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Estimation of Heritability, Genetic Correlation and Kleiber ratio in Ghezel Sheep

M.V.Ghasemi[1*], N.Emam Djomeh-Kashan[1], M.Aminafshar[1], M.Honarvar[1], R.Moghadasi[1], R.Pahlavan[2]

[1]*Department of Animal Science, College of Agriculture, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[2]*Department of Genetic and Breeding Research, Animal Science Research Institute, Karaj, Iran*

Corresponding Author: *M.V.Ghasemi, Department of Animal Science, College of Agriculture, Science and Research Branch, Islamic Azad University, Tehran, Iran, Emailid:ghasemimirvahid@gmailk.com*

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ABSTRACT

The aim of this study was to estimate heritability, genetic and environmental correlation for weaning weight (WW), post-weaning weight (W_{3-6}), average daily gain before and after weaning (ADG0-3, ADG_{3-6}) and KR (KR) in Ghezel sheep. Gibbs3f90 software was used to estimate genetic parameters. Heritability for ADG0-3, ADG_{3-6}, and KR, WW and W_{3-6} traits was estimated to be 0.29, 0.31, 0.34, 0.29 and 0.22, respectively. Increased genetic correlation between traits ranged from -0.29 (ADG0-3- (ADG_{3-6}) to 0.95 (WW-ADG0-3). The genetic correlations of ADG0-3 with KR, ADG_{3-6}, WW and W_{3-6} were estimated to be 0.88, -0.29, 0.95 and 0.193, respectively. Also, the genetic correlation between KR and ADG_{3-6} was -0.276. The genetic correlation between KR and WW and W_{3-6} was estimated to be 0.703 and 0.106, respectively. Genetic correlation between WW and ADG_{3-6} was predicted to be about negative (-0.24). Environmental correlation between KR and ADG0-3, ADG_{3-6}, WW and W_{3-6} was estimated to be 0.84, -0.36, 0.53 and 0.01, respectively. The results of this study show that it is possible to improve the growth traits of Ghezel sheep in selection programs.

Keywords: Genetic parameters, Average daily gain, kleiber ratio, Ghezel sheep

INTRODUCTION

Early growth traits are the main factors affecting the profitability of mutton production units. Some of these traits have been suggested as selection criterion to produce meat in sheep. If these traits are included in the corrective program, accurate estimates of the corrective values will be needed to optimize the selection programs, which requires knowledge of the components of variance and covariance. Genetic improvement is one way to improve growth rate. In any selection program with the aim of increasing the performance of growth traits, improving feed conversion efficiency is essential to achieve maximum results. An indirect criterion for evaluating feed conversion ratio is the use of KR, as a large correlation between KR and feed efficiency is seen. KR is the ratio of Average Daily Gain (ADG) to metabolic body weight that can show growth rate in a very accurate way. KR can be determined under field conditions and has a positive correlation with average daily growth [1]. In fact, animals with larger KRs need less energy to maintain. Therefore, selection for KR leads to indirect selection for feed efficiency and improved feed efficiency and growth traits under centralized systems. Predicting feed conversion ratio using KR is 36% more accurate than predicting it using ADG reported that selection for KR can further improve the energy efficiency-related traits such as feed conversion ratio and growth rate without affecting feed consumption [2,3]. Showed that KR has a high correlation (-0.81) with feed conversion efficiency in beef cattle [4]. In addition, it is possible to select growth traits in each weight to improve the marketable weight of sheep. In order to improve growth rate and KR genetically, it is necessary to know about genetic parameters such as heritability and genetic correlations between traits. Genetic parameters may vary due to genotype, race, location, or herd [5]. Therefore, proper estimation of parameters for growth traits is important for corrective strategies and accurate estimation of corrective value. This genetic information is used to form optimal selection criteria in order to achieve genetic improvement in the desired traits through selection programs. A new topic in this study is to consider a wide range of average daily gain traits and kleiber ratios at different ages of Ghezel sheep. Therefore, the aim of this study is to estimate genetic parameters and genetic trends for average daily gain and kleiber ratios in Ghezel sheep.

