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PHENOTYPIC AND GENETIC CHARACTERISTICS OF GROWTH AND CARCASS TRAITS OF LORI-BAKHTIARI SHEEP**

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Abstract: In this study, direct and maternal heritabilities were estimated for growth traits and carcass characteristics in Lori-Bakhtiari sheep. Data for birth weight (BW; n=5826), weaning weight (WW; n=5408), body weight at six months of age (6MW; n=4237), body weight at slaughter (SW; n=396), cold carcass weight (CCW; n=291), lean weight (LW; n=204), bone weight (WB; n=291), fat weight (WF; n=204) and fat-tail weight (FTW; n=396) were used to estimate the heritabilities. The data for first three traits had been collected during seventeen years, 1990 to 2006, while for other traits had been collected during six years, 2000 to 2006. Genetic parameters including both direct and maternal genetic effects were estimated using multivariate animal models, and a Derivative Free Restricted Maximum Likelihood (DFREML) approach. The direct heritability for BW, WW, 6MW, SW, CCW, LW, WB, WF and FTW were 0.30 ± 0.03, 0.13 ± 0.03, 0.20 ± 0.03, 0.24 ± 0.06, 0.16 ± 0.06, 0.16 ± 0.06, 0.20 ± 0.11, 0.23 ± 0.11, and 0.27 ± 0.11, respectively. Maternal heritability estimates were 0.22, 0.17, 0.06, 0.10, 0.09, 0.15, 0.26, 0.06 and 0.07 for BW, WW, 6MW, SW, CCW, LW, WB, WF and FTW, respectively. Consequently, genetic progress is possible for growth traits and carcass composition by selection.

Key words: Genetic parameters; growth; carcass; Lori-Bakhtiari sheep.

Introduction and literature review

Lori-Bakhtiari is a fat-tailed breed of sheep, with a population more than

1.7 million, which is well adapted to hilly and mountain ranges of Bakhtiari region, west of Isfahan stretched out to Southern Zagros Mountain. Relative to other Iranian fat-tailed breeds Lori-Bakhtiari is a large breed, having the largest fat-tail. The typical color of this sheep is creamy white, however, black and brown colored individuals are also found in the population.

Improving growth performance and carcass characteristics of lambs are very essential for meat production. The relative importance of direct and maternal additive genetic effects for growth should be considered when sheep producers formulate their breeding plans. Profitability of sheep production for meat depends to a great extent on lamb growth and carcass traits, which the later is mainly used to assess muscle development and fatness, as important economic factors. Moreover, in numerous countries, these traits are used in breeding programs for young male (*Banks,* 1997). In order to optimize such a selection program, the genetic parameters of these traits have to be estimated for the assessment of breeding values and to compare responses from different selection schemes. This has been done for variety of sheep breeds (*Fogarty,* 1995*; Safari et al,* 2005), but no estimates have yet been made for carcass traits in the Lori-Bakhtiari sheep. The objective of this study was to estimate variance due to additive direct and maternal genetic effects as well as the heritabilities of growth and carcass traits of Lori-Bakhtiari lambs.

Materials and methods

In this study, data for birth weight (BW; n=5826), weaning weight (WW; n=5408), body weight at six months of age (6MW; n=4237), body weight at slaughter (SW; n=396), cold carcass weight (CCW; n=291), lean weight (LW; n=204), bone weight (WB; n=291), fat weight (WF; n=204) and fat-tail weight (FTW; n=396) were analyzed. The data for first three traits had been collected during seventeen years, 1990 to 2006, while for other traits had been collected during six years, 2000 to 2006. All of the data came from Lori-Bakhtiari sheep breeding station in Chaharmahal and Bakhtiari province, Iran. The station flock was kept generally from December to May inside the barn and the sheep were fed with alfalfa, barley and wheat stubbles, and they were grazed on range and cereal remainder in other months of the year. The breeding season was from late August to late October and ewes were assigned randomly to the rams. About 15 days after parturition, the lambs were creep-fed during the suckling period. The creep-ration consisted of 50% barley, 10% cotton seed meal, 20% wheat bran, 18%

dried sugar beet pulp, 1% bone meal, 0.5% salt and 0.5% vitamin, mineral and antibiotic supplement. The ration was ground, mixed and fed *ad libitum*. Lambs had also access to free choice alfalfa hay. The lambs were weaned at 90±5 days of age, of which their body weights were measured and recorded. After weaning, female lambs were kept on pasture and male lambs remained in drylot until six months of age. The ration, fed to male lambs, contained alfalfa hay, barley, beet pulp, cottonseed meal, salt and mineral supplements, which were ground and mixed. Body weight was recorded at 6 month of age. Lambs were slaughtered at 196±27 days of age in different years. After slaughtering and skinning, all the abdominal and thoracic organs were removed. The fatty tissues surrounding kidney (kidney fat), heart (pericardial fat) and those in the abdominal cavity (omental and mesentery fat) were separated and weighted. The warm carcass was weighed immediately after dressing and removal of offal parts. The carcasses were chilled at 3±2 °C for approximately 18 h, and then cold carcasses were weighed and separated into right and left sides. The right side was disjointed into the commercial wholesale cuts traditionally offered in Iran. The cuts were leg, shoulder, back (loin + fore-rib), flap (flank + brisket), neck and fat-tail. The method of cutting is described by *Farid* (1998). All cuts were trimmed, removing subcutaneous fat, intermuscular fat, de-boned and the weight of each component was recorded. Data were analyzed using multiple trait derivative free restricted maximum likelihood (DFREML) methods (*Meyer*, 2000). The employed eighth-trait animal model was as follows:

