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Growth Performance and Biometry of Nellore Brown Lambs from Birth to Weaning under Different Systems of Rearing

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ABSTRACT

Background: Among the three varieties of Nellore sheep, Nellore brown was most popular among the shepherds of Telangana state. The research on the performance of the other two varieties *i.e.* Palla and Dora was done extensively in their home tract but less data was available about performance of Nellore brown under different system of rearing. The growth rate of lambs was highest from birth to weaning in their life. The system of rearing can influence both growth rate and biometrical measurements of the lamb. The performance of the lambs during this stage influence the productive and reproductive performance in the lifetime.

Methods: Sixty Nellore brown ewes (1.5 - 2 years) were selected from Sheep unit, Livestock Research Station, Mamnoor, Telangana for the present study. The lambs born in intensive (G1, lambs born N= 14), Semi-intensive (G2, lambs born N= 14) and Extensive (G3, lambs born N= 12) system of rearing were used to study the growth performance and biometry of lambs from birth to weaning.

Result: The birth weight (kg) of lambs in G1 and G2 groups were significantly (P<0.01) higher than lambs in G3 group. The weaning body weight (Kg) was significantly higher (P<0.01) in G1 group as compared to weaning body weights in G2 and G3 group. The mean average ADG (gm) of lambs from birth to weaning was significantly (P<0.01) higher in G1 (105.4±0.19) followed by G2 (97.9±0.14) and G3 (92.8±0.07) group. The mean pin shoulder length (cm) of lambs at birth in G1 group was higher than G2 and G3 group but had a significant (P<0.05) difference with the only G3 group. In G1 group, the mean heart girth (cm) of lambs from15th day to weaning was significantly (P<0.01) higher than G2 and G3 groups. The mean gain in paunch girth from birth to weaning in lambs of three groups was nearly 19 cm and had no significant (P<0.05) difference between groups.

Key words: ADG, Body length, Body weight, Height at withers, Heart girth, Paunch girth.

INTRODUCTION

In India, Sheep are raised on natural vegetation, common grazing lands, waste lands, stubbles of cultivated crops and top feeds. In developing countries like India, the farming system could be categorized as Intensive, Semi-intensive and Extensive system of rearing. The contribution of small ruminants is highly important in rural areas (Ramesh *et al*., 2012). The most important factor for adoption of type of farming system are climate and regional conditions but the cost of production is the most significant factor affecting the success of the system. Sheep need fewer capital to expand and provide an alternative source of income for marginal farmers (Arora *et al*., 2016).

Of the three strains in Nellore breed, Nellore brown is popular amongst the farmers due to its hardiness and better adaptability to the very hot and humid climatic conditions. Sheep farmers are evincing keen interest in intensive system of rearing of Nellore brown sheep, on account of shrinking grazing lands, changes in the cropping patterns and poor pasture quality. Presently very little information is available on performance of Nellore brown sheep under different systems of rearing. Keeping in view of the shrinking grazing resources and increasing popularity of Nellore brown sheep, the present study is planned to know the performance of the Nellore brown sheep in the different systems of rearing.

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MATERIALS AND METHODS

Animals

Sixty Nellore brown ewes (1.5 - 2 years) were selected from Sheep unit, Livestock Research Station, Mamnoor,

Telangana for the present study. Three rams of average 2.5 years age were selected for tupping of ewes during the study period. The animals were housed in well ventilated shed made up of asbestos sheet roofing with morum flooring and maintained under hygienic conditions. The animals were provided with bore well water *ad libitum* for drinking purposes. The waterers were cleaned every day and filled with fresh water in the morning and evening. The ewes were dewormed at the starting of the study. Prophylactic measures against Sheep pox, Enterotoxaemia, Pests des petits ruminants, Blue tongue, Hemorrhagic Septicemia, endo and ecto parasitic infections were carried out as per the institution calendar to ensure animal health conditions throughout the study period. The estrous ewes were identified by teaser rams in the morning and evening hours. The separated estrous ewes were tupped by designated rams and date of tupping was recorded.