MATERIALS AND METHODS

The collection of data and pedigree information used in this research was taken from Ghezel sheep breeding station between 1994 and 2011. Traits which are examined included the weight of 3 months (W_3), the weight of 6 months (W_6), average daily gain from birth to 3 months (ADG_3), average daily gain from 3 to 6 months (ADG_6), and kleiber ratio corresponding with average daily gain were calculated. The kleiber ratio has been proposed as a suitable indicator for animal growth efficiency and as an indirect selection criterion for feed conversion under field conditions. R software as well as Excel was used to edit the data, cfc software was used to determine the quality of the pedigree file. Also, to estimate genetic parameters of family members of genetic software blupf90 including renumf90, gibbs3f90 and postgibbsf90 were used to change the data format (file parameter, pedigree and data), multivariate genetic analysis, and analysis of the results of gibbs3f90 software, respectively to achieve genetic parameters and corrective values.

The statistical model used in this study was as follows:

Y is the matrix of variables of response or attributes under consideration.

X_i is the model of the fixed effect coefficients of the model for the i_{th} trait, β_i is the constant effects vector for the i_{th} trait, Z_i is the coefficient matrix for the random effects for the i_{th} trait, ai is the animal random vector for the i_{th} trait and ei is the residual effects vector for the i_{th} trait.

RESULTS AND DISCUSSION

Table 1 report the number of records used the average value, standard deviation and coefficient of variation for each of the studied traits. ADG_{0-3} of Ghezel lambs was calculated to be 0.175 grams per day. While ADG_{3-6} shows a downward trend (0.094 grams per day). This result is consistent with the results of who reported similar findings [6,7] . The amount of ADG_{0-3} in Sanjabi and Kermani breeds has been reported to be 187 and 174 grams per day, respectively. These results, especially at pre-weaning age, indicate that Ghezel lambs have high genetic potential, especially with appropriate nutritional conditions to enhance growth. In the present study, the mean KR for trout was calculated to be 0.016 g / day [8]. The mean KR is based on the fact that there is a direct relationship between body weight and animal maintenance and production needs . The mean KR in the pre-weaning period in Sanjabi and Kermani sheep was reported to be 15.6 and 19 g, respectively. KR and ADG play an important role in improving production performance and thus the profitability of the sheep industry. The results of research showed that the effect of sex has a significant effect on KR in different age periods in a number of Indian breeds and many breeds of Iranian sheep [9,10] . In addition, in many studies, the effect of birth season on ADG has been reported to be meaningful in a number of breeds such as Madras Red, Marwara and Nali. Also, the effect of birth season on KR has been meaningful in Iranian Moghani lambs and in Mecheri sheep [11]. The effect of ewe weight on fertility on ADG6-9 was significant in Madras Red sheep and also on ADG_{0-3} in Marravi sheep. In addition, reported a significant effect of ewe age on fertility on ADG_{0-3} and also on ADG_{3-6} in Madras-Red sheep [12]. The effect of calving on ADG and KR has also been reported to be insignificant. However, reported a meaningful effect of calving on ADG_{0-3} in Nali sheep, while they reported a significant effect of calving [13]. Coefficient of Variation (CV) is a normal criterion used to measure the distribution of statistical data. The coefficients of variation for WW and W_{3-6}, ADG_{0-3}, ADG_{3-6} and KR are 23.2% and 25.1%, 29%, 52% and 14.1%, respectively. In addition to the genetic potential of the animal itself, growth-related traits in livestock are also influenced by permanent maternal genetic and environmental factors. In the pre-weaning period, lambs are breastfed and are less exposed to environmental conditions. Therefore, animals show less reaction to environmental effects. This factor minimizes phenotypic variance (CV=29%). After the weaning period, most lambs' growth depends on the animals' access to food sources and pastures. Differences between lambs' performance in terms of growth rate and feed efficiency may not be well established during the pre-weaning period because maternal care can cover the weak genetic potential of lambs and vice versa [6,10].