$$y_i = X_i b_i + Z_i a_i + W_i m_i + e_i$$

Where $\mathbf{y_i}$ is a vector of observations for trait i, $\mathbf{b_i}$ is a vector of fixed effects for trait i, $\mathbf{b_1}$, $\mathbf{b_2}$, $\mathbf{b_3}$ and $\mathbf{b_4}$ includes year of lambing, age of dam, sex and type of birth of lamb, $\mathbf{b_5}$, $\mathbf{b_6}$, $\mathbf{b_7}$ and $\mathbf{b_8}$ includes year of lambing, age of dam, type of birth of lamb and age of lamb at evaluation as covariate, $\mathbf{a_i}$ is a random vector of direct additive genetic effects of the animals for trait i, $\mathbf{m_i}$ is a vector of random maternal additive genetic effects for trait i, $\mathbf{e_i}$ is a vector of random residual effects for trait i, and $\mathbf{X_i}$, $\mathbf{Z_i}$ and $\mathbf{W_i}$ are known incidence matrices relating the observations to the fixed and random effects in the model.

Results of investigation and discussion

The average, standard deviation and coefficients of variation for BW, WW, 6MW, SW, CCW, LW, WB, WF and FTW of the lambs are presented in Table 1. The average for BW, WW and 6MW in this study was in the range reported by *Safari and Fogarty* (2003) that summarized published genetic parameters for sheep production traits, and reported means from 4.1, 17.6 and 38.8 to 5.8, 47.2 and 63.2 kg, for BW, WW and 6MW for meat breeds, respectively. The coefficients of variation for BW, WW and 6MW were 15.77, 18.81 and 19.20 percent, respectively, which were in the range reported by *Fogarty* (1995), *Safari and Fogarty* (2003) and *Vatankhah et al* (2005). The coefficients of variation for WF and FTW were 35.31 and 45.85 percent, respectively. *Waldron et al* (1992) reported that coefficient of variation for fat and meat were 25 and 13 percent in the carcass of lambs of Romney and its crosses. It is important to note, that considerable variation exists for growth and carcass composition traits, especially for carcass fat and fat-tail.

Table 1. Number of records, means (±S.D.), coefficient of variation (C.V.) for considered traits

Trait acronyms	Trait	No. of records	Means ± S.D.	C.V.(%)
BW	Birth weight	5826	4.85 ± 0.77	15.77
WW	Weaning weight	5408	27.61 ± 5.19	18.81
6MW	Body weight at 6 months of age	4237	39.79 ± 7.64	19.20
SW	Body weight at slaughter	396	43.64 ± 8.04	18.42
CCW	Cold carcass weight	291	22.07 ± 4.28	19.40
LW	Carcass lean weight	204	11.05 ± 1.85	16.74
WB	Carcass bone weight	291	3.47 ± 0.45	12.87
WF	Carcass fat weight	204	6.38 ± 2.25	35.31
FTW	Carcass fat-tail weight	396	3.25 ± 1.49	45.85

Estimates of variance components, direct and maternal heritability of the traits are given in Table 2. The direct heritability for growth and carcass traits was from low to moderate in magnitude and ranged from 0.13 to 0.30. Direct heritability was higher for BW and lower for WW and increased with age to post weaning. The heritability estimates of growth traits in current study are not different from the reported heritabilities by most researchers (*Fogarty*, 1995; *Safari and Fogarty*, 2003; *Vatankhah et al,* 2005). The direct heritabilities of SW and CCW were 0.24 and 0.16, respectively, which were lower than the 0.29 and 0.22 reported for Southdown × Romney lambs (*Bennett et al*, 1991), however, heritability of carcass weight was in the range reported by *Safari and Fogarty* (2003). WF and FTW were more heritable than LW. These results are similar with those reported by *Bennett et al* (1991) for fat and fat-free carcass weight.

