تأثير بعض العوامل الوراثية وغير الوراثية في بعض صفات الوزن المبكرة لدى الحملان البربرية

Influence of Some Genetic and Non-genetic Factors on Early Body Weight Traits of Barbary Lambs

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المُلَخَّص

أُجريت هذه الدراسة لتقييم أوزان حملان الأغنام البربرية وراثياً، خلال الفترة الممتدة من عام 2003 وحتى 2006 في محطتي بحوث صواف وجبيبينة في الجمهورية التونسية المتعاونة مع المركز العربي لدراسات المناطق الجافة والأراضي القاحلة (أكساد)، وذلك باستخدام 6802 سجل لصفات الوزن عند الميلاد، وعند عمر 30 و 60 و 90 يوماً.

حُللت البيانات وفق النموذج الخطي ذات التأثيرات المختلطة باستخدام البرنامج الإحصائي (Harvey، 1990) لتقدير المكافئات الوراثية، والارتباطات الوراثية والمظهرية، ودراسة تأثير العوامل الوراثية (الأب) وغير الوراثية (سنة الولادة، المحطة، نموذج الميلاد، جنس المولود، وعمر النعجة عند الولادة) في الصفات المدروسة.

بلغت قيم المكافئات الوراثية 0.020±0.061 و0.020±0.056 و0.017±0.018 و0.019±0.046 لصفات الوزن عند الميلاد، وعند عمر 30 و 60 و 90 يوماً، على الترتيب. تراوحت قيم الارتباطات الوراثية من 0.273±0.108 إلى 0.204±0.927، وتراوحت قيم الارتباطات المظهرية من 0.320±0.328 إلى 0.709±0.713 للصفات المدروسة.

كان التأثير الوراثي (الأب) عالي المعنوية في الصفات المدروسة ماعدا الوزن عند عمر 60 يوماً. وكانت معظم العوامل غير الوراثية (سنة الولادة ، أنموذج الميلاد، جنس المولود وعمر النعجة عند الولادة) معنوية التأثير في تفسير التباينات للصفات المدروسة، أما أثر المحطة، فقد كان غير معنوي في الصفات المدروسة.

بلغت متوسطات المربعات الصغرى والخطأ القياسي لصفات الوزن عند الميلاد، والوزن بعمر 30 و 60 و 90 يوماً، 0.01±3.58 كغ و0.04±9.13 كغ و0.10±14.05 كغ و0.06±18.72 كغ، على التوالي.

يُستنتج من الدراسة: إن الارتباطات الوراثية والمظهرية كانت موجبة للأوزان المدروسة، لذلك فإن الانتخاب لإحدى الصفات الوزنية المدروسة يساعد على تحسين الصفات الوزنية الأخرى. وأيضاً بما أن المكافئات الوراثية منخفضة، فإن التباينات في الصفات المدروسة عائدة بشكل كبير للعوامل غير الوراثية مثل سنة الولادة وأنموذج الولادة وجنس المولود وعمر النعجة.

الكلمات المفتاحية: أغنام البربري، الأوزان، معالم وراثية، العوامل الوراثية وغير الوراثية.

Abstract

This study was conducted to evaluate Barbary sheep lambs genetically, during the period 2003 to 2006. Data were obtained from Sawaf and Gebbenh sheep stations in Tunisia, which are cooperating with the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD). A total of 6802 records, of weight traits of lambs at birth (BWT), 30 (WT30), 60 (WT60) and 90 (WT90) days of ages, were evaluated.

The data were analyzed by Mixed Linear Model, using statistical program (Harvey, 1990), to estimate heritability as well as Genetic and Phenotypic correlations, and to study the impact of genetic (sire) and non genetic (lambing year, station, type of lambing, sex of lamb, age of ewe at lambing) factors on body weight traits.

