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Heritability Estimates of Birth and Weaning Weights in Saanen, Bornova and Saanen x Kilis Goats

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Abstract: Heritabilities for birth and weaning weight of 127 Saanen, 140 Bornova and 80 Saanen x Kilis crossbred kept in the Experimental Farm of Faculty of Agriculture, Ege University, İzmir, Turkey were estimated. Restricted Maximum Likelihood (REML) technique was used to estimate variance components. Heritabilities for birth and weaning weight were 0.43 and 0.05, respectively.

Key words: Heritability, birth weight, weaning weight, goat

INTRODUCTION

Genetic improvement is an integral part of many goat development programmes in the tropics and undeveloped country, where breeding policies mostly aim to upgrade local goats by crossbreeding with, either temperate or tropic exotic breeds[1-7]. Breeding based on selection, utilising the variability within a population to upgrade the population, is less often in such programmes. This is due to availability of apparently superior stock from elsewhere and due to difficulties in running field based performance recording. Where local goat breeds are involved, the flocks are mainly kept in state or university farms, in which low numbers of animals and management constraints limit selection intensity and genetic progress. The potential of genetic improvement is largely dependent on the heritability of the trait and its genetic relationship with other traits of economic importance. Information on heritabilities is essential for predicting response to selection and for planning efficient breeding programmes. In Turkey, goats are raised for mainly milk and meat production[8-11]. Therefore, growth traits such as birth and weaning weight are important. Body weight and daily gain are the most economically important and easily measured traits of milk animals[12-14]. Although weight is an important selection objective, knowledge of the phenotypic and genetic parameters of the growth traits based on selection is of utmost importance. Genetic and phenotypic parameter estimates are scarce for goat reared in Turkey, especially in West Anatolia conditions.

The aim of this study was to estimate heritabilities of growth traits for Saanen, Saanen x Kilis and Bornova breeds raised in the Experimental Farm of Faculty of Agriculture, Ege University, İzmir, Turkey.

MATERIALS AND METHODS

In this study, body weights at birth and weaning of 127 Saanen, 140 Bornova and 80 Saanen x Kilis crossbred were obtained.

Saanen goat, known all over the world, is a Swiss dairy breed[15]. Bornova goat was obtained in Faculty of Agriculture, Ege University. This genotype is a crossbred of White German (25%), Maltase (25%) and Anglo-Nubian genotypes (50%)[10]. Kilis goat is a local dairy breed and raised in South East Anatolia[9]. All kids were identified at birth. Sexes, birth type, birth of month and year, age of dam and pedigree information of kids were recorded individually. Weights were obtained by using a scale discriminating 0.1 kg after 12 h feed restriction (removal) period. Animals were kept at Ege University, Faculty of Agriculture, Department of Animal Science Research Station. Kids were reared with their dam until 60±5 days of age. Free suckling was allowed. All kids were weaned at 60±5 days of age. After two weeks of age, kids were encouraged to consume roughage alfa alfa and concentrate mixer feed as *ad libitum* to stimulate their ruminal activity. Concentrate feed was containing 16% crude protein and 2600 kcal kg^{-1} ME.

Animal model Restricted Maximum Likelihood (REML) analyses were used to estimate heritabilities, using a mixed model by DFREML computer program written MEYER[16].

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Model used in the analysis: $Y = X b + Z u + e$

Where, Y is a vector of birth or weaning weight,
X is design matrix corresponding to the fixed effects,
b is a vector of fixed effects,
Z is design matrix corresponding to random effects,
u is a vector of animal's additive genetic effects with mean = 0 and variance = σ^2_u,
e is a vector of random errors with mean = 0 and variance = σ^2_e and covariance's assumed = 0.

The fixed effects in the model were age of dam (2, 3, 4 or 5), genotype (Saanen, Bornova or Saanen x Kilis), sex (male or female), month of birth (February or March), year of birth (1994, 1995, 1996 or 1997), type of birth (single, twin, 3 or 4) for birth weight. In addition to these factors birth weight was included as covariate for weaning weight analysis.

Preliminary analysis has shown that the factors except year of birth, type of birth and birth weight were not significant on weaning weight. Heritability for weaning weight was estimated by using the reduced model including year of birth, type of birth and birth weight as fixed effect in the mixed model.