Table2. Estimates of variance components and genetic parameters for the considered traits

Trait	σ^2_a	σ^2_m	σ^2_e	σ^2_p	h^2	m^2
BW	0.11	0.08	0.18	0.38	0.30 ± 0.03	0.22 ± 0.02
WW	2.15	2.73	11.68	16.56	0.13 ± 0.03	0.17 ± 0.02
6MW	5.94	1.82	22.20	29.96	0.20 ± 0.03	0.06 ± 0.02
SW	7.39	3.20	20.55	31.14	0.24 ± 0.06	0.10 ± 0.04
CCW	1.61	0.39	7.71	10.25	0.16 ± 0.06	0.09 ± 0.04
LW	0.38	0.33	1.59	2.30	0.16 ± 0.06	0.15 ± 0.06
WB	0.10	0.04	0.09	0.16	0.20 ± 0.11	0.26 ± 0.07
WF	0.74	0.18	2.33	3.25	0.23 ± 0.11	0.06 ± 0.07
FTW	0.32	0.09	0.80	1.20	0.27 ± 0.11	0.07 ± 0.06

σ^2_a , direct additive genetic variance ; σ^2_m , maternal additive genetic variance ; σ^2_e , residual variance ; σ^2_p , phenotypic variance ; h^2 , direct heritability ; m^2 , maternal heritability.

The maternal heritability for live weight declined with increasing age from birth to post-weaning weights, as maternal effects were considerably higher at birth and weaning and the share of this component in the total variance of the trait was more than the variance of the direct additive effects for WW (Table 2). As the age of lamb increases, the environmental relationship between individual traits and maternal potentials after birth to weaning and afterwards, will gradually reduce. *Burfening and Kress* (1993) utilized information of maternal and paternal half-sibs, full-sibs and offspring on dam and sire for three breeds, Ramboulliet, Targhee and Columbia, and obtained maternal heritability of 0.30 to 0.65 and 0.07 to 0.48 for birth weight and 120-d weight, respectively, which are generally larger than direct heritability estimates. All the estimates on maternal heritability for carcass traits were generally lower compared to direct heritability, except for the estimate on WB. Maternal heritability estimates concerning carcass characteristics of sheep are scarce in the literature (*Safari and Fogarty*, 2003).

Conclusion

Consequently, according to the present study, considerable variation exists for growth and carcass composition traits, especially for carcass fat

and fat-tail. Genetic improvement is possible for growth traits and carcass composition, that selection for decreased carcass fat and fat-tail also will improve carcass composition.

FENOTIPSKE I GENETSKE KARAKTERISTIKE OSOBINA PORASTA I TRUPA OVACA RASE LORI-BAKHTIARI

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Rezime

U ovom ispitivanju ocenjivani su direktni heritabiliteti i heritabiliteti sa majčinske strane za osobine porasta i karakteristike trupa kod ovaca rase lori-bakhtiari. Za ocenu heritabiliteta korišćeni su podaci o težini na rođenju (BW; n=5826), težini pri odbijanju (WW; n=5408), težini u uzrastu od šest meseci (6MW; n=4237), težini pre klanja (SW; n=396), masi hladnog trupa (CCW; n=291), težini/količini mesa (LW; n=204), težini/količini kostiju (WB; n=291), težini/količini masti (WF; n=204) i težini/količini masti u repu (FTW; n=396). Podaci za prve tri osobine su sakupljani tokom sedamnaest godina, od 1990. do 2006. godine, a za ostale osobine tokom šest godina, od 2000. do 2006. godine. Svi podaci su dobijeni iz stanice za odgoj ovaca rase lori-bakhtiari u provincijama Chaharmahal i Bakhtiari, u Iranu. Genetski parametri uključujući direktne i genetske uticaje sa majčinske strane su ocenjivani korišćenjem animalnih modela višestrukih varijanti i pristup Derivative Free Restricted Maximum Likelihood (DFREML). Srednje i standardno odstupanje za osobine BW, WW, 6MW, SW, CCW, LW, WB, WF i FTW je bilo 4.85 ± 0.77, 27.61 ± 5.19, 39.79 ± 7.64, 43.64 ± 8.04, 22.07 ± 4.28, 11.05 ± 1.85, 3.47 ± 0.45, 6.38 ± 2.25 i 3.25 ± 1.49 kg, respektivno. Direktni heritabilitet za osobine BW, WW, 6MW, SW, CCW, LW, WB, WF i FTW je bio 0.30 ± 0.03, 0.13 ± 0.03, 0.20 ± 0.03, 0.24 ± 0.06, 0.16 ± 0.06, 0.16 ± 0.06, 0.20 ± 0.11, 0.23 ± 0.11, i 0.27 ± 0.11, respektivno. Procene heritabiliteta sa majčinske strane su bile 0.22, 0.17, 0.06, 0.10, 0.09, 0.15, 0.26, 0.06 i 0.07 za osobine BW, WW, 6MB, SW, CCW, LW, WB, WF i FTW, respektivno. Prema tome, postoje značajne varijacije kod osobina porasta i sastava trupa, posebno za osobinu mast u

trupu. Genetsko poboljšanje je moguće za osobine porasta i sastav trupa, a selekcija na smanjenje masti u trupu će uticati na poboljšanje sastava trupa.

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