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Full Length Research Paper

Heritability of pre-weaning growth performance traits in Mengali sheep in (Balochistan) Pakistan

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Genetic parameters were estimated for weights at birth (BW), 30 days (MW), 120 days weaning weight (WW), and pre-weaning average daily gain (PRADG) of four flocks of Mengali sheep maintained at the Experimental Station CASVAB, Quetta, (ESC), Mastung, Noshki and Quetta over a period of 5 years from 2005 to 2009. Records on 2750 lambs descended from 581 ewes and 56 rams were included in the analysis. Variance components were estimated fitting animal model using restricted maximum likelihood (REML) procedure. Genetic parameters were computed by pos-processing of the variance components. The heritability estimates for BW, MW, WW, and PRADG were 0.39 ± 0.06; 0.125 ± 0.02; 0.177 ± 0.03 and 0.23 ± 0.05, respectively. BW was highly heritable while other growth traits were found moderately heritable, showing larger proportional of environmental variances. In general, heritability estimates were moderate in early growth traits of Mengali sheep. Hence it was suggested that improvement can be achieved by mass selection.

Key words: Genetic parameters, Mengali sheep, heritability estimates.

INTRODUCTION

Mengali sheep is an important sheep breed of Balochistan which is black or brown with white patches on the body (Khan et al., 2007; Kakar and Ahmad, 2004) but poorly documented and not recognized in the census up till 2006. The animals are well adapted to the local conditions of most of the Districts of Quetta, Khuzdar, Chaghi, Kalat, Mastung, Awaran and Kharan of Balochistan Province. Source of origin of Mengali sheep is still unknown. This sheep breed is mostly raised by native Baloch tribe “Mengal” (main tribe of Chaghi area). The breed is therefore known as Mengali of the region for adoptability and profitability. Since animals of this breed have been isolated from other sheep breeds, they were expected to have developed some distinctive characteristics. Information on this breed is scanty and its current population status is not known. No evaluation or improvement program has been undertaken for this breed before. Sheep raising in Pakistan (especially in Balochistan) and neighboring countries is mostly kept by local pastoralists on extensive production system. In such a system, output is lower than in an intensive system. Within local area natural selection of breeds is an appropriate method for genetic improvement in the traditional low input production systems of small ruminants (Khan et al., 2007; Akhtar et al., 2008; Ali, 2008).

Performance traits of farm animals are determined not only by an animal's genetic potential for growth but also by maternal genetic and permanent and temporary environmental effects. Hence, to achieve optimum genetic progress in a selection program, both direct and maternal genetic components should be taken into account, especially if there is not an antagonistic relationship between them (Meyer, 1992; Snowder and Van Veilk, 2003)

Numerous studies have been conducted to estimate the heritability of performance traits of different sheep breeds reported by several researchers; Yazdi et al. (1997) in Baluchi sheep found low estimates for BW. Shaat et al. (2004) who studied the genetic trends for

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Lamb weights in flocks of Egyptian Rahmani and Ossimi sheep observed moderate estimates for BW. Refik et al. (2009) who studied the genetic and non-genetic influences on the body weights of Turkish Merino were evaluated using REML reported low estimates for BW however, moderate for WW. Borg et al. (2009) also analyzed the data of Targhee flock used to estimate genetic and environmental relationships between lamb birth weight and adult ewe weight, condition score, and prolificacy and estimates for BW and WW found were low. In Pakistan, few workers have also done their research on the same lines: Qureshi et al. (1992) did in Kajli; Babar (1994) in Lohi. Akhtar (1996) in Hissardale sheep used paternal half sib correlation method (PHSC) while, Hussain (2006) in Thalli sheep had used restricted maximum likelihood (REML) to estimate the heritability estimates. Especially in Balochistan Province, 48% of sheep populations of Pakistan exist but scarce research has been carried out to explore their real genetic potentials. Only some efforts have been done by Sharif (2001) in Balochi and Bibrik sheep breeds, and Ali (2008) on some of the performance traits of Karakul sheep. Such heritability estimates of performance traits are not yet available for Mengali sheep. Therefore the present study was conducted in order to estimate heritability of some performance traits (birth weight to pre-weaning weight) of economic importance in Mengali sheep breed by using multivariate animal models.

MATERIALS AND METHODS

The data used in this study were scored from 2005 to 2009 on 2750 lambs obtained from 581 dams and 56 sires of Mengali sheep. Mengali flocks were kept in four stations at three different locations (Experimental Station CASVAB, UoB, Quetta (ESC), Killi Hassni, Quetta; Khadkucha, Mastung and Peer Wala, Noshki). The traits included in the present study were weights at birth (BW), 30 days (MW), 120 days, Weaning weight (WW), and Pre-weaning average daily gain (PRADG). Animal ID, sire ID, dam ID and lamb IDs were checked. Pedigree and other pertaining information were obtained from the record registers maintained at these farms. Data were checked for inconsistencies.