Heritabilities were 0.061 ± 0.020, 0.056 ± 0.020, 0.018 ± 0.017, and 0.046 ± 0.019 of lamb's weights at birth (BWT), 30 (WT30), 60 (WT60) and 90 (WT90) days of ages, respectively. Genetic correlations ranged from 0.018 ± 0.273 to 0.927 ± 0.204, and phenotypic correlations ranged from 0.328±0.320 to 0.7132 ± 0.709 for the studied traits.

The effect of genetic factor (sire) were highly significant ($P<0.01$) on all weight traits except of WT60, and also for all non-genetic effects were significant ($P<0.05$), except for stations.

Least squares means and standard error (kg) for body weights were 3.58 ± 0.01, 9.13 ± 0.04, 14.05 ± 0.10 and 18.72±0.06 at birth, 30, 60 and 90 days of age, respectively.

The results indicated that, because genetic and phenotypic correlation were positive, so the selection for lamb weight at any age will help to improve other traits. Heritability values were low, therefore, the variations in the studied traits were mostly associated with the non genetic factors such as lambing year, birth type, sex of lamb, and age of ewe at lambing.

Keywords: Barbary sheep, Weights, Genetic parameters, Genetic and non genetic factors.

Introduction

Barbary sheep (*Ammotragus lervia*) is a native breed in North Africa, and well-adapted to a dry rough, barren and water less habitat. It has common characteristics with Capra and Ovis, so it is conceded as ancestor to these species (Cassinello, 1998; Monica et al, 2004). Barbary breed is one of the most important Arab fat tail sheep. It is Wide-spread in Tunisia, and characterized with high productivity especially in spring season, where pasture is considerably available (Khaldi, 1989; Naziha et al, 2004; Inigiez, 2005). It might have been brought from Syria to North Africa by the Phoenicans (Mason, 1967). Barbary sheep become the dominant breed in Tunisia, with population of 80 to 85% of the national sheep, and two types (the red face and the white face) were identified. In Tunisia Barbary is also called Arabi or Nejdi and distributes in all regions from Sahara to the north Coast and in the central regions too. Under the harsh conditions of North Africa Barbary could cover meat shortages if its growth and reproductive performance improved. This improvement is the core of the ongoing project between the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) and the National Institute for Agriculture Research in Tunisia (Ministry of Agriculture) for selection of Barbary sheep from native sheep flocks based on growth performance. Djemali et al. (1994) estimated growth performance of Barbary lambs and concluded that lamb's growth is very slow after 30 days of age. So the selection for body weight performance maybe better to start at this age for Barbary lambs. In order to design proper breeding plans, the heritabilities and genetic correlations of the body weight traits must be known, however little information is available on Barbary sheep at this stage.

As a result, the objectives of this study were to estimate heritability, genetic and phenotypic correlation of the early body weight traits, at birth, 30, 60, 90 days of age, and to study the influence of genetic (sire) and non - genetic factors (lambing year, stations, type of lambing, sex of lamb and age of ewe) on some body weight traits of Barbary lambs.

Materials and Methods

A total of 6802 records of Barbary lamb>s body weight traits at birth (BWT), weight at 30 (WT30), weight at 60 (WT60), weight at 90 (WT90) days of age were collected throughout 2003 to 2006, from Sawaf and Gebbenh research stations, in Tunisia and analyzed.

The herds were maintained in semi shaded barns, fed basically on natural pastures which varied according to the intensity of rainfall for 4-6 months (October to May), in addition to some green crop products (Tlemat, 1996). During the reproductive season 5 rams were allowed for natural mating per 100 ewes. Rams were randomly allocated and hand-mated to ewes. All lambs were marked at birth and the traits, such as weights, sex of lamb, birth type, lambing year, age of ewe at lambing and Station were recorded, throughout 2003 to 2006.