The lambs born (G1- 14, G2 -14 and G3 - 12) in each systems of rearing were used to study the growth performance and biometry of lambs. The lambs in intensive system of rearing kept along ewes throughout the day. In semi-intensive and extensive system of rearing, the lambs kept along with ewes in the sheds except during the grazing hours.

Body weight recording

The body weight of lambs at birth were recorded within 24 hours after lambing. The body weight of the lambs at different fortnights were recorded at 7.30 - 8.30 am in the morning by using platform balance. The weight of the lambs were recorded at 15th, 30th, 45th, 60th, 75th and day weaning *i.e* 90th day.

Biometry of lambs

The biometric measurement of lambs were measured in centimetres with the help of a flexible measuring tape. Pin shoulder length was measured from the shoulder point to pin bone. Height at withers was measured from the ground to the level of withers. Heart girth was measured as circumference around the chest just behind the point of elbow. Paunch girth was measured as circumference of the body just before the hind legs.

Experimental procedure

The study was conducted for a period of more than 1 years from March 2019 to June 2020. All 60 ewes selected for the study was allotted to three rearing systems *i.e* Intensive (G1), Semi- intensive (G2) and Extensive (G3) system by using complete randomized design (3x20). In G1 group, the ewes were kept in the shed throughout the day provided with farm grown chaffed green fodders (APBN, CO-3 and 4, Super Napier, SSG and Hedge lucerne which ever available in the farm) in the morning and evening time, concentrate feed @ 1% of their body weight offered only in the evening time and not sent for grazing. In G2 group, the ewes were sent for grazing for about 6 hours per day and offered 200 grams of concentrate feed in the shed in the evening time. For G3 group ewes no concentrate feed were offered in the shed and sent for grazing for 8-10 hours per day. The concentrate feed offered to the ewes in G1 and G2 group contain CP - 17.3 per cent, TDN - 72 per cent. The statistical significance of body weight and biometry of lambs were analyzed as per the methods described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Body weight gain

The lower birth weight of lambs in G3 (Table 1) group might be due to thermal and nutritional stress during pregnancy period. These results were similar to findings of Chaturvedi *et al*. (2006), Chaturvedi *et al*. (2010), Idris *et al*. (2010), Sultana *et al*. (2011), Kumar and Vasanthakumar (2016) and Kumar *et al*. (2017d) have reported that the birth weight of lambs was higher in supplemented ewes than grazing ewes.

In the present study, the mean weaning weight of lambs in G1 group was significantly (P<0.01) higher followed by G2 and G3 groups, which could be the result of lambs getting sufficient quantity of quality milk from ewes in intensive system. The results of the present study were not in agreement with Sultana *et al*. (2011), however Sahoo *et al.* (2016) reported that the lambs born to ewes fed with concentrate feed during late gestation had higher weaning weights than lambs from ewes only on grazing. In contrast, Jalajakshi *et al*. (2017) reported slightly higher weaning weight of Nellore brown lambs in semi-intensive system of rearing.

The weaning weight of the lambs reared in different systems in the present study was similar to the findings of Raman *et al*. (2003), Mishra *et al*. (2004) in Ganjam sheep and Kumar *et al*. (2017c) in Nellore jodipi sheep, but higher weaning weights were reported by Lalit *et al*. (2016) in Harnali sheep.

Table 1: Comparative body weight (kg) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	Birth weight**	Days						Mean body weight gain**
		15th day**	30th day**	45th day**	60th day**	75th day**	90th day**	
G1	2.95±0.04^{b}	5.13±0.04^{c}	7.16±0.05^{c}	8.98±0.13^{c}	10.64±0.12^{c}	12.14±0.08^{c}	13.54±0.09^{c}	10.59±0.09^{c}
G2	2.90±0.05^{b}	4.85±0.06^{b}	6.67±0.09^{b}	8.23±0.10^{b}	9.60±0.10^{b}	10.80±0.12^{b}	11.94±0.14^{b}	9.04±0.14^{b}
G3	2.55±0.06^{a}	4.38±0.05^{a}	6.15±0.04^{a}	7.63±0.06^{a}	8.78±0.08^{a}	9.85±0.06^{a}	10.82±0.06^{a}	8.26±0.07^{a}
SEM	0.392	0.059	0.082	0.085	0.09	0.11	0.124	0.16
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

