Journal of Animal and Veterinary Advances 8 (12): 2590-2593, 2009
ISSN: 1680-5593

Estimation of Genetic and Environmental Parameters Affected Pre-Weaning Traits of Arabi Lambs

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Abstract: In this study, the data of Birth Weight (BW), Weaning Weight (WW) and Daily Gain from birth to weaning (DG) of Arabi lambs were used to estimate of environmental effects, heritability, phenotypic and genetic correlations among these traits. The effect of age of dam on BW was highly significant ($p<0.01$). The BW of lambs born to 2-year-old ewes in comparison to other lambs born to 3-6 year-old was significantly lighter. The male lambs as compared to the female ones had a heavier BW, WW and DG significantly ($p<0.01$). A comparison between born single (4.12, 26.21 and 0.252 kg, respectively) and twin lambs (3.55, 23.88 and 0.201 kg, respectively) indicated that the BW, WW and DG of born single lambs were significantly higher ($p<0.01$). Lambing year had a highly significant effect on the pre-weaning traits ($p<0.01$). Heritability of BW, WW and DG were 0.121±0.073, 0.095±0.072 and 0.096±0.079, respectively. Phenotypic and genetic correlations between BW-WW, BW-DG and WW-DG were (0.229 and 0.489), (0.119 and 0.429) and (0.987 and 0.999), respectively.

Key words: Arabi lamb, genetic parameters, environmental effects, growth traits

INTRODUCTION

Arabi sheep found in southwestern Iran, southern Iraq and northeastern Arabia, the Arabi is a meat breed of the Near Easter Fat-Tailed type. The wool is of carpet quality. The breed is usually black, pied, or white with a black head. The males are horned and the females are hornless (polled). To determine optimal breeding strategies to increase the efficiency of sheep production, knowledge of genetic parameters for weight traits at various ages and also the genetic relationships between the traits is needed. Various environmental effects on lamb growth have previously been studied in several investigations on other breeds (Neser *et al*., 2001; Lavvaf *et al*., 2007; Ghafouri *et al*., 2007).

By far, the most important environmental factors are year, sex, type of birth, age of dam and age of lambs at weighing. Many random factors affect the growth of lambs. The most important these factors are animal random effect and environmental factors, which affect both the lamb and its dam (Ekiz, 2005; Neser *et al*., 2001; Heydarpour *et al*., 2007). Effect of maternal age, birth year and sex and type of birth lamb on pre- weaning traits have reported by several authors (Eltawil *et al*., 1970; Notter *et al*., 1975; Jorgenson *et al*., 1993). Usually male lambs in comparison to female lambs have higher BW, WW and DG. Also, twin born lambs compared to single born lambs have lighter BW, WW and DG at per-weaning period (Bourfia and Touchberry, 1993; Bennett *et al*., 1991).

The objective of this study was to estimation of genetic and environmental parameters affected pre-weaning traits of Arabic lambs. In addition, the correlations between the traits were estimated.

MATERIALS AND METHODS

Data: The data used in the present study, were collected at Animal Science Research Station of Agricultural and Natural Resources Ramin University in Khuzestan province of Iran during 2003 and 2004. Three traits were considered: Birth Weight (BW), Weaning Weight (WW) and Daily Gain from birth to weaning (DG) and for this trait used 710, 611 and 611 records of Arabic lamb, respectively. These records used for predict the effects of environmental factors age of dam, sex, type of birth, birth year and estimate of heritability and phenotypic and genetic correlations between traits mentioned above. In general, animals were managed following semi-moving. On the other hand, sheep fed in site of station from late December to mid February and remain the year reared on natural pasture. The mating period began from early August to early October and continued as controlled.