The collected data were analyzed for BWT, WT30, WT60, and WT90 traits using Harvey program (1990), according to the following main model:

$$Y_{ijklmno} = \mu + SR_i + YR_j + ST_k + T_l + X_m + A_n + e_{ijklmno}$$

Where, $Y_{ijklmno}$ is weights at birth, 30, 60 and 90 days of age the ijklmnoth records, μ is grand mean, SR_i is effect sire random and assumed to be normally independent distribution with zero mean and common variance (0, $I\sigma^2 s$). YR_j effect of the j^{th} year of lambing coded as j = 1, 2, 3 and 4 of the years 2003-2006 respectively, ST_k is effect of the k^{th} stations coded as k =1 and 2 of Sawaf and Gebbenh respectively, T_l is effect of the l^{th} type of lambing coded as l = 1 and 2, of the single and twins respectively, X_m is effect of the m^{th} gender lambs coded as M =1 and F=2, of male and female respectively, A_n is effect of the n^{th} age of ewe coded as n = 2, 3 and ≥7 years old. $e_{ijklmno}$ is random error term associated with each of observation ($Y_{ijklmno}$) and assumed to be normally independent distribution with zero mean and common variance (0, $I\sigma^2 e$).

Heritabilities and the genetic and phenotypic correlations of different studied weights were estimated using variance-covariance component of the paternal half-sib relationship.

Duncan multiple range test was used for comparison of the differences among the mean's effects (Duncan, 1955), using (SAS, 1996) program.

Results and Discussion

Heritability is the proportion of the differences among animals which can be transmitted to the next generation. So it is important to estimate the amount of expected improvement in one year of one generation. Genetic correlation indicates how closely traits are genetically related by reflecting the effect of selection for one trait, that could have an effect on other traits.

Heritability and standard error that were estimated for the studied traits, in addition to the genetic and phenotypic correlation among them are presented in Table 1.

Table 1. Estimates of heritability (diagonal and bold), genetic correlations (below the diagonal), and phenotypic correlations (up the diagonal) for BWT, WT30, WT60, WT90, on Barbary Sheep.

Traits	BWT	WT30	WT60	WT90
BWT	0.061 ± 0.020	0.369 ± 0.372	0.340 ± 0.339	0.328 ± 0.320
WT30	0.331 ± 0.212	0.056 ± 0.020	0.532 ± 0.537	0.540 ± 0.564
WT60	0.435 ± 0.341	0.457 ± 0.309	0.018 ± 0.017	0.713 ± 0.709
WT90	0.480 ± 0.219	0.108 ± 0.273	0.927 ± 0.204	0.046 ± 0.019

BWT: birth weight, WT30: weight at 30 days of age, WT60: weight at 60 days of age, WT90: weight at 90 days of age.

Estimated heritability of all studied traits showed low heritability values ranging between 0.018 for WT60 and 0.061 for BWT. Such traits are essentially developed by improving the environmental factors such as the appropriate feeding strategy before and after parturition.

Similar heritability values for BWT were reported by Abdul-Rahman (1978), Al-Tae (1981) and Ayied, et al. (1988), their estimates were 0.07, 0.07 and 0.06 on Awassi, Awassi and Arabi sheep, respectively. Whereas, high estimate of heritabilities were 0.24 and 0.20, which obtained by Alnajjar et al. (2008) and Alabas (2009), respectively on Awassi sheep. Kazzal (1973) and Abdul-Rahman (1978), found closer heritability estimates of WT60, which were 0.06 and 0.07, respectively on Awassi sheep. The heritability estimate of WT60 in the current study was lower than those found by Alnajjar et al. (2008) and Alabas (2009) Their estimater were 0.51 and 0.22, respectively on Awassi sheep in Syria. These differences may be due to gene frequencies in each herd according to pedigree relationship.

Table 1 shows that the genetic and phenotypic correlations between BWT and WT60 were 0.435 and 0.340, respectively. This means that the increases in birth weight will be accompanied by a significant increase in other weights. This would be considered a beneficial correlation since selection for one trait has a positive effect on another trait. However, it is possible to identify and use ram that excel genetically for both traits. Current results indicate that all studied body weight traits were positively correlated. So selection for higher weight will also tend to increase other studied weights. This correlation is particularly high when lambs are reared under intensive conditions. Alnajjar et al. (2008) estimated positive values between birth and weaning weights, which were 0.29 and 0.51 for both genetic and phenotypic correlation, respectively.

