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Environmental and Genetic Effects on Early Growth Traits in Moghani Sheep Breeds

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Abstract: The effects of environmental factors on early growth traits (birth weight, weaning weight, body weight at 6 months of age and daily gain from birth to weaning and weaning to 6 months of age) using 10432 records in Moghani sheep breed were studied and Genetic and Environmental variance component were estimated using 8468 records of Jafarabad Animal Breeding Station from 1999 to 2004. Birth year on all traits and dam age had significant effect only for birth and weaning weight. Sex of lambs and birth type had no significant effect only daily gain from weaning to 6 months of age. Additive genetic direct variance, maternal environmental variance and heritability were estimate by REML fitting two different Animal models. The estimate of maternal environment variance was higher than additive genetic direct variance in some traits. Estimates of direct heritability for all traits were low.

Key words: Environmental and genetic factor, growth traits, Moghani sheep

INTRODUCTION

Moghani is an Iranian fat-tailed sheep and its main breeding center is Moghan plain on the North East of Azarbayjan and West of Caspian sea and categorized in meat-wool type breed (Saadat Nori and Siah Mansour, 1989; Tavakkolian, 2000). The early growth traits (Birth Weight (BW), Weaning Weight (WW), Body Weight at 6 months of age (BW6)) is an important role in productivity and is one of the major selection traits in this breed.

These traits are known to be influenced by direct and maternal genetic effects as well as by environmental effects. A number of reports indicate considerable maternal effects for these traits in sheep (Hassen *et al*., 2003; Nasholm, 2004; Van Vleck *et al*., 2003). From the mother's perspective, maternal effects on progeny performance result from maternal traits controlled by her genotype and associated environmental factors. Therefore, these effects are divided into genetic and environmental components. However, from the side of the offspring, maternal effects are reflected as environmental (Szwaczkowski *et al*., 2006). Therefore, it is essential for genetic assay, selection programs, animal breeding strategy, breeding value estimation and mating strategy that estimates this components and correcting data for this effects.

There are many reports for genetic parameters in other breed sheep, but in Moghani sheep there is a few report and nor in order to multiple traits analysis (Cloete *et al*., 2002; Saadat Nori and Siah Mansour, 1989).

The objective of this research was to estimate direct additive genetic variance as well as non-genetic effects on early growth traits. Maternal environmental variance was also estimated.

MATERIALS AND METHODS

The effects of environmental factors on BW, WW, BW6, Daily Gain from Birth to Weaning (DGB-W) and Daily Gain from Weaning to 6 months of age (DGW-6) using 10432 records of Moghani breed in Jafarabad Sheep Breeding and Genetics Station in East Azarbayjan in related of Jahad Organization were studied from 1999 to 2004. The effects of genetic factors on these traits were estimated using 8468 records with DFREML and Animal model method due to improper saving information and unknown pedigree in some data. Statistical analysis of data for the understudied traits was done using SPSS software and the following model.

$$Y_{ijkl} = \mu+YS_i+S_j+B_k+A_l+e_{ijkl}$$

Where:

Y_{ijkl} = Observation of each trait
μ = Mean of trait
YS_i = ith year-season of fixed effect (included 12 classes)

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S_j = jth lamb sex of fixed effect (included 2 classes)
B_k = kth birth type of fixed effect (included lamb and twin lambs)
A_l = lth dam age of fixed effect (included 7 classes from 2 to 8 years of age)
e_{ijkl} = Residual random effect.

The random effects including direct additive genetic effect, maternal environmental effect and variance components estimate for each trait are study using DFREML software (Meyer, 1997) and Meyer 1, 2 the following Animal models which included direct additive genetic random effect and direct additive genetic and maternal environment effects respectively.

$$Y = X b + Z_1 a + e \quad \text{(Meyer 1)}$$
$$Y = X b + Z_1 a + Z_2 c + e \quad \text{(Meyer 2)}$$

Where:
Y = Observation vector
b = Fixed effect vector (year, season, lamb sex, birth type, dam age)
a = Direct additive genetic effect vecto
c = Maternal environment effect vector
X, Z_1, Z_2 = Design matrix for relationship between a, b and e vector with observation respectively
e = Residual random effect vector.

RESULTS AND DISCUSSION

The effects of environmental factors: The effect of birth year was significant on all traits. The lamb sex and birth type don't significant only for DGW-6 and dam age was significant only for BW and WW (Table 1).

The significant effect of environmental factors can be influenced phenotypic data for growth traits and therefore, it is necessary that inclusion these effects in genetic assay models in this breed.