Table 1: Descriptive statistics of growth traits in Ghezel sheep

Number of records			CV	Traits
12500	0.175	0.052	29	ADG_{0-3}
11200	0.094	0.050	52	ADG_{3-6}
11200	0.016	0.002	14.1	KR
12500	21.122	4.900	23.2	WW
12500	27.938	7.006	25.1	W_{3-6}

Note: ADG_{0-3}: growth rate until weaning, ADG_{3-6}: growth rate at 3 to 6 months, KR: KR, WW: weaning weight, W_{3-6}: live weight at 3 to 6 months, CV: coefficient of variation, σ: standard deviation, μ: average

Genetic parameters of growth traits

Table 2 shows the genetic parameters including estimation of genetic and environmental correlations and heritability for growth traits including ADG_{0-3}, ADG_{3-6}, KR, WW and W_{3-6} in the flock of Ghezel sheep. According to Table 2, the diameter elements are the estimated heritability value, and the upper and lower diameter elements are the values related to the environmental and genetic correlation coefficients, respectively. The heritability estimates indicate the amount of improvement that may be achieved by selecting a particular trait. Total heritability is estimated to be 0.29, 0.31, 0.34, 0.29 and 0.22 for ADG_{0-3}, ADG_{3-6}, KR, WW and W_{3-6}, respectively. For ADG_{0-3}, heritability estimates ranged from 0.03 for Sangesari sheep to 0.46 for Moroccan-Timahdit sheep [6]. If ADG_{0-3} is considered by breeders, the genetic potential of Ghezel sheep can be enhanced by using breeding techniques and selecting superior breeders for the next generation. According to the results of studies, heritability estimates for growth rate after weaning have a wider range and range from 0.02 in Moghani sheep to 0.7 in Menz sheep [6,14]. With age, the role of the genetic effect of the animal in the phenotype of growth traits increases and in contrast, the role of the mother environment decreases. This result is in line with other researchers' reports on sheep breeds at home and abroad. This seems natural given the current breeding conditions because as the animal ages, its ability to feed on pastures increases and the animal's dependence on the mother decreases. Differences in heritability estimates can be attributed to differences in body weight gain at different ages of sheep breeds, the type of model used to analyze the information, the structure and volume of information available to estimate the components of (Co) variance, and differences in Herd management programs and finally the implementation of different breeding strategies [8,15,16].

Table 1: Genetic parameters: Correlation coefficient and heritability of growth traits in Ghezel sheep

ADG_{0-3}	ADG_{3-6}	KR	WW	W_{3-6}	Traits
0.29	-0.46	0.84	0.87	0.08	ADG_{0-3}
-0.29	0.31	-0.36	-0.44	0.75	ADG_{3-6}
0.884	-0.276	0.34	0.53	0.01	KR
0.95	-0.244	0.703	0.29	0.14	WW
0.193	0.74	0.106	0.24	0.22	W_{3-6}

Note: The diameter elements of heritability, the upper and lower diameter elements are the environmental and genetic correlation coefficient between the traits, respectively. ADG_{0-3}: growth rate until weaning, ADG_{3-6}: growth rate at 3 to 6 months, KR: KR, WW: weight gain, W_{3-6}: live weight at 3 to 6 months

