Indian Journal of Animal Sciences **80** (7): 693–696, July 2010

Nutrient utilization and production performance of lambs grazing on community rangeland with and without concentrate supplementation

O H CHATURVEDI[1], R BHATTA[2], S K SANKHYAN[3] and S A KARIM[4]

Central Sheep and Wool Research Institute, Avikanagar, Rajasthan 304 501 India

Received: 4 November 2008; Accepted: 23 December 2009

Key words: Lambs, Nutrient utilization, Production performance, Rangeland, Supplementation

The biomass yield of the community rangeland is low and livestock stocking density is high (Sankhyan *et al.* 1999a). Sheep grazing on such lands are underfed for most part of the year. Majority of the sheep farmers in semi-arid region do not supplement their sheep feed with concentrate mixture even in critical physiological stages (Chaturvedi *et al.* 2002). It was observed that limited concentrate supplementation in addition to free grazing on community rangeland substantially improves production performance of ewes (Chaturvedi *et al.* 2001, Chaturvedi *et al.* 2003) and growth performance of lambs (Shinde *et al.* 1995, Chaturvedi *et al.* 2000, Santra *et al.* 2002). The information on the effect of supplementary feeding on nutrient utilization and production performance of lambs under field conditions is scanty. The present study was therefore undertaken to demonstrate the effect of concentrate supplementation to lambs on their nutrient utilization and production performance at farmers' field.

This study was carried out on farmers' sheep flock maintained on natural rangeland at Bheepur village of district Tonk in Rajasthan, about 15 km from the Central Sheep and Wool Research Institute, Avikanagar, located in hot semi-arid region. The experiment was conducted for 90 days, extending from late summer to early monsoon season. Malpura and Kheri male lambs (20), 2–3 months old, weighing 10.15±0.0.432 kg were selected and randomly divided into 2 groups of 10 each (G1 and G2). Lambs in both the groups were grazed on natural rangeland from 07.00 to 18.00 hr, followed by night shelter in the animal shed. G2 lambs were maintained on sole grazing while lambs in G1, in addition to grazing, received concentrate mixture at the rate of 1.5% of their body weight. Lambs were weighed at fortnightly interval to assess growth performance. The wool yield was calculated by shearing an 8 cm × 8 cm area of left flank before and after the experiment following the procedure of Pierce (1934) using surface area in square metres $\{(m^2) = 0.121(BW, kg)^{0.59}\}$. The wool fibre characteristics, viz. staple length (cm), fiber diameter, medullation (hetro and hairy,%) and crimp per centimeter were assessed (ASTM 1967). The biomass yield of the community rangeland was assessed (Papanastasis 1977). Five lambs from each treatment were randomly selected for digestibility trial. The diet samples were collected through hand picking method (Sankhyan *et al.* 1999b) and faecal samples were collected from the rectum at 08.00 h for 5 consecutive days. Subsequently, samples were properly mixed and pooled for 5-day collection period for individual lambs. Representative samples of concentrate mixture, rangeland, diet and faeces were analysed for dry matter (DM) by drying them in the hot air oven at 60°C till constant weight. The above samples were then ground to pass through 1 mm sieve in a Willey mill and analysed for crude protein (CP) and ash (AOAC 1995), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) (Van Soest *et al.* 1991). Cellulose and hemicellulose contents were calculated, respectively by subtracting ADL from ADF and ADF from NDF. The ash free NDF was also estimated in all the diet samples to calculate voluntary intake (Osbourn *et al.* 1970).

SVI (g DM/kgW $^{0.75}$) = 95.0–0.713 NDFsc+ 4

where, SVI is the sheep voluntary intake, NDFsc is the ash-free NDF of the diet sample.

The IVDMD of all the diet samples was estimated by the method of Tilley and Terry (1963). The faecal outgo was estimated by the following formula. Subsequently the digestibility was calculated.

Faecal outgo (g DM/day) = Intake (g DM/day) × (100-IVDMD)

The metabolizable energy (ME) intake was calculated as MEI= OMI (g) × 19 × 0.82 (ARC 1980). The data were statistically analyzed using SPSS (version 10) statistical package.

The mean biomass yield of the community rangeland was found to be 13.8 q DM/ha, which is higher to earlier reports (Sankhayn *et al.* 1999a,Chaturvedi *et al.* 2000, 2001, 2003).

Present address: [1]Senior Scientist (omharichaturvedi @yahoo.co.in), [3]Principal Scientist, [4]Director.

[2]Senior Scientist NIANP, Bengaluru 560 030.

