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A comparative study on growth performance of crossbred and purebred Mecheri sheep raised under dry land farming conditions

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Abstract

In order to improve mutton production, Dorset x Mandya and Dorset x Nellore halfbred rams were mated with Mecheri ewes to produce Dorset x Mecheri x Mandya and Dorset x Mecheri x Nellore quarterbreds. Least-squares analyses of the body weight of crossbred (n = 541) and purebred (n = 959) Mecheri sheep were made. The overall means for bodyweight of crossbred Mecheri sheep at birth, three, six, nine and 12 months of age were 2.27 ± 0.05, 7.97 ± 0.24, 11.84 ± 0.38, 14.73 ± 0.48 and 17.55 ± 0.56 kg, respectively and for purebred Mecheri sheep the values were 2.27 ± 0.02, 7.80 ± 0.10, 11.48 ± 0.15, 14.04 ± 0.17 and 16.23 ± 0.18 kg, respectively. Crossbreds had higher body weight than purebred Mecheri sheep at all age groups. However, it was not significant up to nine months of age. In general, period of lambing and sex of the lambs had significant effects on body weight of both genetic groups at different ages. The estimates of heritability for body weight ranged from 0.177 ± 0.129 to 0.338 ± 0.176 among different age groups. Highest heritability estimates were obtained for body weight at three and six months of age, hence these traits may be considered as selection criteria for improving the body weight of Mecheri sheep at different age groups.

Keyword: Dorset quarterbred, body weight, genetic parameters
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Introduction

Sheep contribute meat, wool and skin as well as manure and serve as a sole or subsidiary source of income to the livelihood for a large number of small and marginal farmers and landless labourers in India. India is a rich repository of sheep germ plasm with 42 recognized breeds and a large proportion of non-descript or mixed breeds. According to the 2003 livestock census, there were 6 147 million sheep in India, which is about 12.7% of the total livestock population in India. Mecheri sheep are one among the meat breeds of sheep in Tamil Nadu and have unique qualities like higher dressing percentage and better skin quality (Acharya, 1982; Karunanithi *et al*., 2005). Since Nellore and Mandya (important meat breeds of sheep in South India) have better growth rates than Mecheri sheep (Acharya, 1982), a cross breeding programme has been conducted with Dorset for improving the body weight of Mecheri sheep. However, studies on performance of purebred and crossbred Mecheri sheep are scanty (Ulaganathan *et al*., 1989; Karunanithi *et al*., 2005; 2007), and no detailed study has been made on comparative performance of Dorset quarterbreds with those of purebred Mecheri sheep. Hence, an attempt was made to compare the body weights of purebred and crossbred Mecheri sheep at different ages from birth to 12 months to establish the variability in these traits caused by genetic and non-genetic sources as well as to estimate heritability of body weights and genetic correlations among weight at different ages.

Materials and Methods

Data on body weight of crossbred (n = 541) and purebred (n = 959) Mecheri sheep were collected from the Mecheri Sheep Research Station, Pottaneri, Tamil Nadu, India for a period of 20 years (from 1986 to 2005). Dorset x Mandya and Dorset x Nellore halfbred rams were mated to Mecheri ewes to produce Dorset x Mecheri x Mandya (DMM) and Dorset x Mecheri x Nellore (DMN) quarterbreds. The quarterbreds were again mated to produce Dorset x Mecheri x Mandya x Nellore (DMMN) with the Mecheri blood level of 50 to 75%. These crossbreds were compared with purebred Mecheri contemporaries. Both crossbred and purebred Mecheri lambs were run together for grazing for a duration of seven to eight hours per day. In addition they were supplemented with a concentrate mixture of about 50 to 150 g depending upon their age. To study the main causes of variation and to overcome the difficulty of disproportionate subclass numbers and non-orthogonality, the data were analyzed by least-squares procedure of fitting constants (Harvey, 1990). The differences among all possible pairs of least-squares means of each significant main effect were tested by Duncan's multiple range test. The crossbreds and purebreds were analyzed separately to find out the actual bodyweight of them. The non-genetic factors considered were period and season of birth, sex of the lamb and parity of the dam. The measurement of year effect included a four year period from 1986 to 2005. Seasonal divisions were made as follows: main-season (September to February) and off-season (March to August). First six parities were considered and the parities six and above were lumped together as sixth parity. The genetic parameters were estimated separately for crossbred and purebred Mecheri sheep as per Harvey (1990) and Meyer (2000).