The sire effect was highly significant on BWT, WT30 and WT90 and insignificant on WT60 as shown in Table 2. Results obtained in the present study agree with those reported by Alnajjar et al. (2008), and Alabas (2009) for birth weight, but it contradicted for WT60. The weight traits, were expressed in Kg's, indicates the genetic effects which a sire will have on the weight of his offspring.

It is evident in table 2, that year of lambing, lambing type, sex of lamb, and age of ewe at lambing had in general significant ($P<0.01$) influence on studied body weights. The effect of the station on studied traits was insignificant. Both differences between the years and the stations might be due to the variation in management, feeding and climatic conditions during years of the study. The higher least square means of BWT was in Sawaf station, while WT30, WT60, WT90 were higher in Gebbenh station.

Least squares means of lambs born as single were higher than those of twins (Table 3). The same result was found by Cassinello (1998), Zaied and Ayad (1992) and Rekik et al. (2005), confirming that, type

Table 2. Analysis of Variance of Barbary Sheep Lambs for BWT (kg), WT30 (kg), WT60 (kg), WT90 (kg) on Barbary Sheep.

Source of variance	Mean Squares				
	D.F.	BWT	WT30	WT60	WT90
Ram	326	0.41**	4.58**	6.43^{ns}	9.55**
Year of lambing	3	2.90**	382.31**	1487.19**	3334.38**
Stations	1	0.62^{ns}	0.09^{ns}	2.90^{ns}	2.64^{ns}
Lambing Type	1	371.51**	2118.86**	2427.68**	2797.47**
Gender	1	35.38**	189.37**	338.26**	780.47**
Age of ewe	5	0.73*	25.53**	56.14**	70.16**
Remainder	6464	0.31	3.54	5.87	7.72

BWT: birth weight, WT30: weight at 30 days of age, WT60: weight at 60 days of age, WT90: weight at 90 days of age.

of lamb had high significant effect on birth weight (Table 2). This may be due to the fact that single lambs have more adequate milk supply than other lambs on all studied traits.

The sex of lamb showed high significant (P<0.01) effect on all studied traits (Table 2). The present result agrees with that of Khaldi (1989) on weight of lambs at different ages. But it disagrees with the result of Zaied and Ayad (1992) who did not find significant effect of lambs gender on body weights at birth and weaning. The least squares means of male lambs were higher than female lambs at birth and subsequent ages. Similar result was observed by Khaldi (1989). The effect of lamb's gender on body weights might reflect the effect of sex hormones. Physiological differences between male and female growth.

The age of ewe had high significant (P<0.01) effect on all studied traits as presented in Table (2). This result is in agreement with those of Khaldi (1989) who found significant effect of ewe age on weight lambs, meanwhile it contradicts with the findings of Zaied and Ayad (1992) on birth and weaning weights.

The overall least squares means and standard errors of BWT, WT30, WT60, and WT90 are shown in Table 3. In the literature review few studies had estimated weights of Barbary sheep and generally were in agreement with the results of the current study. Birth weight (kg), for single males, single females and twin were 3.6, 3.4 and 3.1, respectively of Barbary lambs in Tunisia (Khaldi, 1989). However Zaied and Ayad (1992) observed that, birth weight in general was 3.86 kg and weaning weight ranged between 16.8 to 19.1 kg of Barbary lambs in Libya.

Body weights for males and females of Barbary lambs at birth, 30, and 90 days of age were 3.8, 3.5; 10.6, 9.8; 21.0, 19.1 kg, respectively (Rekik et al., 2005).

Comparing the results of 2006 with those of 2003, it was found that the least squares means of BWT were higher in 2006, while WT30, WT60, WT90 were higher in 2003. This may be related to management differences.

