be made at an early stage of age

Keywords: *Multiple traits, animal model, genetic parameters, growth and milk production traits, Zaraibi goat*

Statistical analysis

Data were analyzed using Multi-Trait Animal Model program (MTDFREML) of Boldman et al. (1993) to estimate genetic parameters and variance components with Best Linear Unbiased Prediction (BLUP) methodology.

The assumed model for milk production traits was:

$$Y= X\beta + Z_a a + Z_c c + e \qquad \text{(Model 1)}$$

Where,

Y is vector of observations;

X the incidence matrix for fixed effects;

β the vector of an overall mean and fixed effects of litter size, season of kidding, doe parity and year of kidding

Z the incidence matrix for random effects;

a the vector of animal additive genetic effect;

c the vector of permanent environmental effect ;and

e the vector of random errors ~ N (0, R) assumed normally distributed with 0 mean and variance σ^2_e.

The assumed model growth traits was:

$$Y = X\beta + ZU+ e \qquad \text{(Model 2)}$$

Where,

Y the vector of observations;

X the incidence matrix for fixed effects;

β the vector of an overall mean and fixed effects of type of birth, gender of kids, age of doe and year-season of birth;

Z the incidence matrix for random effect (direct genetic effect);

U the vector of additive genetic effect; and

e the vector of random errors ~ N (0, R) assumed normally distributed with 0 mean and variance σ^2_e.

Results and discussions

Milk production traits

The overall mean of TMY was 263.0 kg, 135.8 kg for MY90 and 262 days for LP. Estimates of additive genetic and permanent environmental variance for milk production traits are shown in Tables 1.

Genetic Parameters

Heritability estimates for milk production traits are presented in Table 1. The results showed that the milk yield traits have moderate heritability while, lactation period was low. The same pattern was found for the repeatability estimates for milk yield traits as that for heritability. The estimate of repeatability for total milk yield was 0.43 and was 0.33 for milk yield up to 90 days.

Table 1. Estimates of heritability (on diagonal), genetic correlations (above diagonal)and phenotypic correlations (below diagonal) for TMY, MY90 and LP.

Traits	TMY	MY90	LP
TMY	**0.35**	0.89	0.80
MY90	0.67	**0.27**	0.46
LP	0.70	0.14	**0.15**
Additive genetic variances	2045.12	284.45	582.89
Environmental variances	4258.30	4258.30	3148.19

The genetic and phenotypic correlations amongst the milk production traits are shown in Table 3. Results of genetic correlation show high and positive estimates especially between total milk yield trait and each of milk yield up to 90 days and lactation period (0.89 and 0.80). The phenotypic correlations among milk production traits were moderate (Table 3) and show the same trend for the genetic correlation. However, it was low between milk yield up to 90 days and lactation period being 0.14.

Growth traits

The overall means for studied growth traits were 2.0, 10.7, 16.0 and 24.2 kg for WB, W90-D, W180-D and W365-D, respectively and 96.8 and 60.0 g/d for PRW and PSW, respectively.

Genetic Parameters

The heritability estimates of body weights showed a decreasing trend from WB to W365-D and for daily gains (Table 2). Heritability estimates for all studied weight traits are lower than those for the same breed (Shaat et al., 2005) and Mekkawy, 2000). The differences in heritability estimates could be due to the different methods were used for the estimation and the population sampled. The Preliminary analysis of the data used in this study showed that the single trait analysis by using MTDFREML programme resulted in higher estimates of heritability than when using the multi trait analysis. There are strong positive genetic correlations among late weight traits (W90-D, W180-D, and W360-D). However, genetic correlation was moderate between weights at birth (WB) with late weights (Table 2)

The high genetic correlation (0.99) between the daily gain traits indicate that genes responsible for the phenotypic expression of pre-weaning daily gain were also responsible for expression of post-weaning daily gain. Therefore, selection for the PRW trait will improve the PSW trait as well and selection can be made at an early stage of age.

Table 2. Estimates of heritability (on diagonal), genetic correlations (above diagonal) and phenotypic correlations (below diagonal) for Zaraibi growth traits.

Traits	WB	W90-D	W180-D	W365-D	PRW	PSW
WB	**0.21**	0.42	0.47	0.62	0.18	0.10
W90-D	0.13	**0.16**	0.77	0.82	0.47	0.33
W180-D	0.21	0.59	**0.12**	0.77	0.41	0.29
W365-D	0.25	0.50	0.62	**0.12**	0.40	0.26
PRW	0.11	0.37	0.29	0.33	**0.33**	0.99
PSW	0.11	0.02	0.30	0.32	0.99	**0.28**
Additive genetic variance	**0.06**	**0.85**	**0.78**	**0.78**	**0.09**	**0.03**
Environmental variance	**0.21**	**4.53**	**5.75**	**5.83**	**0.17**	**0.07**

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