The breeding of Moghani sheep is very depending on pasture condition and considerate to unstable environmental such as difference in raining, humidity and temperature in different years which effect the quality and quantity of pastures and situation of ewe's breeding and her milk production will cause to significant effect of year on all traits. This trends were mentioned in many of breeds such as Baluchi (Yazdi *et al*., 1998) and Afrino (Snyman *et al*., 1995) and Horro and Menz sheep (Tibbo, 2006).

According to many of study, birth weight increased significantly from the first to third parity, was higher for lambs born as singles than multiples and for male than female lambs (Tibbo, 2006; Mavrogenis, 1996; Yazdi *et al*., 1998) that correspond to results of this study can be caused by higher body condition in older ewes, sexual male hormones in ram lambs and higher competition in multiples.

The significant effect of dam age on early growth traits have been published with many scientists such as Olthoff and Boylan (1991), Snyman *et al*. (1995), Yazdi *et al*. (1998) and Esmaeili Zade *et al*. (2002) and shown that this effect in different of ages is a curve status and between 4 to 6 years of age is a optimal condition.

The effects sex and birth type for DGW-6 in this study are opposite to few study (Snyman *et al*., 1995; Yazdi *et al*., 1998) because inaccuracy in weighting the lambs. Moreover BW6 and DGW-6 in lambs from ewes with 3 to 6 years old were higher than other ages in some study (Yazdi *et al*., 1998; Bathaei, 1994) and its opposite

Table 1: Least square means and standard errors for early growth traits

Sources	BW (kg)	WW (kg)	BW6 (kg)	DGB-W (kg)	DGW-6 (kg)
Mean	4.51±0.01	20.73±0.10	34.33±0.15	0.180±0.002	0.151±0.001
Year	****	****	****	**	***
1999	4.62±0.03	-	-	-	-
2000	4.17±0.04	21.83±0.21	37.38±0.33	0.196±0.002	0.172±0.001
2001	4.52±0.04	19.78±0.20	36.82±0.37	0.169±0.002	0.189±0.002
2002	4.30±0.03	20.89±0.27	36.11±0.39	0.184±0.003	0.169±0.002
2003	4.74±0.03	19.21±0.21	31.62±0.29	0.160±0.002	0.138±0.001
2004	-	22.03±0.21	31.83±0.25	-	0.109±0.001
Sex	****	****	****	*	ns
Female	4.32±0.02	19.64±0.13	31.70±0.17	0.170±0.001	0.134±0.001
Male	4.69±0.02	21.74±0.14	36.73±0.22	0.189±0.002	0.167±0.001
Birth type	****	****	****	*	ns
Lamb	4.79±0.02	22.21±0.11	35.44±0.19	0.193±0.001	0.147±0.001
Twin lambs	4.09±0.02	18.35±0.15	32.36±0.25	0.158±0.002	0.156±0.001
Dam age	****	**	ns	ns	ns
2 years	4.27±0.05	20.07±0.29	32.29±0.44	0.175±0.003	0.147±0.002
3 years	4.59±0.04	21.14±0.26	34.60±0.44	0.184±0.002	0.149±0.002
4 years	4.64±0.05	20.60±0.32	34.30±0.48	0.177±0.003	0.152±0.002
5 years	4.44±0.07	21.36±0.39	35.51±0.59	0.188±0.003	0.157±0.002
6 years	4.62±0.08	20.97±0.51	33.87±0.71	0.182±0.005	0.143±0.002
7 years	4.22±0.17	19.33±0.72	33.28±0.91	0.168±0.006	0.155±0.002
8 years	5.55±0.50	22.00±0.98	34.50±0.66	0.183±0.005	0.139±0.003

ns = non significant; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; **** $p<0.0001$

Table 2: Genetic and phenotype parameters for growth traits

Traits	σ^2_a	σ^2_c	σ^2_e	σ^2_p	h^2_a±SE	C^2+SE	Log l
BW							
Model 1	0.1784	-	0.2145	0.3929	0.4541±0.055	-	-326.596
Model 2	0.0528	0.09509	0.2278	0.3757	0.1406±0.048	0.1542±0.053	34.8872
WW							
Model 1	1.9514	-	10.7039	12.6553	0.1542±0.053	-	-4393.41
Model 2	0.6404	1.2877	10.596	12.5242	0.0511±0.032	0.1028±0.027	-4385.71
BW6							
Model 1	2.7499	-	15.5446	18.2946	0.15.3±0.051	-	-4193.27
Model 2	2.4752	0.2692	15.5184	18.2628	0.1355±0.056	0.0147±0.028	-4193.14
DGB-W							
Model 1	0.0197	-	0.1165	0.1362	0.1446±0.054	-	45.1868
Model 2	0.0065	0.0132	0.1152	0.1349	0.048±0.052	0.097±0.042	48.7202
DGW-6							
Model 1	0.0088	-	0.0537	0.0625	0.1408±0.057	-	4493.464
Model 2	0.0203	0.0113	0.0546	0.0862	0.2335±0.048	0.1310±0.026	4502.207

