Small Ruminant Research 104 (2012) 62–69

Contents lists available at SciVerse ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

# Evaluation of models for estimation of genetic parameters and maternal effects for early growth traits of Iranian Baluchi sheep

M.A. Abbasi[a], R. Abdollahi-Arpanahi[b,*], A. Maghsoudi[c], R. Vaez Torshizi[c], A. Nejati-Javaremi[b]

[a] Department of Animal Breeding and Genetics, Animal Science Research Institute, Karaj, Iran
[b] Department of Animal Science, University College of Agriculture and Natural Resources, University of Tehran, 31587-77871 Karaj, Iran
[c] Department of Animal Science, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran

ARTICLE INFO

*Article history:*
Received 24 August 2010
Received in revised form 17 August 2011
Accepted 11 October 2011
Available online 1 November 2011

*Key words:*
Early growth traits
Maternal effects
Genetic parameters
Baluchi sheep

ABSTRACT

Genetic and non-genetic parameters were estimated for early growth traits of Iranian Baluchi lambs using univariate and multivariate models. The investigated traits were: birth weight (BWT), weaning weight (WWT), 6-month weight (6MW) and pre-weaning average daily gain (ADG). Data and pedigree information used in this research were collected at the Abbasabad Sheep Breeding Station during a period between 1973 and 2003 on 15,568 lambs descended from 326 sires and 4737 dams. Twelve models including different combination of direct and maternal effects (additive genetic, permanent environmental and common environmental) as well as additive genetic relationship between direct and maternal effects were used to analyze data. For each trait, the most appropriate model was chosen based on likelihood ratio tests. In addition, multivariate analysis was performed using the most appropriate models obtained in univariate analysis. Based on the most appropriate fitted models, estimates of direct heritabilities were $0.12 \pm 0.02$, $0.10 \pm 0.02$, $0.06 \pm 0.01$ and $0.09 \pm 0.02$ for BWT, WWT, 6MW and ADG, respectively. Estimates of maternal additive genetic and maternal permanent environmental variances, as a proportion of phenotypic variance ($m^2$ and $pe^2$, respectively) were $0.08 \pm 0.02$ and $0.08 \pm 0.01$ for BWT, $0.04 \pm 0.01$ and $0.09 \pm 0.01$ for WWT, $0.03 \pm 0.01$ and $0.03 \pm 0.01$ for 6MW, and, $0.01 \pm 0.01$ and $0.08 \pm 0.01$ for ADG, respectively. Maternal common environmental component was significant only on BWT and was estimated to be $0.19 \pm 0.02$. The estimate of maternal common environmental variances as a proportion of phenotypic variance ($c^2$) was significant only for BWT ($0.19 \pm 0.02$). Direct genetic correlations among studied traits were positive and ranged from 0.37 (BWT–6MW) to 0.98 (WWT–ADG). Maternal genetic correlation estimates between studied traits were positive varying from 0.11 (BWT–ADG) to 0.64 (ADG–6MW). The estimates of phenotypic and environmental correlations were positive and generally lower than those of genetic correlations. Results indicated that besides direct genetic effects, maternal effects should be included in the statistical model to obtain accurate estimates of genetic parameters for early growth traits.



## 1. Introduction

The growth potential of lambs is one of the most important factors in genetic improvement schemes. Particularly in small ruminants, fast growth rate ultimately determines their meat producing capability up to marketing age, therefore, affects economic success of producing system. In

* Corresponding author. Tel.: +98 2612248082; fax: +98 2612246752.
*E-mail address:* r.abdollahi@ut.ac.ir (R. Abdollahi-Arpanahi).

0921-4488/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.smallrumres.2011.10.003

mammals, including most livestock species, because there are long periods of maternal dependence, the early growth traits are not controlled only by direct additive genetic effects but also by maternal effects (Ghafouri-Kesbi and Eskandarinasab, 2008; Maghsoudi et al., 2009). In multiparous animals, maternal environmental effect can be partitioned in to permanent and common sectors. However, the later has been ignored in most genetic studies on growth traits. In species having several progenies per parturition, progenies (full sibs) share a common environment that contributes to the likeness among them, which is a further source of variation among families (Falconer and Mackay, 1996). This resemblance refers to some common factors such as nutrition, maternal common care and climatic or nest conditions.

Studies on growth traits have shown that including common environmental effect in animal models, significantly affected the estimates of direct heritability ($h^2$), even in some studies the proportion of common environmental effect to phenotypic variance ($c^2$) was higher than direct and maternal heritabilities (e.g. Ekiz, 2005). This researcher found that considering common environmental effect in animal models could decrease direct heritabilities for pre and post weaning average daily gains by 25.3 and 2.3%, respectively.