In this study, the heritability of KR (0.34) is higher than the values reported in other studies. For KR, heritability estimates have been reported in the range of 0.04 (Arman sheep) to 0.15 (Sanjabi sheep) [8]. Inheritance estimates for a trait can vary among sheep breeds and may change slightly over time. According to studies, heritability estimates show that KR is essentially a trait with low heritability in sheep. In beef cattle, higher estimates of heritability for KR have been reported. For example reported that heritability estimates range from 0.22 (KR at 205 days) to 0.54 (KR at 365 days) in the Herford breed [17]. These results indicate that heritability estimates are specific to each breed and species. For traits with low heritability, animal performance is less improved by identifying animals with the best genes for the trait [18]. For this reason, the choice for both ADG and KR for such animals should be based on estimates of breeding values [19]. Incremental genetic correlation between traits is in the range of -0.229 (ADG_{0-3} (ADG_{3-6} to 0.95 (WW-ADG_{0-3})) and it is in accordance with the results [20-22]. As can be seen in Table 2, the genetic correlation of KR with each of the ADG_{0-3}, ADG_{3-6}, WW and W_{3-6} traits has been estimated to be 0.88, -0.276, 0.703 and 0.106, respectively. A high and positive genetic correlation between KR and ADG_{0-3} means that lambs with higher growth rates are presumed to eat more, and by selecting them, the biological efficiency of the herd is improved. On the other hand, it seems that selection for KR could lead to favorable genetic responses in the reported those genetic and phenotypic correlations between ADG_{0-3} and KR in Dormer sheep are 0.93 and 0.94. Using the paternal model reported that a corresponding genetic correlation in Boer goats is 0.97 [23]. These estimates are consistent with the results obtained in the present study. Negative genetic correlation indicates that different mechanisms play a role in the expression of these traits at different growth ages [9]. The calculated environmental correlation between KR and each of ADG_{0-3}, ADG_{3-6}, WW and W_{3-6} traits was calculated to be 0.84, -0.36, 0.53 and 0.01, respectively, which has a similar process to genetic correlations. Negative environmental correlation between KR and ADG_{3-6} may be due to negative values for some animals [9]. Based on the estimates, it seems that growth efficiency in terms of KR can be used in selection programs to increase growth efficiency. In addition, the results show that using KR is important in breeding strategies in order to improve feed conversion efficiency and reduce production system costs [24-26].

In addition to genetic and environmental correlations between KR and each of the other traits, the genetic correlation between ADG_{0-3} and ADG_{3-6} was estimated to be about negative (-0.29). Reported that genetic correlation betweenADG_{0-3} and ADG_{3-6} is -0.13 [16]. Negative genetic correlation between ADG before and after weaning in Baluchisheep has been reported by other researchers [8] Genetic correlation between ADG_{0-3} and WW was calculated tobe positive and high (0.95) versus relatively lower correlation with W_{3-6} (0.193). Very high and positive genetic correlation indicates the existence of common and desirable genes for both traits. Therefore, breeders can improve the weight of weaning by selecting animals with high growth rate. Environmental correlations between ADG_{0-3} and ADG_{3-6} were calculated to be (-0.46), and between WW and ADG_{3-6} to be (-0.44), which are negative values. The environmental correlation between ADG_{0-3} and W_{3-6} is also estimated to be negligible (0.08). One strategy to increase meat production efficiency in both traditional and centralized systems involves selecting animals over feed efficiency. Because sheep's ability to feed efficiently varies, selecting the animals with the highest feed efficiency, and lower maintenance needs, significantly reduces production costs. Direct selection is not easy for less maintenance needs. However, feed efficiency measurements such as KR are used to achieve this goal [27]. In addition, reported a strong correlation between KR and feed conversion ratio (-0.81) in bulls [4]. Also, there is a positive genetic correlation between KR and growth-related traits [28]. These findings suggest that improved feed efficiency can occur without adverse effect on body weight or growth rate. In addition to heritability, the genetic correlation between the desired traits and the economic weight of the traits are also important to allow a trait to be considered in the selection index. The high economic weight of the trait can compensate for its low heritability. Finally, since traits have moderate heritability, animal selection should be based on selection methods [29,30].