σ^2_a = Direct additive genetic variance; σ^2_e = Residual variance; σ^2_c = Maternal environment variance; σ^2_p = Phenotype variance; $h^2_a = \sigma^2_a/\sigma^2_p$; $C^2 = \sigma^2_c/\sigma^2_p$

with current study that's could be the consequence of inaccuracy in lamb weight and birth date of lamb data files.

Genetic and phenotype parameters: Estimation of variance components and genetic and phenotype parameters for two animal models and base on single trait analysis are shown in Table 2.

Evaluation of growth traits depends on heritability variation arising from additive genetic and maternal effects (Wilson and Reale, 2006). It is well known that estimates of genetic parameters vary widely across authors, year, methods and genetic groups for the same traits (Szwaczkowski *et al*., 2006).

In this study the ewe's records were not available and the numbers of lambs per ewes were low and therefore it's not possible that estimate maternal genetic effect and maternal environment effect accurately.

The results show direct heritability is nearly low for all traits because of high environmental variance as the result of unfavorable and variable conditions of breeding and inaccuracy in pedigree information.

Direct heritability estimates obtained in the present study are in agreement with reported for various populations by a number of authors. For instant in study of Van Vleck *et al*. (2003) and Hassen *et al*. (2003) direct heritability for birth weight were estimated about 0.27 and 0.17, respectively. Similar results were also reported by Fossceco and Notter (1995) for crossbred sheep and indicate the impact of size and structure of data on estimates of the parameters.

The estimate of heritability for early growth trait of Iranian native sheep was done in many study and direct heritability were estimate between 0.06 to 0.45 for BW, 0.12 to 0.52 for WW, 0.14 to 0.43 for BW6, 0.11 to 0.44 for DGB-W and 0.15 to 0.34 for DGW-6 (Mavrogenis, 1996; Snyman *et al*., 1995; Esmaeili Zade, 2002) and estimate of heritability in this study for early growth traits were in the range of other scientist.

The likelihood ratio test based on the two models likelihood logarithm shows don't significant difference between two models for all traits and therefore the first model is suggested for all traits analysis. The maternal environment effect in Moghani breed growth traits is don't significant in this study and corresponding with other study that reported the importance of direct genetic or maternal environment effects or at least one of these and difference between them can be because of don't sufficient records, large number of ewes without records and low number of progeny per ewes. However many of study such as Vaez Torshizi *et al*. (1996) on Australian Merino and Yazdi *et al*. (1998) on two herd of Baluchi breed have reported significant maternal effects specially maternal additive genetic effect on early growth traits.

One of the most popular criteria of goodness of model fit is residual variance estimates. These error variance estimates for the traits studied are listed in Table 2. In the most case, the smallest ones were obtained for a model with direct genetic and maternal environmental effect. So, the likelihood ratio test indicates that maternal environmental effect, should not be include into the linear model for genetic evaluation of studied traits in this breed. In this study, comparison between residual variance in model 2 relative with model 1 show that for WW the reduction in variance is maximum and show that for this trait the effect of maternal environmental variance is great relatively.

Ignoring these effects in the model will cause bias and up estimate direct heritability. Also studies show that due to difference ewe's milk production, the effect of maternal environment in weaning weight and daily gain up to weaning is more than birth weight which is in accordance with results of this study. However improper information and records could result in up explainable estimation. It is suggested that in understudy herds correct pedigree registration and accurate information collection is necessary for analysis of traits.

CONCLUSIONS

Birth weight is an important economic traits that have an effect on many traits related with it in sheep follow the results of many study and in order to the significant effects of birth year, lamb sex, birth type and dam age, this effects must be mentioned in study of this trait. The Meyer one Animal model is proper to total traits analysis and show that maternal environmental effect fraction (in pregnant or lactation period) is less important than direct genetic effect especially for after weaning age traits. However ignoring this effects cause biases in results.

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