Indian Journal of Animal Sciences 77 (6): 477–480, June 2007

Effect of concentrate supplementation on nutrient intake, utilization and performance of pregnant sheep maintained on community grazing land of semiarid Rajasthan

S K SANKHYAN[1], A K SHINDE[2], N P SINGH[3] and D L VERMA[4]

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

Received: 17 October 2005; Accepted: 31 January 2007

ABSTRACT

A study was conducted to compare the nutrition and performance of sheep maintained on grazing alone and grazing plus concentrate-supplemented system during advance stage of pregnancy. Average dry matter yield of community grazing land was recorded as 10.23 qDM/ha. *Indigofera cardifolia* (27.84%), *Erichloa polystachya* (34.22%), *Dactyloctenium aegypticum* (26.31%), *Commenlina bengalensis* (1.88%) and *Eleusine indica* (9.59) were found as dominant vegetation in the grazing land. The diet of pregnant ewes consisted of *Indigofera cardifolia* (11.99%), *Tephrosia heminatonia* (26.57%), *Crotolaria burhia* (2.84%), *Commenlina bengalensis* (10.45%), *Eriochloa polystachya* (21.41%), *Dactyloctenium aegyticum* (6.55%), *Melilotus indica* (7.16%) and other native grasses. DM, CP, NDF, ADF, cellulose and lignin, total ash, soluble and insoluble ash contents of community grazing land during monsoon season were 85.23, 5.57, 63.46, 44.31, 19.01, 7.57, 28.5, 11.54 and 17.05% respectively. Diet of pregnant ewes contained DM 15.30, CP 9.69, NDF 54.74, ADF 36.23, cellulose 18.59, lignin 5.33 and total ash 18.32%. Average dry matter intake of sheep in supplemented and non-supplemented groups was 1164 and 1152 g day^{-1} or 3.39 and 3.40% of body weight respectively. Average digestible crude protein (DCP) intake was 74.09 and 69.34 g day^{-1} or 2.19 and 2.02 g kg^{-1} day^{-1} in supplemented and non-supplemented groups. Metabolizable energy intake was 14.67MJ day^{-1} or 0.43MJkg^{-1} day^{-1} in supplemented group and 14.82 MJ day^{-1} or 0.43 MJkg^{-1} day^{-1} in non-supplemented group. Birth weight of lambs born from sheep supplemented sheep were 3.35 kg in males and 3.20 kg in females. The weights of sheep were higher during pregnancy and loss in weights after lambing was minimum in supplemented than non-supplemented group. It was concluded from the study that daily supplementation of concentrate mixture @ 350 g during last 45 days of advance pregnancy improved the weights of sheep at lambing and birth weights of lambs.

Key words: Community grazing land, Concentrate supplementation, Nutrient intake, Pregnancy, Sheep

Sheep flocks in the semiarid regions of Rajasthan are grazed and maintained on community land under round the year grazing system. These flocks often faced feed scarcity for major part of the year due to poor precipitation, low forage yield and wide seasonal variations and higher stocking density of animals. Because of over stocking, community grazing lands are grossly inadequate to supply DM and other nutrients with the progressive shift from monsoon to winter and summer resulting in decreased DMI and nutrient utilization pattern in grazing sheep even to meet the maintenance requirements (Sankhyan *et al.* 1999).

Sheep during advance pregnancy requires higher amount of nutrient for maintenance and growing foetuses in the womb, which are not met in range sheep from community grazing land alone, poor nutrient during pregnancy resulting in poor birth weight of lambs and body condition of sheep at lambing (Chaturvedi *et al.* 2001). Thus the present study was planned on a field flock to ascertain the improvement in nutrient intake and its utilization and production after concentrate supplementation vis-á-vis demonstrate the beneficial effect of supplementation.

MATERIALS AND METHODS

The community land (1.5 km^2) in the vicinity of the village near the Central Sheep and Wool Research Institute, Avikanagar, was used for the study. The rainfall during the study year was 258 mm and about 50% of annual rainfall was received during August and September. The annual heterogenous herbaceous grasses, forbs, bushes, shrubs and xerophytes were the major vegetation cover in the community

Present address: [1]Senior Scientist (AN), [2]Senior Scientist (LPM), [4]Technical Officer (AN), Division of Animal Nutrition.