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Lambing was from early January and continued until early February. Lambs kept by mother at all the time of first month and use of mother's milk twice daily at second and third month. The lambs were weaned at about 90±5 day-old. Lambs fed from 15 day-old in addition to mother's milk by complementary feed containing 45% barley, 5% corn, 10% cottonseed meal, 19% bran, 17% of sugar beet pulp, 2% alfalfa powder, 1% bone powder, 0.5% salt, 0.1% Multi vitamin and 0.4% antibiotic. Male and female Lambs separated after weaning and females were with the main herd at pasture. Considering the variable being weaning age, WW based on 90 day-old using the following equation was correct (Notter *et al*., 1975):

$$WW_C = \frac{(WW - BW) \times 90}{WA} + BW$$

Where,

WW_C = Corrected Weaning Weight on 90 day-old
WA = Weaning Age

Statistical analysis: To identify fixed effects to be included in the models, least square analyses were conducted using the GLM procedure (SAS, 1998). This was performed on a model including fixed effects (year-2 levels; age of dam in years-5 levels; sex-2 levels and type of birth (single and twin). For environmental effects prediction (maternal age, sex, type of birth and year of lamb birth) and genetic parameters estimation using variance components and covariance within groups (sires) related to half sibs paternal, Harvey (1980) software and the following models were used:

To prediction of environmental effects:

$$Y_{ijklm} = \mu + A_i + B_j + C_k + S_l + E_{ijklm}$$

To estimation of genetic parameters:

$$Y_{ijklnm} = \mu + A_i + B_i + C_k + S_l + F_n + E_{ijklnm}$$

Where,

Y_{ijklm}, Y_{ijklnm} = Observation of each trait
μ = Mean of trait
A_i = Ith maternal age of fixed effect (i = 2, 3, 4, 5 and 6)
B_j = Jth birth type of fixed effect (j = single or twin)
C_k = Kth sex K of fixed effect (k = male or female)
S_l = Lth birth year of fixed effect (l = 2003 or 2004)
F_n = Nth sire of random effect (n = 1, 2, 3,…,40)
E_{ijklnm}, E_{ijklm} = Residual random effect

In this experiment, supposed that F_n, E_{ijklnm} and E_{ijklm} factors had zero mean and σ^2e and σ^2s variance. Other effects were considered as fixed. The BW, WW and DG traits as dependent variables enter to model.

RESULTS AND DISCUSSION

Analysis of variance and least squares mean and standard error for BW, WW, DG and prediction of environmental effects on these traits have shown in Table 1 and 2. Effect of dam age on BW was significant ($p<0.01$). If noticeable in Table 2, BW of lambs born from 2-years old ewes in comparison to other is the lowest significantly. Lambs born from 6-years old had the highest BW. The difference between BW in lambs from 4, 5 and 6 years old was not significant. It seems that the difference between BW of lamb born from 2 and 3 years old ewes compared to other age groups was due to differences between the degree of physical evolution (body weight and reproductive system) in ewes. Effect of dam age on WW and DG was not significant ($p<0.05$). WW of lambs born from 2 and 3 years old ewes in comparison to other was lower significantly ($p<0.05$). DG of lambs born from 5-years old ewes was lowest and had significant difference with other ($p<0.05$). Considering that the most important factor affecting lamb growth rate in pre-weaning is capacity of lactation, also ewe milk production at the peak, so DG in lambs born from 4-6 years old ewes higher than lambs born from 2 years old ewes. The results of this experiment in agreement with reports by Notter *et al*. (1975), Eltawi *et al*. (1970) and Stobart *et al*. (1986) and contrast to Farid and Makarechian (1976).

The effect of type of birth on per-weaning growth traits in Arabi lambs was significant ($p<0.05$). The means of BW, WW and DG in single lambs (4.12, 26.24 and 256.73) in comparison to twin lambs (3.55, 24.52 and 222.85) was higher. Different BW in single and twin lambs can relate to environmental characteristics of uterus, placenta cotyledons number. Because of Higher WW and DG of single lambs compared to twins was competition for milk suckling and lower BW in them. This result confirm to others Eltawi *et al*. (1970).

The effect of sex on per-weaning growth traits in Arabi labms was significant ($p<0.05$). Male lambs were heavier than females and the difference between the two sexes increased with age of lamb, that in addition to physiological differences, genetic can an agent for these results. Also, because of increasing was differences in the endocrine system between males and females, probably. The results of this experiment in agreement with others (Eltawi *et al*., 1970; Boujenans *et al*., 1992).