Average daily gain

In the present study, the ADG of lambs was significantly (P<0.01) higher in G1 group (Table 2) from birth to weaning and these results were supported by Bharambe and Burte (2012). Further, the overall mean ADG of lambs in the study was higher than those reported by Devendran *et al*. (2009), Sivakumar *et al*. (2009), Balasubramanyam*et al*. (2010) and Dass*et al*. (2016): lower than Mandal *et al*. (2012) and similar to Lalit *et al*. (2016), Kumar *et al*. (2017a) and Reddy *et al*. (2017a).

Biometry of lambs from birth to weaning

Pin shoulder length (cm)

The average pin shoulder length of lambs at birth in G1, G2 and G3 group was 22.75±0.15, 22.42±0.11 and 22.31±0.12, respectively (Table 3). The present study values were similar to the findings Mondal and Kakati (2010) and Dass *et al*. (2012). Further, Mishra *et al*. (2004) and Tailor and Yadav (2011) reported slightly higher at birth because have considered pin shoulder length measured up to one month age as pin shoulder length at birth. There was significant (P<0.01) difference in the pin shoulder length of lambs at the time of weaning in three systems of rearing and the findings of the present study are similar to the average pin shoulder length at weaning observed by Mishra *et al*. (2004).

Height at withers (cm)

The mean height at withers of lambs at birth in G3 group was lower than G2 and G1group as the pregnant ewes in extensive system were not provided with supplemented feed and forage which leads to less nutrients available for foetal skeletal development. Mishra *et al*. (2004) and Dass *et al*. (2012) have reported similar birth height at withers in lambs of Ganjam and Muzzffarnagari breeds, respectively reared in farmers flocks.

The height at withers of the lambs at the time of weaning in G1 group was significantly (P<0.01) higher than other two groups. But, the gain in height at withers of lambs in G1 group from birth to weaning had no significant (P<0.05) difference with G2 and the means of G2 and G3 groups were comparable (Table 4). Mishra *et al*. (2004) and Mondal and Kakati (2010) have reported a lower height at withers of lambs than the results of the present study at 3 months of age and could be due to the fact that Nellore breed is the tallest among sheep breeds in India (Yadav *et al*., 2017).

Heart girth (cm)

The heart girth of lambs at birth in G1and G2 group was significantly (P<0.01) higher than the G3 group (Table 5). This was due to more bony growth along with body weight as a result of better nutrients availability during pregnancy in ewes. Dass *et al*. (2012), Tailor and Yadav (2011), Mondal and Kakati (2010) and Mishra *et al*. (2004) who have also reported similar heart girth values at birth of the lambs.

At the time of weaning, the mean heart girth of lambs in G1 group was significantly (P<0.01) higher than G2 and G3 group due to more body weight gain. The findings of Mishra *et al*. (2004), Tailor and Yadav (2011) and Dass *et al*. (2012) revealed similar values of heart girth of lambs at 3 months age in different sheep breeds.

Paunch girth (cm)

The mean paunch girth (cm) of lambs from birth to weaning in G1 group had non-significant (P<0.05) difference with G2 group (Table 6). The result of the present study was in agreement with Chaturvedi *et al*. (2003) who have observed non supplemented group had no significant difference with supplemented group in paunch girth. Arora *et al*. (2007) observed higher paunch girth value than present study.