Animal model was fitted using REML procedure. ASREML Version 2.0 (Gilmour et al., 2007) was used for computing genetic parameters like heritability, genetic and phenotypic correlations. The statistical model fitted for estimation of heritability was as follows:

$$Y_{ijklm} = \mu + H_i + P_j + A_k + a_{ijkl} + e_{ijkl}$$

Where

μ = overall mean
H_i = effect of i^{th} flock (1-4)
P_j = effect of j^{th} parity group (1-2^{nd} and later)
A_k = age of dam
a_{ijkl} = random animal effect
e_{ijkl} = random error associated with each observation, assumed as normally distributed with mean zero and variance σ_e^2

For computing genetic parameters, an analysis of variance was performed prior to fitting the statistical model. Only significant fixed effects were included in the final model.

RESULTS AND DISCUSSION

Overall means at birth weight for Mengali lambs (n = 2750) were observed in male (3.61 ± 0.36), female (3.48 ± 0.37) and combined sexes (3.54 ± 0.36 kg). The lambs born during spring were heavier (3.68 ± 0.35 kg) than the lambs born during autumn season (3.49 ± 0.33 kg). Similarly, single born lambs were (3.72 ± 0.29 kg) heavier than twin born lambs (3.45 ± 0.34 kg). Results also revealed that male lambs were heavier than female. Average for WW was 20.33 ± 3.37; 18.04 ± 3.35 and 19.16 ± 3.63 for male, female and combined sexes respectively of Mengali lambs. The data also revealed that the spring born lambs weighted at WW were heavier (19.95 ± 3.39 kg) as compared to autumn born lambs (18.54 ± 3.30 kg). Similarly, single born lambs were (20.15 ± 3.10 kg) heavier than twin born lambs (18.45 ± 3.00 kg).

The findings of the effect of sex and SOB on body weights obtained in present study are in agreement with that observed by Refiq et al. (2009) and Mokhtari and Rashidi (2010) who reported that SOB (season of birth) and sex had significant effect on BW and WW. Birth weight of lambs born in spring season was significantly heavier than autumn born lambs. However, non significant effect of SOB on birth weight was observed by Naikare et al. (1987). Deccani and Hussain (2006) findings in Thalli lambs were contrary to the present study.

The analysis of variance for the birth weight of Mengali lambs is presented in Table 1. Results have shown that birth weight of lambs varied significantly due to location, year of birth (YOB), SOB, TOB type of birth) and sex ($P < 0.05$). However, the difference in birth weight of lambs due to YOB*SOB and TOB*sex was non- significant (Table1).

The results of WW revealed that the weight at weaning varied significantly due to location, YOB, SOB, TOB, and sex ($P < 0.05$) but the differences in WW of lambs due to YOB*SOB and TOB*sex were non- significant. The single born and male lambs were heavier than the twin female lambs groups (Table 2). The significant effect of YOB, TOB, SOB and sex on BW and WW of lambs as obtained in the present study was in line with the findings of many researchers (Babar et al., 1994; Akhtar et al., 1996; Shah and Khan, 2004; Hussain, 2006; Refiq et al., 2009 and Mokhtari and Rashidi, 2010).

Heritability estimates and their standard errors are shown in Table 3. Heritability estimates were 0.39±0.06 (BW), 0.125 ± 0.02 (MW), 0.177 ± 0.03 (WW), and (PRADG), 0.23 ± 0.05. Generally, estimates of heritability were low to moderate. MW and BW had the lowest (0.125 ± 0.02) and highest (0.39 ± 0.06) estimates, respectively. Heritability estimates for BW were similar to the estimates reported by Kaul and Tomar (1982)

Table 1. Analysis of variance for birth weight (BW) in Mengali sheep.

Source of variation	d.f.	Mean squares	F	Significant (Sig.)
Location of flock	3	2.698	38.144	0.000
YOB	4	0.434	6.133	0.000
SOB	1	0.899	12.716	0.000
TOB	1	143.369	2026.869	0.000
Sex	1	3.497	49.432	0.000
YOB * SOB	4	3.162	0.447	0.775
TOB * Sex	1	0.158	2.228	0.136
Error	2363	7.073		
Total	2379	2.698		

(Sig.) = Significant ($P < 0.05$).

Table 2. Analysis of variance for 120 days (Weaning Weight) (WW).