Table 1. Ingredient and chemical composition of concentrate mixture and diet consumed by lambs

Item	Part (%)								
Ingredient composition (%)									
Barley					35				
Wheat bran					20				
De-oiled rice bran					09				
Groundnut cake					33				
Mineral mixture					02				
Common salt					01				
Chemical composition (%)									
Component	DM	OM	CP	NDF	ADF	Hemi-cellulose	Cellulose	ADL	GE(MJ/kg)
Concentrate mixture	92.00	92.29	21.19	49.50	14.95	34.55	14.65	2.83	20.57
Diet	38.01	85.84	14.92	63.65	35.02	28.63	17.64	4.01	14.64

These differences in biomass yield are attributed to the variation in year, season, fertility of land, type of pasture, type of grazing and stocking density on the rangeland. The vegetation cover of the community rangeland consisted of *Cynodon dactylon*, *Desmostachya bipinnata*, *Celosia argentia*, *Cenchrus biflorus* and *Tephrosia purpurea* grasses, *Zizyphus nummularia*, *Calotropis procera* and *Capparis decidua* shrubs and *Acacia nilotica*, *Azadirachta indica* and *Prosopis cineraria* fodder trees. However, the diet consisted mainly of *Cynodon dactylon*, *Desmostachya bipinnata*, *Cenchrus biflorus* and *Tephrosia purpuria* and *Zizyphus nummularia*.

The lambs' diet obtained from the grazing land contained 14.9, 63.6, 35.0 and 17.6% CP, NDF, ADF and cellulose, respectively (Table 1). Shinde *et al.* (1994) reported that sheep grazing on silvipastures maintained 13–16% CP in their diets. The calculated values of digestible crude protein (DCP) and total digestible nutrient (TDN) contents of the concentrate mixture were 13.0 and 68.0%, respectively. The chemical composition of the diet of the lambs in the 2 groups was almost similar.

Although the roughage intake was similar between the 2 groups, there was significant (P<0.01) difference in total DMI between supplemented group (G1) and non-supplemented (G2) group (Table 2). The DMI of 2.45% of body weight recorded in G2 was lower than the requirement (Ranjhan 1998). The trend observed in the intakes of DCP and ME were similar to that of DMI, obviously because of the supplementation schedule. DCP and ME intakes in G1 were on higher side than the recommended standard for growing lambs (Ranjhan 1998). The digestibility of DM, OM, CP, NDF and ADF was higher (P< 0.01) in supplemented group (G1) as compared to non-supplemented group, G2 (Table 3). It is established that supplementation in the form of concentrate mixture improves nutrient digestibility of the total diet (McDonald *et al.* 1988). Although the digestibility of nutrients recorded in the lambs was similar to that of earlier reports in sheep (Shinde *et al.* 1998,Chaturvedi *et al.* 2003) and in goats (Bhatta *et al.* 2002), the nutrient intake was not sufficient to meet their requirements.

The initial body weight of lambs was 10.19 and 10.11 kg, in G1 and G2 respectively. After 90 days of experimental feeding, the lambs achieved 21.64 and 18.74 kg, in G1 and G2 respectively (Table 3). The average body weight gain (11.45 kg) and average daily gain (ADG, 127.2 g) in the supplemented group was higher (P<0.01) than that of non-supplemented group (8.63 kg and 95.9 g). The finishing weight (21.6 kg) at 5–6 months of age in this study was lower than that (27.3 kg) reported by Shinde *et al.* (1995) under farm conditions where the lambs were maintained on good quality established pasture. On the other hand, a finishing weight of 20.8 kg at 6 months of age with 8.9 kg post weaning gain at the rate of 98.1 g ADG

Table 2. Intake and digestibility of nutrients in 2 groups of lambs

Item	G1	G2	SEM	Level of significance
Body weight (kg)	17.20	15.42	0.861	NS
Metabolic body weight (kg)	8.43	7.78	0.318	NS
Nutrient intake				
Roughage intake (g/d)	383.00	378.40	20.212	NS
Concentrate intake (g/d)	258.00	—	ND	ND
Dry matter (g/d)	653.00	378.40	27.278	**
Dry matter (g/kg B.W)	38.04	24.63	0.719	**
Dry matter (g/kgW$^{0.75}$)	77.29	48.74	1.266	**
DCP (g/d)	91.04	37.65	4.053	**
DCP (g/kg B.W)	5.30	2.45	0.083	**
DCP (g/kgW$^{0.75}$)	10.76	4.85	0.174	**
ME (MJ/d)	8.99	5.05	0.376	**
ME (MJ/kg B.W)	0.52	0.33	0.001	**
ME (MJ/kgW$^{0.75}$)	1.06	0.65	0.002	**
Nutrient digestibility (%)				
Dry matter	63.83	40.41	1.278	**
Organic matter	75.20	64.16	2.575	**
Crude protein	80.07	66.61	0.725	**
Neutral detergent fibre	60.20	39.28	2.295	**
Acid detergent fibre	39.97	24.68	1.173	**
Cellulose	76.29	72.96	1.914	NS

ND, not detected; NS, nonsignificant; **, P<0.01.