Table 2: Comparative ADG (gm) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	Fortnights						Overall mean
	0 - 15th day**	16 - 30th day**	31 - 45th day**	46 - 60th day**	61 - 75th day**	76 - 90th day**	ADG**
G1	145.34±1.74^{c}	135.71±1.65^{c}	120.95±2.19^{c}	110.48±1.67^{c}	100.48±2.03^{c}	93.33±1.21^{c}	117.5±0.01^{c}
G2	130.00±1.82^{b}	120.96±3.83^{b}	104.52±3.36^{b}	91.44±2.39^{b}	79.76±2.53^{b}	76.44±3.11^{b}	100.5±0.01^{ab}
G3	122.05±2.55^{a}	117.69±3.23^{ab}	98.46±3.53^{ac}	77.69±3.43^{a}	70.26±2.96^{a}	64.62±4.31^{a}	91.6±0.06^{a}
SEM	1.903	2.11	2.29	2.56	2.44	2.54	0.001
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

Table 3: Comparative pin shoulder length (cm) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	At birth*	15th day	30th day	45th day	60th day**	75th day**	90th day**	Mean gain in pin shoulder length**
G1	22.75±0.15^{b}	25.96±0.19	29.06±0.27	32.11±0.18	34.86±0.24^{b}	37.71±0.30^{b}	40.50±0.22^{c}	17.75±0.27^{c}
G2	22.42±0.11^{ab}	25.64±0.23	28.90±0.16	31.71±0.16	34.39±0.18^{ab}	36.86±0.11^{ab}	39.04±0.22^{b}	16.61±0.20^{b}
G3	22.31±0.1^{a}	25.58±0.11	28.81±0.13	31.65±0.16	33.88±0.20^{a}	35.96±0.37^{a}	37.92±0.29^{a}	15.62±0.31^{a}
SEM	0.084	0.108	0.114	0.10	0.135	0.191	0.214	0.200
P	0.02	0.39	0.66	0.12	0.00	0.00	0.00	0.00

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

Table 4: Comparative height at withers (cm) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	At birth*	15th day	30th day	45th day	60th day**	75th day**	90th day**	Mean gain in height at withers*
G1	32.10±0.13^{a}	36.11±0.19^{c}	40.04±0.17^{c}	43.54±0.25^{c}	46.57±0.25^{c}	49.18±0.28^{c}	51.54±0.22^{c}	19.43±0.26^{b}
G2	31.82±0.11^{ab}	35.60±0.12^{b}	39.04±0.12^{b}	42.54±0.11^{b}	45.82±0.17^{b}	48.14±0.19^{b}	50.79±0.13^{b}	18.96±0.13^{ab}
G3	31.46±0.13^{b}	34.92±0.11^{a}	38.15±0.15^{a}	41.38±0.15^{a}	44.50±0.23^{a}	47.15±0.25^{a}	50.15±0.13^{a}	18.69±0.17^{a}
SEM	0.082	0.113	0.148	0.172	0.182	0.190	0.129	0.121
P	0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.04

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

Table 5: Comparative heart girth (cm) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	At birth*	15th day	30th day	45th day	60th day**	75th day**	90th day**	Mean gain in heart girth *
G1	32.25±0.14^{b}	36.39±0.13^{b}	40.29±0.13^{c}	43.75±0.14^{c}	46.82±0.14^{c}	49.64±0.16^{c}	52.25±0.22^{c}	20.00±0.78^{c}
G2	31.82±0.19^{b}	35.86±0.29^{b}	39.46±0.36^{b}	42.82±0.26^{b}	45.89±0.22^{b}	48.61±0.25^{b}	51.25±0.23^{b}	19.43±0.70^{ab}
G3	31.12±0.17^{a}	35.02±0.17^{a}	38.62±0.13^{a}	41.91±0.11^{a}	44.92±0.17^{a}	47.62±0.16^{a}	50.19±0.17^{a}	19.08±0.26^{a}
SEM	0.119	0.148	0.171	0.157	0.160	0.170	0.177	0.137
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

Table 6: Comparative paunch girth (cm) of Nellore brown lambs in different systems of rearing from birth to weaning.