Estimation of genetic trends

Figures 1 and 2 show the estimated annual genetic trend (mean annual increase in EBV) of the growth traits studied in the present study from 1994 to 2011. Positive genetic improvement has shown a difference in the right and impressive choice in selection programs. According to Figure 1, the genetic trends in ADG_{0-3}, ADG_{3-6} and KR do not show a continuous and directional pattern. Also, the genetic trends of these traits are relatively similar to each other, which can be due to a lot of genetic correlation between these traits. The genetic trend in ADG_{0-3} and KR 76 to 81 shows a growing trend, but the growth trend in these traits is almost sinusoidal or constant in other years. This type of process can have many reasons, but in this particular case it seems that the reason is the inefficiency of selection or breeding in this breed. The ADG_{3-6} trait has almost the same pattern, except that it shows an upward trend from 76 to 78 and a downward trend from 78 to 83 with a very gentle slope, and returns almost to its original state [31-34].

According to Figure 2, genetic trends in W3 and W6 traits have a more specific trend than the traits mentioned above, so that from the beginning to 2002, it has an increasing trend and then has a relatively constant state. The amount of genetic improvement in the six-month-old trait was higher than all other traits, and this may be because this trait was the main target of selection [35-39].

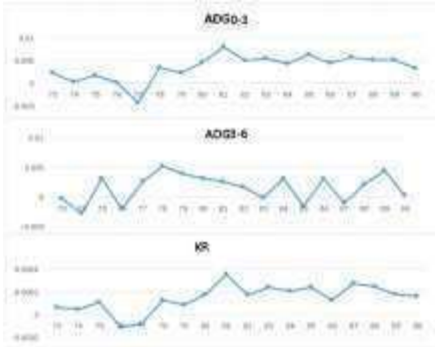

Figure 1. Genetic trend of ADG_{0-3}, ADG_{3-6} and KR traits

Figure 2. Genetic trend of W_3, W_6 traits

CONCLUSION

The response to selection can be estimated from the annual genetic trend (mean annual increase in EBV) without the need to compare with the control herd. Genetic trends reported for weaning weight in tropical sheep have included 0.092 kg for Rahmani sheep, 0.020 kg for Ossimi sheep and 0.25 kg for Barki sheep reported that an annual genetic response to 6 months weight is 0.059 kg. The genetic trend for growth rate before weaning increased by 0.01 and 0.01 (kg/year), respectively Genetic trend estimates for WW were 7 gr/year in Baluchi breed, 40.6 gr/year in Dormer breed, 96 gr/year in Dorper sheep, 128 gr/year in Kurdish sheep and 167 gr/year in Afshar sheep. Differences in genetic trends between breeds can be due to different selection criteria which is different among sheep breeds. Annual positive genetic trends for growth traits in the present study can be attributed to moderate estimates for heritability and positive and high genetic correlations between traits. Therefore, moderate genetic development for these traits in the Ghezel breed can be achieved through selection under the Ghezel sheep breeding management system.

REFERENCES

1. Anil Pavan,KD., Prakash,MG., Gupta,BR., et al. J Pharm Innov. 2017;6(6): 194-197.
2. Badenhorst,M.A. The shepherd. 2011;4(1):9-12.
3. Hoque,MA.,Hosono,M.,Oikawa,T.,et al. Anim Sci J. 2009;87(1):99-06.
4. Arthur,PF., Renand,G., Krauss,D. Livest Prod Sci. 2001;68(2):131-139.
5. Abegaz,S.,van Wyk., J.B. Olivier, JJ. S Afr J Anim. Sci. 2005;1(1):35.
6. GhafouriKesbi,F. Archiv Tierzucht. 2013;56(1):564-572. .
7. Mokhtari,MS.,Moradi,SM.,Moradi,SH., et al. J Livest Sci Tech. 2013;1(1):35-43. .
8. Saqi,DA., Shahdadi,AR. Iranian Anim Res J. 2016;8(2): 370-381.
9. Hedayatollah,R. Int J Adv Biol Biom Res. 2014;2(11):2830-2836.
10. Jeichitra,V., Rajendran,R. Indian Vet J. 2014; 91(7):17-19.