[3]Director, CIRG Makhdoom, Farah, Mathura 281 122, Uttar Pradesh.

land. Five random quadrates (1 m^2) were clipped close to ground level at uniform heights to determine the quantity of available forage (Papanastisis 1977), percentage distribution of individual species on a DM basis in the grazing land (Holechek *et al.* 1982) and chemical composition of forage. Pregnant ewes (20) from a farmer's sheep flock were adopted and divided into 2 groups of 10 each. Sheep in the group 1 were maintained on grazing alone while the sheep in group 2 were supplemented with concentrate mixture @ 350 g daily after grazing at the stall.

Pregnant (>4 months of pregnancy) females (5) in the flock were identified and used for collection of representative samples of diet and faeces for estimation of forage intake and nutrient digestibility. Diet samples were collected daily during the digestion trial period by snatching 40 to 50 bits before swallowing from the mouth of each females (Sankhyan *et al.* 1999). Samples were collected throughout the grazing hour to avoid the diurnal variation in nutrient content due to dietary preferences. Diet samples of individual animals were botanically identified and individual plant species were expressed as percentage of total population on a dry matter basis. Chromic oxide (Cr_2O_3) as an inert and undigested trace was used for determining the amount of faeces excreted (Krishna *et al.* 1981). Each animal was dosed with 2 g of chromic oxide in divided doses of 1g each in morning and evening hours for 10 days. After 5 days of acclimatization period, faeces samples were collected *per se* rectum for the last 5 consecutive days. Diet and faeces samples of individual animals were dried at 60°C in the oven and kept for further laboratory analysis.

Nitrogen in the forage, diet and faeces samples was determined by the Kjaldahl's method (AOAC 1990) and NDF, ADF, cellulose and lignin by the method of Van Soest *et al.* (1999). Nutrient digestibility was estimated by the lignin ratio technique (Wallace and Van Dyne 1970). Metabolizable energy (ME) intake was calculated by the formulae suggested by ARC (1980) MEI = OMI, g × 19 × 0.82.

Botanical and chemical composition of samples of community land and diets was presented as mean. Nutrient intake and digestibility parameters were statistically analysed for significant differences between the 2 groups using SPSS package Version 10.

RESULTS AND DISCUSSION

Biomass yield and botanical composition

Average dry matter yield of community land used for grazing of pregnant ewes during monsoon season was 10.23 q DM/ha. Average yield of semiarid rangeland during lush season lies between 1.57 to 4.20 qDM/ha (Sankhyan *et al.* 1999, Chaturvedi *et al.* 2000). Higher forage yield in the present study was associated with good rainfall, its frequency and distribution. *Indigofera cardifolia* (27.84%), *Eriochloa polystachya* (34.22%), *Dectyloctenium aegypticum* (26.31%), *Commenlina bengalensis* (1.88%) and *Eleusine indica* (9.59) were dominant plant species in the grazing land. In the natural cycle, native grass species sprouts immediately after rains and constituted major portion of diet of sheep grazing on community grazing land. The diet of pregnant ewes consisted of *Indigofera cardifolia* (11.99%), *Tephrosia hemintonia* (26.57%), *Crotolaria burhia* (2.84%), *Commenlina bengalensis* (10.45%), *Eriochloa polystachya* (21.41%), *Dectyloctenium aegyticum* (6.55%), *Melilotus indica* (7.16%) and other native grasses (Table 1). Many of these species were green, succulent and legume in nature and preferred by the sheep during monsoon.