Group	At birth*	15th day	30th day	45th day	60th day**	75th day**	90th day**	Mean gain in paunch girth
G1	29.14±0.22^{b}	33.46±0.18^{b}	37.46±0.26^{b}	40.93±0.26^{b}	44.14±0.23^{b}	46.75±0.21^{b}	49.07±0.20^{b}	19.93±0.30
G2	28.75±0.18^{ab}	32.82±0.27^{ab}	36.64±0.25^{ab}	40.32±0.22^{ab}	43.46±0.22^{ab}	46.21±0.20^{ab}	48.50±0.22^{ab}	19.75±0.22
G3	28.27±0.20^{a}	32.31±0.20^{a}	36.08±0.23^{a}	39.65±0.22^{a}	42.77±0.23^{a}	45.54±0.20^{a}	48.04±0.22^{a}	19.77±0.24
SEM	0.126	0.144	0.165	0.156	0.154	0.139	0.123	0.145
P	0.015	0.003	0.001	0.002	0.001	0.001	0.006	0.862

^{a,b,c}Means with different superscripts column wise differ significantly **(P<0.01), *(P<0.05).

CONCLUSION

The body weight gain, average daily weight gain was statistically higher in intensive system rearing than semi intensive and extensive system of rearing. The biometrical measurements of lambs were lower in the extensive system of rearing than two other systems might be due to milk from the ewes in the extensive system was not sufficient to meet the growth rate of the lambs.

Conflict of Interest: None.

REFERENCES

Arora, A.L., Prince, L.L.L and Mishra, A.K. (2007). Performance evaluation of Jaisalmeri sheep in farmers' flocks. Indian Journal of Animal Sciences. 77(8): 759.

Arora, R., Kulkarni, V.S., Anand, J. and Yadav, D.K. (2016). Yalaga sheep-a microsatellite based genetic profile. Indian Journal of Animal Sciences. 86(10): 1155-1158.

Balasubramanyam, D., Jaishankar, S. and Sivaselvam, S.N. (2010). Performance of Madras red sheep under farmer's flocks. The Indian Journal of Small Ruminants. 16(2): 217-220.

Bharambe, V. Y and Burte, R. (2012). Comparative Growth Performance of Deccani Lambs under Various Rearing Systems in Agro-ecological Conditions of Konkan. Indian Journal of Hill Farming. 25(1): 44-47.

Chaturvedi, O.H., Bhatta, R., Santra, A., Mishra, A.S. and Mann, J.S. (2003). Effect of supplementary feeding of concentrate on nutrient utilization and production performance of ewes grazing on community rangeland during late gestation and early lactation. Asian-Australasian Journal of Animal Sciences. 16(7): 983-987.

Chaturvedi, O.H., Bhatta, R., Verma, D.L and Singh, N.P. (2006). Effect of flushing on nutrient utilization and reproductive performance of ewes grazing on community rangeland. Asian-Australasian Journal of Animal Sciences. 19(4): 521-525.

Chaturvedi, O.H., Mann, J.S. and Karim, S.A. (2010). Effect of concentrate supplementation to ewes grazing on community rangeland during late gestation and early lactation. Indian Journal of Small Ruminants. 16(1): 97-100.

Dass, G., Dige, M.S. and Rout, P.K. (2016). Factors affecting average daily weight gains (ADG) in Muzaffarnagari sheep. Indian Veterinary Journal. 93: 87-89.

Dass, G., Mandal, A., Rout, P.K. and Roy, R. (2012). Rearing practices, morphological characteristics and growth performance of Muzaffarnagari sheep in its home tract. Indian Journal of Small Ruminants. 18(1): 37-40.

Devendran, P., Cauveri, D and Gajendran, K. (2009). Growth rate of Madras Red sheep in farmers' flocks. Indian Journal of Animal Research. 43(1): 53-55.

Idris, A.O., Kijora, C., El-Hag, F.M and Salih, A.M. (2010). Effect of supplementation on late pregnancy and early lactation of body weight of desert ewes and their lambs. Livestock Research for Rural Development. 22(10): 45-56.