11. Sima,SS., Ardeshir,NJ., Mokhtar,A. et al. World Appl Sci J. 2011;14(9):1313-1319.
12. Sivakumar,T., Balasubramanyam,D., Jawahar,K.,et al. Indian j small rumin. 2009;15(2):248-252.
13. Albial,AM, Singh,J., Singh,DP.,et al. Indian J Anim Res. 2014; 48(1):75-77. .
14. Mohammadi,Y.,Rashidi,A.,Mokhtari,MS.,etal. Small Rumin Res. 2010;93(2):88-93. .
15. Mokhtari,MS., Rashidi,A., Mohammadi,Y. Small Rumin Res. 2008;80(1):22-27.
16. Vatankhah,M., Moradi,SM., Nejati-Javarmi,A., et al. J. Anim. Sci. 2005;69(1):19-28
17. Köster,E., VanDer,WJ., Erasmus,GJ. S Afr J Anim Sci. 1994;24(1):71-72
18. Cassel,B. Using Heritability for Genetic Improvement. 2009 .
19. Janssens,S., Vandepitte,W. Small Rumin Res. 2004;54(1):13-24.
20. Savar,SS., Nejati,JA., Abbasi,MA.,et al. World Appl Sci J. 2011;14(9):1313-1319
21. Maria,GA., Boldman,KG., VanVleck,LD. J Anim Sci. 1993;71(1):845-849.
22. VanNiekerk,MM., Schoeman,SJ., Botha,ME. S Afr J Anim Sci. 1996;26(1):6-10.
23. Yazdi,MH., Engstrom,G., Nasholm,A.,et al. J Anim Sci. 1997;65(2):247-255.
24. Kleiber,M. Physiol Rev. 1947;27(4):511-541
25. Ghafouri,KF., Abbasi,MA., Afraz,F.,etal. Trop Anim Health Prod. 2011;43(6):1153-1159.
26. Gizaw,S., Lemma,S., Komen,H.,et al. Small Rumin Res. 2007;70(2):145-153.
27. Klerk,HC., Heydenrych,HJ. BLUP analysis of genetic trends in the Dohne Merino. 1990
28. Bosso,NA., Cissé,MF., VanDerWaaij,EH.,et al. Small Rumin Res. 2007;67(2):271-278.
29. GhafouriKesbi,F., Eskandarinasab,MP., Hassanabadi,A. Can J Anim Sci. 2009;89(3):301-307.
30. Boujenane,I.,Boujenane,IT. Small Rumi Res. 2017;146(1):61-68.
31. Gholizadeh,M.,GhafouriKesbi,F. Meta Gene. 2017;13(1):119-123.
32. Abbasi,MA., Abdollahi,AR., Maghsoudi,A.,et al. Small Rumin Res. 2012;104(1):62-69.
33. Chopra,A., Prince,LLL., Gowane,GR., et al. Indian J Anim Sci. 2010; 80(4):376-378.
34. Eskandarinasab,M., GhafouriKesbi,F., Abbasi,M. J Anim Breed Genet. 2010;127(1):26-33.
35. On Genetics Applied to Livestock Production, vol. XV, Edinburgh, UK, 23–27 July. Beef Cattle Sheep Pig Genet. Breed. Fiber. 1990.
36. Fur Meat Qual. 15, 77–80.
37. Rashidi,A.,Mokhtari,MS.,SafiJahanshahi,A.,etal. Small Rumin Res. 2008;74(1):165-171.
38. Supakorn,C., Pralomkarn,W. Songklanakarin J Sci Technol. 2012;34(1):165-172
39. Van Wyk,JB., Erasmus,GJ., Konstantinov,KV. S Afr J Anim Sci. 1993;23(3):72-76.