Table 1. Botanical composition (% on DM basis) of the community grazing land and sheep diet

Name of the plant	Community grazing land	Diet
Indigofera cardifolia	27.84	11.99
Crotolaria burhia	–	2.84
Commenlina bengalensis	01.88	10.45
Dectyloctenium aegyticum	26.31	6.55
Eriochloa polystachya	34.22	21.41
Melilotus indica	–	7.16
Tephrosia hemintonia	–	26.57
Sesamum indicum	–	0.80
Eleusine indica	09.56	5.46
Aristida adscensionis	–	3.80
Cenchrus cathurticus	–	2.57

Nutrient contents, digestibility and plane of nutrition

DM, CP, NDF, ADF, cellulose, and lignin of community grazing land during monsoon season were 85.23, 5.57, 63.46, 44.31, 19.01 and 7.57%, respectively (Table 1). The total, soluble and insoluble ash were 28.59, 11.54 and 17.05%. Diet of pregnant ewes contained DM 15.30, CP 9.69, NDF 54.74, ADF 36.23, cellulose 18.59, lignin 5.33 and total ash 18.32%, respectively (Table 2). Average CP content of 8.0–10.0% of community land forage species during monsoon season was reported earlier (Sankhyan *et al.* 1999, Chaturvedi *et al.* 2000). The DM digestibility was 56.66 in non-supplemented and 62.42% in supplemented ewes. The CP, NDF, ADF and cellulose digestibility was higher in supplemented than non-supplemented group, similar findings in sheep grazing on community land were also observed by Chaturvedi *et al.* (2003). The overall nutrient digestibility (% on DM basis) was significantly ($P>0.05$) higher in supplemented as compared to non-supplemented group. This may be due to the fact that supplementation of concentrate improved the nutrient digestibility (Mc Donald *et al.* 1980) by increasing the number and activity of cellulolytic bacteria (Santra *et al.* 2002).

Dry matter intake (DMI) of pregnant sheep in non-supplemented and supplemented groups was 1164 and 1152 g^{-1} day respectively. DM intake of 3.39 and 3.40% of

Table 2. Nutrient composition of community grazing land and diet and dry matter, protein and energy intakes of sheep (%DM basis)

Nutrient composition (%)	Community grazing land	Diet
DM	17.45±1.22	
OM	71.40±2.65	81.73±1.25
CP	5.57±0.75	09.69±1.39
NDF	63.46±5.54	54.74±2.65
ADF	44.31±3.27	36.23±1.41
Cellulose	19.01±2.47	18.59±0.98
Lignin	7.57±2.06	05.33±0.23
Soluble ash	17.05±2.94	07.32±1.98
Insoluble ash	11.54±1.49	10.95±0.96
Total ash	28.59±2.65	18.32±2.28
	Non-supplemented	Supplemented
Digestibility of nutrients (%)		
DM	56.66±2.44	62.42±4.48
CP	60.69±2.67	64.59±3.46
NDF	53.85±1.63	58.42±5.01
ADF	45.79±2.12	51.74±5.76
Cellulose	69.76±1.87	71.61±3.66
Nutrient intake		
DMI (g/d)	1164±122.6	1152±162.3
DMI (g/kg BW)	33.95±3.32	34.07±4.97
DMI (g/kg $W^{0.75}$)	82.16±8.13	82.02±11.90
DCPI (g/d)	69.34±8.67	74.09±14.40
DCPI (g/kg BW)	02.02±0.24	02.19±0.44
DCPI (g/kg $W^{0.75}$)	04.89±0.58	05.29±1.05
MEI (MJ/d)	14.82±1.56	14.67±2.06
MEI (MJ/kg BW)	00.43±0.04	00.43±0.06
MEI (MJ/kg $W^{0.75}$)	01.05±0.10	01.05±0.15

body weight or 82.16 and 82.02g/kg$W^{0.75}$ or 34.07 and 33.95 g/kg BW was recorded in supplemented and non-supplemented groups, respectively. Average digestible crude protein (DCP) intake of sheep in pregnancy stages was 69.34 and 74.09g/day or 2.02 and 2.19 g/kg/day in non-supplemented and supplemented groups. Metabolizable energy intake (MEI) in pregnant sheep was 14.82 MJ/day or 0.43 MJ/kg BW/day in non-supplemented group and 14.67 MJ/day ro 0.43 MJ/kgBW/day in supplemented group (Table 2). There were no significant difference in nutrient intake of sheep in the supplemented and non-supplemented groups. It was observed that when forage supply from grazing land is adequate, the supplementation of extra concentrate mixture did not increase the nutrient intake but improved its digestibility. Kearl (1982) reported DM (g), DCP (g) and ME (MJ) intake of 40, 3.07 and 0.46/kg BW for pregnant sheep of tropical region. The intake of DM, DCP and ME of pregnant sheep in the present study were slightly lower than the requirement suggested by the Kearl (1982). It was lower by 6 g DM, 1 g CP and 0.03MJ ME/kg BW. The study showed that pregnant sheep grazing in community land during monsoon season were unable to meet their requirement even after supplementation because of gut fill limitation imposed by higher moisture content of vegetation and gravid uterus.