Table 3. Production performance of lambs and cost benefit ratio

Item	G1	G2	SEM	Level of significance
Body weight (*kg*)				
Initial	10.19	10.11	0.627	NS
Finishing	21.64	18.74	0.748	*
Body weight gain				
Total gain (kg)	11.45	8.63	0.653	**
Average daily gain during 90 days (g)	127.22	95.89	7.257	**
Body conformation (*cm*)				
Height				
Initial	50.60	51.00	1.007	NS
Final	61.00	57.30	1.371	NS
Length				
Initial	49.40	50.40	1.284	NS
Final	65.00	63.80	1.320	NS
Heart girth				
Initial	55.3	53.80	1.751	NS
Final	72.90	71.20	1.338	NS
Paunch girth				
Initial	56.90	54.20	2.461	NS
Final	80.40	76.80	2.137	NS
Wool yield (*g*)	304	271	14.2	NS
Wool fibre characteristics				
Diameter (micron)	44.30	39.58	1.403	*
Medullation (%)				
Hetro	21.69	23.92	2.403	NS
Hairy	68.32	55.05	4.190	*
Staple length (cm)	3.96	4.10	0.201	NS
Crimp/cm	0.43	0.46	0.006	NS
Body weight gain over G2	2.82	—	ND	ND
Concentrate consumed (kg)	22.00	—	ND	ND
Cost of concentrate @ Rs 4.5/kg (Rs)	99.00	—	ND	ND
Cost of additional live weight @ Rs 50/kg (Rs)	141.00	—	ND	ND
C: B	1: 1.42			

ND, not detected; NS, not significant; *, (P<0.05); **, (P<0.01)

in 90 days of feeding was reported in Malpura weaner lambs grazing on established pasture with concentrate supplementation @ 1.5% of the body weight under farm conditions (Santra *et al.* 2002). The concentrate-supplemented group had consistently better growth rate during the experiment. The present trend of growth rate corroborates the earlier reports (Santra *et al.* 2002). The body conformation parameters, viz. height, length, heart girth and paunch girth being almost similar in both the groups initially, were higher in G1 as compared to G2 at the end of supplementation. The wool yield (g) and fibre characteristics, viz. hetro medullation (%), staple length (cm) and crimp per centimeter did not differ significantly between the two groups. However, diameter (micron) and hairy medullation (%) were significantly higher (P<0.05) in G1 than that of G2. The present findings of wool yield and wool fibre characteristics are in agreement with earlier reports (Singh and Sankhyan 2003). The lamb in supplemented group (G1) consumed 22 kg concentrate mixture costing Rs 99 and gained 2.82 kg more than non-supplemented group (G2). The cost of additional live weight at the rate of Rs 50/kg worked out to Rs 141 and the cost: benefit (C: B) ratio of supplementary feeding to 1: 1.42 (Table 3). Chaturvedi *et al.* (2000) have, however, reported higher C: B ratio (1: 1.74) while supplementing the lambs with concentrate @ 1% of the body weight. It is concluded from this study that the biomass yield of the community rangeland in semi-arid region of India is low and insufficient to meet nutrient requirement of growing weaner lambs. However, concentrate supplementation at the rate of 1.5% of the body weight to the lambs during this active phase of growth enhanced their growth rate for cost effective mutton production.

SUMMARY

Male lambs (20), 2–3 months age and weighing 10.15±0.0.432 kg were selected and randomly divided into 2 groups of 10 each (G1and G2). Lambs in both the groups were grazed on natural rangeland from 07.00 to 18.00 hr, followed by night shelter in the animal shed. G2 lambs were maintained on sole grazing while lambs in G1, in addition to grazing received concentrate mixture @ 1.5% of their body weight. The mean biomass yield of the community rangeland was 13.8 q DM/ha. The roughage intake was similar between supplemented (G1) and non-supplemented (G2) group. However, there was significant difference in the total DMI, DCP and ME between G1 and G2. The digestibility of DM, OM, CP, NDF and ADF was higher in G1 as compared to G2. After 90 days of feeding, the body weight of lambs in G1 and G2 reached 21.64 and 18.74 kg, respectively. The average body weight gain and average daily gain in G1 was higher than that in G2 (8.63 kg and 95.9 g). The wool yield (g) and fibre characteristics, viz. hetro medullation (%), staple length (cm) and crimp per centimeter did not differ between the two groups. However, diameter (micron) and hairy medullation (%) were higher (P<0.05) in G1 than that in G2. The cost: benefit ratio of the supplementary feeding was 1: 1.42. It is concluded from this study that the biomass yield of the community rangeland in semi-arid region of India is low and insufficient to meet the nutrient requirement of weaner lambs. However, concentrate supplementation @ 1.5% of the body weight to the lambs during this active phase of growth enhanced their growth rate for cost effective mutton production.