Results and Discussion

The least-squares means (± s.e.) of body weight of crossbred Mecheri sheep at different age groups are presented in Table 1. The body weight of crossbreds observed in this study was lower than the values already reported by Ulaganathan *et al*. (1989). However, it was based on smaller sample size over a shorter duration.

Table 1 Least-squares means (± s.e.) of body weight (kg) of crossbred Mecheri sheep at different age groups

Effect	n	Birth	3 months	6 months	9 months	12 months
Overall	541	2.27 ± 0.05	7.97 ± 0 .24	11.84 ± 0.38	14.73 ± 0.48	17.55 ± 0.56
Genetic group						
¼ Dorset, ½ Mecheri and ¼ Mandya (DMM)	47	2.21 ± 0.11	8.03 ± 0.48	12.80 ± 0.74	14.72 ± 1.07	16.49 ± 1.33
¼ Dorset, ½ Mecheri and ¼ Nellore (DMN)	148	2.30 ± 0 .07	8.19 ± 0.31	11.84 ± 0.47	14.66 ± 0.58	17.69 ± 0.68
¼ Dorset, ½ Mecheri, $^1/_8$ Mandya and $^1/_8$ Nellore (DMMN)	47	2.30 ± 0.09	7.91 ± 0.37	11.33 ± 0.59	14.82 ± 0.70	17.95 ± 0.79
$^1/_8$ Dorset, ¾ Mecheri, $^1/_{16}$ Mandya and $^1/_{16}$ Nellore (DMNM)	299	2.27 ± 0.06	7.73 ± 0.26	11.39 ± 0.40	14.69 ± 0.50	16.40 ± 0 .58
Period		**	**	**	**	**
P_1 (1986-1989)	153	2.26^{ac} ± 0.07	6.82^{a} ± 0.31	11.91^{b} ± 0.50	15.59^{c} ± 0.64	18.99^{b} ± 0.75
P_2 (1990-1993)	64	2.35^{bc} ± 0.08	8.87^{b} ± 0.38	11.68^{b} ± 0.61	14.07^{ab} ± 0.75	16.70^{a} ± 0.83
P_3 (1994-1997)	112	2.43^{b} ± 0.07	8.38^{b} ± 0.32	12.33^{b} ± 0.50	14.87^{b} ± 0.62	17.14^{a} ± 0.71
P_4 (1998-2001)	127	2.34^{bc} ± 0.08	8.67^{b} ± 0.35	12.80^{b} ± 0.54	15.93^{c} ± 0.67	18.41^{b} ± 0.79
P_5 (2002-2005)	85	1.96^{a} ± 0.09	7.10^{a} ± 0.38	10.47^{a} ± 0.58	13.18^{a} ± 0.75	16.51^{a} ± 0.92
Season						
S-1 (Sep.-Feb.)	482	2.33 ± 0.05	7.87 ± 0.21	11.43 ± 0.31	14.14 ± 0.40	16.96 ± 0 .47
S-2 (Mar. – Aug.)	59	2.21 ± 0.08	8.06 ± 0.37	12.25 ± 0.59	15.31 ± 0.75	18.14 ± 0 .86
Sex		*		**	**	**
Male	276	2.32^{b} ± 0.06	8.15 ± 0.26	12.21^{b} ± 0.40	15.30^{b} ± 0.51	18.66^{b} ± 0.60
Female	265	2.22^{a} ± 0.06	7.79 ± 0.27	11.47^{b} ± 0.42	14.15^{b} ± 0.53	16.44^{b} ± 0.62
Parity						
First	195	2.20 ± 0.05	7.59 ± 0.25	11.53 ± 0.40	14.74 ± 0.52	17.23 ± 0.62
Second	139	2.32 ± 0.06	8.11 ± 0.27	12.37 ± 0.42	15.18 ± 0.52	18.19 ± 0.61
Third	97	2.22 ± 0.07	8.04 ± 0.30	12.05 ± 0.46	14.71 ± 0.58	17.60 ± 0.69
Fourth	67	2.29 ± 0.08	8.19 ± 0.34	12.12 ± 0.53	15.20 ± 0.65	17.95 ± 0.76
Fifth	30	2.34 ± 0.10	8.55 ± 0.46	12.50 ± 0.70	14.79 ± 0.86	17.35 ± 0.95
Sixth and above	13	2.25 ± 0.15	7.32 ± 0.66	10.46 ± 0.97	13.75 ± 1.27	16.97 ± 1.37

n = Number of observations. *$P < 0.05$; ** $P < 0.01$.
Means bearing same superscript do not differ significantly ($P < 0.05$).