Source of variation	d.f.	Mean squares	F	(Sig.)
Location	3	353.488	78.856	0.000
YOB	4	26.510	5.914	0.000
SOB	1	52.204	11.646	0.001
TOB	1	2130.786	475.333	0.000
SEX	1	1198.966	267.463	0.000
YEAR * SOB	4	0.612	0.137	0.969
TOB * SEX	1	0.759	0.169	0.681
Error	2362	4.483		
Total	2378			

(Sig.) = Significant ($P < 0.05$).

Table 3. Heritability estimates ±SE of various performance traits of Mengali sheep breed.

Trait	Heritability estimate ±SE[1]	Trend of estimate#
BW	0.39 ± 0.06	High
MW	0.125 ± 0.02	Low
WW	0.177 ± 0.03	Low
PRADG	0.23 ± 0.05	Moderate

[1]SE = Standard error; # = according to Refik et al. (2009).

in Corriedale sheep (0.20 ± 0.10), Chaudhry and Shah (1985) in Awassi (0.34), Bathaei (1994) in Mehraban Iranian (0.35), Snyman et al. (1997) in Afrino (0.22), Jara et al. (1998) in Corriedale lambs (0.32), Mcmanus and Miranda (1998) in Bergamasca sheep of Brazil (0.32) and in Bannur (0.29 ± 0.20), Pollott et al. (1998) in Turkish Awassi lambs (0.44 ± 0.09), Al-Shorepy (2001) in crossbred lambs (0.32) and Ali (2008) in Karakul (0.30).

The estimates of the present study were lower than those obtained by many researchers: Chaudhry and Shah (1985) in Hissardale (0.94). They were lower than those of Mahmoud (2000) in Barki (0.81), Rahmani (0.66) and Ebangi et al. (0.61) in Fulbe sheep (2001).

The estimates were higher than those reported by Yazdi et al. (1997) in Baluchi (0.14), Cloete et al. (1998) in Dohne Merino (0.04), Hussain (2006) in Thalli (0.07 ± 0.02), Refik et al. (2009) in Turkish Merino (0.14 ± 0.02), and Borg (2009) in Targhee (0.19).

Heritability estimates for WW were in agreement with the findings of many workers: Alipour and Edriss (1997) in Fars Karakul (0.11), Risam et al. (1999) in Corriedale (0.13 ± 0.04), Bedhiaf et al. (2000) in Barbary (0.001), Qureshi and Ghaffar (2002) in Kajli (0.13 ± 0.02), Babar et al. (2003) in Lohi sheep (0.147 ± 0.034), Shahroudi et al. (2002) in Kermani (0.19 ± 0.08), Simm et al. (2002) in Suffolk (0.17),

Hussain (2006) in Thalli (0.04 ± 0.11) and Borg (2009) in Targhee (0.12).

Estimates of the present study were lower than those of Chaudhry and Shah (1985) in Awassi (0.82), Kacchi (0.52), Lohi (0.55) and Hissardale (0.89), Ali (2008) in Karakul (0.30), and Refik, (2009) in Turkish Merino (0.29 ± 001). Heritability estimates for PRADG were similar to the estimates documented by Dikshit (1982) in Bannur (0.36 ± 0.23), Alrawi et al. (1982) in Awassi (0.29), Mahmoud (2000) in Barki (0.37) and in Rahmani (0.21), Shah and Khan, (2004) in Lohi (0.17 ± 0.05) and Refik et al. (2009) in Turkish Merino (0.29 ± 0.02). The present estimates were higher than those of the study reported by Bohra et al. (1980) in Malpura (0.06), Atkins (1984) in Hill (0.06 ± 0.03). Alipour and Edriss (1997) in Fars Karakul (0.068), Kominakis et al. (1999) in Boutsico (0.05), Gut et al. (2001) in White-headed Mutton (0.0042) and Hussain (2006) in Thalli (0.076 ± 0.013).

Estimates were lower than those of the study documented by Raman et al. (1981) Stavropol Merino (0.68 ± 0.31), Shrestha et al. (1985) in Suffolk (0.47 ± 0.04), Shrestha et al. (1986) in Dorset (0.50 ± 0.04) and Lopez et al. (1991) in Ile-de-France (0.61).

The moderate estimates of heritability obtained in the present study suggested that most of the observed variation in pre-weaning daily gain in this flock was due to environment factors.

Conclusion

Most of the traits were low to moderate heritable except BW that was high. The variation in the findings of present study from other researchers might be due to data set, breed, managemental, feeding, environmental conditions in which the various flocks were raised and due to method of estimation. Larger proportion of environmental variation was responsible for low heritabilities. Conclusively, it is suggested that mass selection based on current breeding practices in Balochistan Province can be an effective way to achieve higher productive performance. This information would be helpful in developing future breeding strategy and for the conservation of genetic resource.

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