The Baluchi sheep is the most common breed in Iran, constituting 30% of total sheep population, approximately 15 million heads (Madad and Ghazanfari, 1999). This breed is well adapted to a wide range of harsh environments from north-east to south-east of the country and commonly reared on low quality pastures via household extensively systems. Small stature and particularly physiological characters of Baluchi sheep make this breed to have a remarkable tolerance against unfavorable natural conditions. For this reason, the Baluchi sheep categorized as a high quality mutton producing breed with low cost.

In order to defining the breeding objectives and designing breeding strategies for Baluchi sheep, genetic and non-genetic parameters of the important economic traits such as body weight at different ages should be recognized. While there are estimates of genetic and non-genetic parameters for some growth traits of Baluchi sheep (Khalili et al., 2002; Yazdi et al., 1997, 1999), but, in these studies common environmental effect has not been included in the analyses. Therefore, the objectives of the current study were, firstly, to determine the most appropriate models to estimate genetic (direct and maternal) and non-genetic (permanent and common environmental maternal) parameters of some early growth traits in Baluchi lambs. Investigation of the genetic and non-genetic relationships among the studied traits was the secondary objective.

## 2. Materials and methods

### 2.1. Animals and management

The information used in the current research was retrieved from Abbasabad Breeding and Rearing Station of Baluchi sheep, located in north-east of Mashhad, Khorasan Razavi province, Iran. In the station, ewes expose to selected rams at about 18 months of age for fist time. Rams are selected based on estimated breeding values for body weight and body conformation traits. The mating season commences in August and ends in November. Normally one breeding ram is allowed to mate with 20–25 ewes and is kept in the flock until 5 years of age. The main reasons for both ewes and rams culling are infertility and natural causes (e.g. disease). Lambing season starts in early February and ends in late March. At lambing, lambing date, number of lambs born, sex of lambs, and lamb birth weights are recorded. The suckling stage lasts for 90 days on average. To protect the animals from the local prevalent diseases, vaccinations are performed twice a year. In addition, animals are dewormed with drugs and dipped in antiparasite bath twice a year. From early-spring to mid-autumn animals are kept on natural pastures and complementary handfed in the rest of the year.

### 2.2. Data

The analyzed characters were body weight at birth (BWT), weaning (WWT) and 6 months of age (6MW) along with pre-weaning average daily gain (ADG). These performance records were collected from 1973 to 2003 on 15,568 lambs which were the progeny of 326 rams and 4737 ewes. Data structure of the investigated traits is presented in Table 1.

Animals with unknown sires and dams were 0.58% and 3.18%, respectively. Records of lambs with missing both parents information were not considered in the final investigations. Out of date or sequence records was discarded, moreover. As told later, lambing season last about 2 months, which result in variation among age of lambs at weaning and other weight traits after weaning. Thus, before data analyses, weaning and 6-month weights were adjusted to 90 and 180 days of age, respectively. While both genetic and permanent maternal effects significantly affect on early growth rate of mammals' litters (Bijma, 2006; Maghsoudi et al., 2009), only body weights of those lambs that were reared with own biological mother included.

### 2.3. Statistical models

In order to identify fixed effects to be included in the models, least square analyses were conducted using GLM procedure (SAS, 2004). The model accounted for fixed effects included: flocks (1 and 2); year of

**Table 1**
Data structure for body weight at different ages and pre weaning average daily gain of Baluchi lambs.

| | Performances | | | |
|---|---|---|---|---|
| | BWT | WWT | 6MW | ADG |
| Number of base animals | 2011 | 1970 | 1952 | 1970 |
| Number of animals with records | 15,568 | 13,900 | 12,914 | 13,989 |
| Number of animals with unknown sire | 91 | 86 | 82 | 85 |
| Number of animals with unknown dam | 308 | 343 | 411 | 336 |
| Number of sires with progeny records | 326 | 320 | 310 | 321 |
| Number of dams with progeny records | 4737 | 4490 | 4282 | 4507 |
| Means (kg) | 4.27 | 22.24 | 32.70 | 198.50 |
| Standard deviations (kg) | 0.58 | 3.51 | 6.17 | 38.00 |
| C.V. (%) | 13.5 | 15.8 | 18.9 | 19.1 |

Birth weight (BWT), weaning weight (WWT), 6-month weight (6MW) and pre-weaning average daily gain (ADG). The unit of all traits is in kg but ADG which is g.