Among the different crossbred genetic groups there were no significant (P >0.05) differences in body weight at different ages. The DMN (25% Dorset, 50% Mecheri, 25% Nellore) and DMMN (25% Dorset, 50% Mecheri, 12.5% Nellore 12.5% Mandya) had higher body weight than other genetic groups in all age groups. Among the different non-genetic factors considered, period of lambing and sex of the lamb had highly significant effect on body weight at different age groups. It is similar to the reports of Nehra & Singh (2006). The difference in weight between sexes increased from 0.1 kg (100 g) at birth to 2.22 kg at 12 months of age. The difference (P <0.01) in bodyweight among lambs born in different periods may be attributed to differences in management and environment conditions such as the ambient temperature, humidity, rainfall, etc. Season and parity of the dam had no significant effect on bodyweight at different ages. Mandal *et al.* (2003) also reported no significant difference in body weight due to parity in Muzaffarnagari sheep.

Table 2 Least-squares means (± s.e.) of different body weight (kg) of purebred Mecheri sheep at different ages

Effect	n	Birth	3 months	6 months	9 months	12 months
Overall	959	2.27 ± 0.02	7.80 ± 0.10	11.48 ± 0.15	14.04 ± 0.17	16.23 ± 0.18
Period		**	**	**	**	**
P_1(1986-1989)	116	2.22^a ± 0.04	7.08^a ± 0.19	11.82^c ± 0.29	13.49^b ± 0.25	16.34^b ± 0.34
P_2 (1990-1993)	92	2.27^a ± 0.04	7.85^b ± 0.21	10.35^a ± 0.31	12.63^a ± 0.3	14.93^a ± 0.37
P_3 (1994-1997)	266	2.23^a ± 0.03	7.24^a ± 0.14	10.26^a ± 0.21	12.93^a ± 0.23	15.46^a ± 0.24
P_4 (1998-2001)	290	2.39^b ± 0.02	8.84^c ± 0.12	12.74^b ± 0.18	15.65^c ± 0.20	17.50^c ± 0.21
P_5 (2002-2005)	195	2.23^a ± 0.03	8.00^b ± 0.14	12.22^b ± 0.21	15.47^c ± 0.24	16.91^b ± 0.25
Season			**	**	**	**
S-1(Sep.-Feb.)	824	2.28 ± 0.01	8.05^b ± 0.08	11.86^b ± 0.12	14.87^b ± 0.13	16.63^b ± 0.14
S-2 (Mar. – Aug.)	135	2.25 ± 0.03	7.55^a ± 0.17	11.09^a ± 0.26	13.21^a ± 0.29	15.83^a ± 0.30
Sex		**	**	**	**	**
Male	356	2.34^b ± 0.02	8.21^b ± 0.12	12.34^b ± 0.18	15.21^b ± 0.20	17.55^b ± 0.21
Female	603	2.20^a ± 0.02	7.40^a ± 0.11	10.62^a ± 0.17	12.87^a ± 0.19	14.91^a ± 0.20
Parity		**	*	*	*	*
First	260	2.19^a ± 0.02	7.76^{ab} ± 0.13	11.25^a ± 0.20	13.81^a ± 0.22	15.93^a ± 0.23
Second	250	2.25^b ± 0.03	7.75^{ab} ± 0.14	11.42^a ± 0.20	14.03^{ab} ± 0.23	16.47^{ab} ± 0.24
Third	202	2.28^b ± 0.03	7.91^b ± 0.15	11.25^a ± 0.22	13.91^{ab} ± 0.24	16.39^{ab} ± 0.25
Fourth	127	2.33^c ± 0.03	8.20^b ± 0.17	12.21^b ± 0.26	14.88^b ± 0.29	16.88^b ± 0.30
Fifth	79	2.33^c ± 0.04	7.79^{ab} ± 0.21	11.52^{ab} ± 0.31	13.78^a ± 0.35	15.80^a ± 0.37
Sixth and above	41	2.23^{ab} ± 0.06	7.38^a ± 0.29	11.21^a ± 0.43	13.81^a ± 0.48	15.89^a ± 0.51

n= Number of observations. *P <0.05 ** P <0.01.
Means bearing same superscript don't differ significantly (P <0.05).