ACKNOWLEDGMENTS

We thank the Director of the CSWRI, Avikanagar, for providing the facilities.

REFERENCES

AOAC. 1995. *Official Methods of Analysis.* 16th edn. Association of Official Analytical Chemists, Washington, D. C.

ARC. 1980. *The Nutrient Requirements of Ruminant Livestock.* Agricultural Research Council Supplement 1, pp.78–80. Slough, U K: Commonwealth Agricultural Bureaux.

ASTM. 1967. Standard method of test for diameter of wool and other animal fibers micro projection. In: Book of ASTM Standards with related materials textiles fibers and zippers. *American Society for Testing Materials, Philadelphia* **25**: 481–485.

Bhatta R, Shinde A K, Sankhyan S K and Verma D L. 2002. Nutrition of range goats in a shrubland of Western India. *Asian-Australasian Journal of Animal Sciences* **15**: 1719–24.

Chaturvedi O H, Mishra A S, Karim S A and Jakhmola R C. 2000. Effect of supplementary feeding on growth performance of lambs under field condition. *Indian Journal of Small Ruminants* **6**: 110–12.

Chaturvedi O H, Mishra A S, Santra A, Karim S A and Jakhmola R C. 2001. Effect of supplementary feeding during late gestation on production performance of ewes grazing on community rangeland. *Indian Journal of Animal Sciences* **71**: 714–17.

Chaturvedi O H, Tripathi M K, Mishra A S, Verma D L, Rawat P S and Jakhmola R C. 2002. Land as well as livestock holding pattern and feeding practices of livestock in Malpura taluk of semiarid eastern Rajasthan. *Indian Journal of Small Ruminants* **8**: 143–46.

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**: 983–87.

McDonald P, Edwards R A and Greenhalgh J F D. 1988. *Animal Nutrition*. 5th edn. Longman Scientific and Technical, Group UK Limited, Longman House, Burnt Mill, Harlow, Essex CM20 2JE, England.

Osbourn D F, Cammell S B, Terry R A and Outen G E. 1970. The effect of chemical composition and physical characteristics of forages on their voluntary intake by sheep (Abstract). In GRI Report. p. 67.

Papanastasis P V. 1977. Optimum size and shape of quadrate for sampling herbage weight in grassland of Northern Greece. *Journal of Range Management* **30**: 446–48.

Pierce A. 1934. Council of Scientific and Industrial Research, Australian Bulletin No. 84. cited from Alexander G 1961. Temperature regulation in newborn lambs: effect of environmental temperature on metabolic rate, body temperatures, and respiratory quotient. *Australian Journal of Agriculture Research* **12**: 1152–74.

Ranjhan S K. 1998. *Nutrient Requirements of Livestock and Poultry*. Publication and Information Division, Indian Council of Agricultural Research, New Delhi.

Sankhyan S K, Shinde A K, Bhatta R and Karim S A. 1999b. Comparison of diet and faecal collection methods for assessment of seasonal variation in dry matter intake by sheep maintained on a *Cenchrus ciliaris* pasture. *Animal Feed Science and Technology* **82**: 261–69.

Sankhyan S K, Shinde A K and Karim S A. 1999a. Seasonal changes in biomass yield, nutrient intake and its utilization by sheep maintained on public rangeland. *Indian Journal of Animal Sciences* **69**: 617–20.

Santra A, Chaturvedi O H and Karim S A. 2002. Effect of concentrate supplementation on nutrient intake and performance of lambs of two genotypes grazing a semiarid rangeland. *Small Ruminant Research* **44**: 37–45.

Shinde A K, Karim S A, Singh N P and Patnayak B C. 1995. Growth performance of weaner lambs and kids under intensive and semi-intensive feeding management. *Indian Journal of Animal Sciences* **65**: 830–33.

Shinde A K, Karim S A, Sankhyan S K and Bhatta R. 1998. Seasonal changes in biomass growth and quality and its utilization by sheep on semiarid *Cenchrus ciliaris* pasture of India. *Small Ruminant Research* **30**: 29–35.

Singh N P and Sankhyan S K. 2003. Effect of supplementary concentrate on growth, wool yield and quality in fine wool sheep. *Animal Nutrition and Feed Technology* **3**: 189–93.

Tilley J M A and Terry R A. 1963. A two stage technique for the *in vitro* digestion of forage crop. *Journal of British Grassland Society* **18**: 104–11.

Van Soest P J, Robertson J B and Lewis B A. 1991. Methods for dietary fibre, neutral detergent fibre and non starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* **74**: 3583–97.