Jalajakshi, K., Reddy, V.V. and Varaprasad, R. (2017). Comparative growth performance of Nellore brown sheep under farm (semi-intensive) and field (extensive) conditions. International Journal of Science Environment and Technology. 6(1): 132-135.

Kumar, D.A.P., Prakash, M.G., Gupta, B.R., Raghunandan, T. and Chandra, A.S. (2017a). Average daily gain and Kleiber Ratio in Deccani Sheep. The Pharma Innovation. 6(6): 194-197.

Kumar, P.S., Vasanthakumar, P., Saravanajayam, M. and Bala--subramaniam, A. (2017d). Effect of various levels of concentrate feed supplementation on birth weight in madras red sheep. Indian Veterinary Journal. 94(06): 19-21.

Kumar, P.S. and Vasanthakumar, P. (2016). Concentrate feed supplementation during late gestation and lactation in madras red sheep. Indian Journal of Small Ruminants. 22(2): 246-248.

Kumar, I.S., Gangaraju, G., Kumar, C.V and Nath, S. (2017c). Study on growth and reproductive traits of Nellore sheep in semi-arid region of Andhra Pradesh. Indian Journal of Small Ruminants. 23(2): 163-167.

Lalit, Z.S., Dalal, D.S., Dahiya, S.P., Patil, C.S and Dahiya, R. (2016). Genetic analysis of growth traits in Harnali sheep. Veterinary World. 9(2): 128-132.

Mandal, A., Dass, G. and Rout, P.K. (2012). Genetic analysis of growth and feed conversion efficiency of Muzaffarnagari lambs under intensive feeding system. International Journal of Livestock Production. 3(4): 47-52.

Mishra, P.K., Barik, N., Patro, B.N and Nayak, S. (2004). Production potentiality of Ganjam sheep under extensive management. Indian Journal of Small Ruminants. 10(2): 171-172.

Mondal, G. and Kakati, B.K. (2010). Body measurements and economic analysis of local sheep reared by farmers in Kargil. Indian Journal of Small Ruminants. 16(2): 240-242.

Raman, K.S., Sundararaman, M.N., Haribhaskar, S. and Ganesakale, D. (2003). Biometrics and breed characteristics of Madras red sheep. Indian Journal of Small Ruminants. 9(1): 6-9.

Ramesh, D., Meena, H.R. and Meena, K.L. (2012). Analysis of Small ruminant market system in different agro-climatic zones of Southern India. Veterinary World. 5(5): 288-293.

Reddy, D.V.V., Sreenivas, D., Gnanaprakash, M. and Harikrishna, C. (2017a). Genetic analysis of growth performance of Nellore Brown sheep. International Journal of Science Environmental and Technology. 6(1): 774-778.

Sahoo, C., Pradhan, C.R., Sahu, S., Kerketta, S. and Lenka, B. (2016). Effect of concentrate supplementation during pregnancy on performance of native ewes in coastal Odisha. Indian Journal of Small Ruminants. 22(1): 116-117.

Sivakumar, T., Balasubramanyam, D., Jawahar, K., Gopi, H. and Jaishankar, S. (2009). Growth and reproductive performance of Madras Red sheep under field conditions. Indian Journal of Small Ruminants. 15(2): 248-252.

Snedecor G.W. and Cochran, W.G., (1994). Statistical Methods Oxford Publishing Company, Calcutta, India 6th Edition.

Sultana, N., Hassan, N., Ershaduzzaman, M., Talukder, M.A.I. and Iqbal, A. (2011). Effect of intensive and semi-intensive feeding system on productive and reproductive performances of native sheep. Journal of Scientific Research. 3(3): 693-698.

Tailor, S.P. and Yadav, C.M. (2011). Growth performance of pre- and post-weaning Sonadi lambs and adults in the native tract. Indian Journal of Small Ruminants. 17(2): 221-224.

Yadav, A.K., Singh, J. and Yadav, S.K. (2017). Characteristic Features of Registered Indigenous Sheep Breeds of India: A Review. International Journal of Pure and Applied Bioscience. 5(2): 332-353.