The least square means (± s.e.) of body weight of purebred Mecheri sheep are presented in Table 2. The weights observed at different ages were within the range of values reported by Karunanithi *et al*. (2007). The period of lambing had a highly significant effect on body weight at different age groups. The highest birth, three, six, nine and 12 months weights were observed in period 4 (1998 - 2001) and they differed (P <0.05) from the rest of the periods. Males were heavier (P <0.01) than females in all age groups. The difference in body weight between males and females increased from 0.14 kg (140 g) at birth to 2.64 kg at 12 months of age. Significant differences in body weight at different period, season and sex of the lamb were also reported by Sharma *et al*. (2003) and Nehra & Singh (2006). The parity had highly significant effect on birth weight and significant effect on three, six, nine and 12 months of age. The body weight at different ages increased with increase in parity. The body weight at 4^{th} parity had highest values than those observed in younger and older parities.

On comparison between purebred and crossbred Mecheri sheep, the overall means observed in purebreds were lower than those observed in crossbreds at all age groups. Initially the birth weight of crossbred and purebred Mecheri sheep was similar (2.27), however, as the age advanced the difference increased marginally. The difference in body weight between purebred and crossbred Mecheri sheep was not significant (P >0.05) up to nine months of age. However, at 12 months of age the body weight of the purebred and crossbred Mecheri sheep differed significantly. On the other hand, higher body weights of crossbreds than the purebred sheep were reported by some workers (Ulaganathan *et al*., 1989; Prasad *et al*., 1991; 1993).

Table 3 Estimates of heritability (diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) of different economic traits of purebred Mecheri sheep

Age	Birth	3 months	6 months	9 months	12 months
Birth	0.177 ± 0.129	0 .931 ±0.094	0.660 ± 0.312	0.626 ± 0.334	0.706 ± 0.285
3 months	0.478 ± 0.229	0.303 ± 0.160	0.771 ± 0.210	0.831 ± 0.161	0.789 ± 0.200
6 months	0.393 ± 0.106	0.732 ± 0.362	0.338 ± 0.146	0.942 ± 0.060	0.993 ± 0.015
9 months	0.380 ± 0.134	0.682 ± 0.329	0.845 ± 0.354	0.229 ± 0.116	0.960 ± 0.044
12 months	0.352 ± 0.148	0.598 ± 0.319	0.715 ± 0.355	0.852 ± 0.387	0.189 ± 0.052

Correlation coefficients observed <0.771 are significant and the values ≥0.771 are highly significant

The genetic parameters for body weight at different ages are presented in Table. 3. The lowest heritability of 0.177 ± 0.129 was observed at birth and the heritability of body weight tended to increase with increasing age from birth to six months and then decreased. In general, it is similar to the reports of Cloete *et al.* (2001) and Cloete *et al.* (2003) for Merino sheep of South Africa, Mandal *et al*. (2003) for Muzaffarnagari sheep and Nehra & Singh (2006) for Marwari sheep. The phenotypic correlations of birth weight with the body weight at subsequent ages were moderate and positive. The magnitude of these correlations declined steadily with age, but genetic correlations for this trait were strongly and significantly correlated with body weight at all ages. The body weight at six months had higher phenotypic and genetic correlations with nine and 12 months body weight. Hence, selection based on six months body weight will increase the weight in subsequent ages.

Conclusions

Based on the comparative performance study, it may be concluded that there was no significant difference in body weight between crossbred and purebred Mecheri sheep, except at 12 months of age Because of no significant difference in body weight and reduced skin quality, rearing of purebred Mecheri sheep is recommended to the farmers. Study on effect of non-genetic factors revealed that the period and season of lambing, sex of the kid and parity of the dam were the main factor affecting body weight of crossbred and purebred Mecheri sheep. The estimates of genetic parameters revealed that the selection based on three or six months body weight would improve the body weights at subsequent ages.

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