RESULTS AND DISCUSSION

Numbers of observation, mean values of birth weight for each level of any fixed effects were given in Table 1. Effects of sex, year of birth and type of birth on birth weight were significant ($p<0.01$) while other effects were not significant ($p>0.05$). Birth weight was changed between 2.86 and 3.87 kg depends on subgroups with average 3.4 kg (Table 1).

Since heritability of birth and weaning weight for each genotype were outside of the parameters space ($0>h^2>1$), so that, only overall estimations were given. Heritability estimate for birth weight was 0.43±0.11.

Table 1: Mean value of birth weight for each level of subgroups

Effects		N	Mean
Age of dam	2	79	3.38
	3	128	3.55
	4	79	3.30
	5	61	3.20
Genotype	S	127	3.44
	B	140	3.31
	SK	80	3.45
Sex	M	181	3.50
	F	166	3.27
Month of birth	2	224	3.33
	3	123	3.51
Year of birth	94	65	3.49
	95	102	3.50
	96	67	3.07
	97	113	3.43
Type of birth	1	56	3.87
	2	253	3.36
	3	30	2.86
	4	8	2.89

Table 2: Mean value of weaning weight for each level of subgroups

Effects		N	Mean
Year of birth	94	65	15.43
	95	73	16.87
	96	63	15.51
	97	82	13.76
Type of birth	1	47	17.19
	2	23	15.20
	3	26	13.56
	4	7	14.00
Birth weight Covariate)	-	-	2.32

In Table 2, number of observation and mean value of weaning weight were shown. Effects of year of birth, type of birth and birth weight on weaning weight were significant ($p<0.01$) while other effects were not ($p>0.05$). Weaning weight was changed from 13.56 to 17.19 kg depends on different subgroups with average 15 kg (Table 2). However heritability of weaning weights was 0.051±0.079.

Heritability estimates for birth and weaning weights from literature were summarized in Table 3. There have been a few published studies on h^2 of birth and weaning

Table 3: Literature summary on heritability estimates for birth and weaning weights

			Birth weight	Weaning weight
Authors	Year	Genotype	h^2	h^2
Al-Shorepy *et al.*[24]	2002	Emirati goat	0.18	0.29
Bishop and Russel[18]	1996	Cashmire goat	-	0.35
Constantinou[23]	1989	Damascus goat	0.20	0.29
Das[4]	1993	Blended goat	0.15	0.09
Mandonnet *et al.*[12]	1998	Creole goat	0.12	0.22
Mourand and Anous[6]	1998	Common Africa and Alpine goat	0.68	0.44
Nadarajah *et al.*[25]	1995	Alpine and Alpine goat	0.14	0.26
Podisi *et al.*[19]	1997	Angora	0.11	-
Portolano *et al.*[20]	2002	Sicilian Girgentana goat	0.20	0.49
Schoeman and van Niekerk [13]	1997	Boer goat	0.32	0.27
Taddeo *et al.*[21]	1998	Angora goat	0.26	0.33
Taskin *et al.*[11]	2000	Damascus	0.030	0.059

weight in goats. Literature values of heritability estimates for weaning weight were generally higher than the estimate for birth weight except the findings of Larsgard and Olesen[17]. They estimated surprisingly higher h^2 for birth weight (0.22) than weaning weight (0.12). Bishop and Russel[18] estimated heritability for weaning weight. Their heritability estimate for weaning weigh in Cashmire goats was higher than the estimate obtained in this study.

Podisi *et al.*[19] estimated heritability for birth weight in Angora goats to be 0.11 while Taskin *et al.*[11] reported rather lower heritability on birth weight and weaning weight in Damascus goats (0.003 and 0.059, respectively). Compared to results of Protolanao *et al.*[20], higher heritability was estimated for birth weight than that in the present study. However, Bishop and Russel[18] have been estimated heritability for weaning weight lower than that in present study. As in Table 3, similar heritability levels were reported for birth weight and weaning in sheep. The heritability estimates were changed between 0.03[2,11] and 0.09[4,20] for birth weight and between 0.003 and 0.47 for weaning weight[2,22-24].

Estimation of heritability for growth traits of goats is much needed information to perform genetic evaluation of dairy and meat goats. The estimation of heritability for birth and weaning weights in goats seem to be in the low-medium range and indicate a moderate genetic progress for growth is possible through selection in the goat population.

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