Table 1: Variance analysis of environmental effects on pre-weaning growth traits of Arabi lambs

	BW		WW		DG	
SOV	df	MS	df	MS	df	MS
Age of dam	4	8.32**	4	62.29^{NS}	4	0.0059^{NS}
Type of birth	1	119.81**	1	860.48**	1	0.1012**
Sex	1	12.76**	1	697.88**	1	0.0911**
Year of birth	1	11.38**	1	354.33**	1	0.0390**
Born weight	-	-	1	901.52**	1	0.0280**
Error	702	0.35	602	25.31	602	0.0029
CV	-	12.31	-	18.77	-	21.7800
R^2	-	0.49	-	0.31	-	0.2400

** = significant in 0.01 ($p<0.01$), NS = Non Significant, BW = Born Weight, WW = Weaning Weight, DG = Daily Gain from birth to 90-days old, SOV = Source of Variation, df = Degree of freedom, MS = Mean of Squares, CV = Coefficient of Variation, R^2 = Coefficient of correlation

Table 2: Least squares means and standard error for pre-weaning growth traits in Arabi lambs

Class	Subclass	Number	BW (kg)	Number	WW (kg)	DG (g)
Age of dam (year)	2	127	3.26±0.06^{a}	111	24.70±0.56^{a}	231.53±6.20^{a}
	3	164	3.66±0.06^{b}	117	25.27±0.56^{ab}	237.79±6.17^{a}
	4	179	3.79±0.05^{bc}	163	25.78±0.42^{ab}	243.53±4.68^{ab}
	5	154	3.78±0.05^{bc}	143	26.05±0.44^{b}	251.97±4.90^{b}
	6	86	3.88±0.06^{c}	77	25.62±0.59^{ab}	241.64±6.53^{ab}
Type of birth	Single	460	4.12±0.03^{b}	411	26.24±0.28^{b}	256.73±3.12^{b}
	Twin	250	3.55±0.04^{a}	200	24.52±0.46^{a}	222.85±5.12^{a}
Sex	Male	369	3.92±0.03^{b}	317	26.71±0.32^{b}	250.80±3.55^{b}
	Female	341	3.63±0.04^{a}	294	24.46±0.3^{a}	228.79±3.78^{a}
Years	2003	364	3.81±0.04^{b}	319	26.43±0.32^{b}	250.77±3.61^{a}
	2004	346	3.53±.04^{a}	292	24.92±0.35^{a}	237.77±3.89^{b}

^{a,b}: Means in each class with different superscripts are significant different ($p<0.05$)

Table 3: Heritability and genetic and phenotypic correlations for pre-weaning growth traits in Arabi lambs

Traits	Heritability ±SE	Genetic correlation±SE	Phenotypic correlation±SE
BW	0.21±0.073	0.489±0.098	0.429±0.056
WW	0.229±0.070	0.095±0.072	0.999±0.079
DG	0.119±0.068	0.987±0.050	0.096±0.079

SE: Means Standard Error

Age of birth had significant effect on per-weaning growth traits in Arabi lambs ($p<0.05$). As Table 2 shown, lambs born at 2003 heavier than lambs born at 2004 and increased with their age. Because of these differences was better management and environment. In this case, there were researches (Eltawi *et al*., 1970; Notter *et al*., 1975) that result of this study conforms to them.

Heritability and standard error for pre-weaning growth traits have shown in Table 3. Heritability and standard error for BW, WW and DG was 0.21±0.073, 0.229±0.070 and 0.119±0.068, respectively. This result in agreement with others (Maria and Van Vleck, 1993; Thrift *et al*., 1973). Low heritability in pre-weaning growth traits probably was due to low variance between males and high variance of environmental effects especially maternal effect.

CONCLUSION

The estimates of genetic parameters reported for the Arabi lambs here are in general agreement with those reported in the literature. The genetic parameters estimated for growth traits indicate that there is genetic variation among the animals that can be utilized for genetic change in these traits by selection in Arabi sheep raised under their specific harsh environmental conditions. Also, The present findings shows that birth weight an important economic trait that has very effect on many traits related with it in lamb.

ACKNOWLEDGEMENTS

The researchers wish thanks to all personnel of Animal Science Research Station of Agricultural and Natural Resources Ramin University, specially M.Sc Hossein Tavasoli for their cooperation in providing the data.

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