Least squares means of BWT, WT30, WT60 showed an increasing trend from the second to the fourth year of ewe age, and it was the highest in sixth year of ewe age. Least squares means of WT90 showed an increasing trend from the second to the fourth years of the ewe age and decreasing thereafter except in sixth year of the ewe age. This may be due to the advance in the ewe's ages (ewes more than six years) which might have cause lose of their ability to withstand the effects of multiple pregnancies. Generally, it was found that, there was a trend in the increase of lambs weight with the increase of age of the ewe to reach a maximum at six years of age and decline thereafter (Table 3). Whereas Cassinello (1998) showed that, high mothering tends to produce heavier lambs than low ones, and birth weights increase with maternal age.

In conclusion, the results indicated that, genetic and phenotypic correlations were positive, so the selection for lamb weight at any age (birth weight) will help to improve other traits. Heritability values were low, so the variation in studied traits is related to non genetic factors such as lambing year, birth type, sex of lamb, and age of ewe at lambing. Consequently, correction factors have to be evaluated before designing any plans for genetic improvement of these traits of Barbary sheep in Tunisia.

Table 3. Least Square Means±Standard Errors (LSM±SE) of Barbary Sheep Lambs at BWT (kg), WT30 (kg), WT60 (kg), WT90 (kg).

S.O.V	Least Square Means ± Standard Errors (LSM±SE)				
	No.	BWT	WT30	WT60	WT90
µ	6802	3.58 ± 0.01	9.13 ± 0.04	14.12 ± 0.05	18.72 ± 0.06
Year of lambing					
2003	2040	3.60 ± 0.01b	9.79 ± 0.05a	15.63 ± 0.06a	20.52 ± 0.07a
2004	1418	3.52 ± 0.01c	8.46 ± 0.05d	13.27 ± 0.06c	18.28 ± 0.07c
2005	1981	3.55 ± 0.01bc	9.27 ± 0.04b	13.37 ± 0.06c	16.78 ± 0.06d
2006	1363	3.63 ± 0.02a	9.01 ± 0.05c	14.20 ± 0.07b	19.32 ± 0.08b
Stations					
Sawaf	3023	3.65 ± 0.05a	9.10 ± 0.18a	13.95 ± 0.23a	18.57 ± 0.26a
Gebbenh	3779	3.50 ± 0.05a	9.16 ± 0.18a	14.28 ± 0.23a	18.88 ± 0.26a
lambing Type					
Single	5728	3.91 ± 0.01a	9.93 ± 0.03a	14.97 ± 0.04a	19.64 ± 0.05a
Twin	1074	3.24 ± 0.01b	8.33 ± 0.03b	13.26 ± 0.04b	17.81 ± 0.05b
Gender					
Male	3358	3.65 ± 0.01a	9.30 ± 0.02a	14.35 ± 0.03a	19.07 ± 0.03a
Female	3444	3.50 ± 0.01b	8.96 ± 0.02b	13.89 ± 0.03b	18.37 ± 0.03b
Age of ewe					
2	1002	3.54 ± 0.02b	8.87 ± 0.06b	13.71 ± 0.07b	18.28 ± 0.08b
3	1012	3.55 ± 0.02b	9.16 ± 0.06a	14.07 ± 0.07a	18.75 ± 0.08ab
4	1027	3.59 ± 0.02a	9.22 ± 0.06a	14.30 ± 0.07a	18.98 ± 0.08a
5	996	3.59 ± 0.02a	9.24 ± 0.06a	14.33 ± 0.07a	18.96 ± 0.08ab
6	910	3.61 ± 0.02a	9.30 ± 0.06a	14.30 ± 0.07a	18.82 ± 0.09ab
≥7	1855	3.58 ± 0.01a	9.01 ± 0.04b	13.99 ± 0.06b	18.54 ± 0.07c

BWT: birth weight, WT30: weights at 30 days age, WT60: weights at 60 days age, WT90: weights at 90 days age, Means with the same letters within the same column for each effect denote no significant differences between means.

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