Animal performance

Birth weight of lambs born from sheep supplemented during last 45 days of pregnancy was 3.85kg in males and 3.60 kg in females and 3.35 kg in males and 3.20 kg in females in non-supplemented sheep (Table 3). Although DM, DCP and ME intake in supplemented and non-supplemented groups were almost similar but the birth weights of lambs were significantly improved in supplemented group probably due to better body condition of the ewes and divert of nutrients towards foetus growth. Chaturvedi *et al.* (2003) also reported an increase of 1 kg in birth weights of lambs in supplemented than non-supplemented group. All the lambs were maintained under similar feeding management and their weaning weights at 3 months of age were 14.00 and 12.96 in males and 12.66 and 9.48 kg in females in supplemented and non-supplemented groups, respectively. This indicated that lambs born from sheep supplemented during advance stage of pregnancy had not only higher weight at birth but also at subsequent age.

The body weight of pregnant sheep was 31.1 kg in both the groups at initial of supplementation and subsequent weights after 1 month were 32.13 and 33.60 kg and after 1.5 months 33.42 and 36.50 kg in non-supplemented and supplemented groups respectively. The body weight of sheep after lambing was 31.20 and 33.80 kg again and after 1 month was 30.42 and 32.60 kg in non-supplemented and supplemented group, respectively. The weights of sheep in supplementation group was higher than non-supplemented group at all the stages and losses in weights after lambing was minimum, indicating concentrate supplementation has beneficial effect in improving the body condition of sheep

Table 3. Birth and weaning weights of lambs

Parameter	Male		Female	
	Control	Supplementation	Control	Supplementation
Birth weight (kg)	3.35±0.32	3.85±0.18	3.20±0.21	3.60±0.15
Weaning weight (kg)	12.66±1.70	14.00±1.14	9.48±1.17	12.96±1.38
ADG (g) (0–3 months)	103±5.62	112±7.11	69±3.13	104±4.22

before and after lambing. Similar observations were also recorded by Chaturvedi *et al.* (2001) in sheep maintained on rangeland of Rajasthan and supplemented with concentrate mixture @ 1% of BW during advance pregnancy.

It was concluded from the study that supplementation of concentrate mixture during advance stage of pregnancy improved the weights of sheep before and after lambing and birth weight of lambs and their subsequent weights at weaning.

REFERENCES

AOAC. 1999. *Official Methods of Analysis*. 15th edn. Association of Official Analytical Chemists, Washington, DC, USA.

ARC. 1980. *The Nutrient Requirement of ruminant Livestock*. Supplement 1. pp 78–80. Agricultural Research Council, Commonwealth Agricultural bureaux, Slough, UK.

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 conditions. *India Journal of Small Ruminant* **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, Raghvendra Bhatta, 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 Science* **16**: 983–87.

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

Kearl Leonard C. 1982. *Nutrient Requirements of Ruminants in Developing Countries*. pp. 45–58. International Feedstuffs Institute, Utah Agricultural Experiment Station, Utah State University, Logan, Utah, USA.

Krishna N, Bhandari D S and Patyanak B C. 1981. A double indicator method of determining dry matter intake and digestibility of nutrients in grazing sheep. *Indian Journal of Animal Sciences* **51**: 716–19.

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

Mc Donald 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 CM 20 2JE, England.

Sankhyan S K, Shinde A K and Karim S K. 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.

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.

SPSS. 1999. *Statistical Package for Social Science*. Version 10.

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**: 3583–90.

Wallace J D, and Van Dyne J M, 1970. Precision of indirect method for estimating digestibility of forage consumed by grazing cattle. *Journal of Range Management* **23**: 424–30.