Effect of Supplementary Feeding of Concentrate on Nutrient Utilization and Production Performance of Ewes Grazing on Community Rangeland during Late Gestation and Early Lactation

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ABSTRACT : Malpura and Kheri ewes (76) in their late gestation, weighing 34.40±0.95 kg were randomly selected and divided into 4 groups of 19 each (G1, G2, G3 and G4). Ewes in all the groups were grazed on natural rangeland from 07.00 h to 18.00 h. Ewes in G1were maintained on sole grazing while ewes in G2, G3 and G4, in addition to grazing received concentrate mixture at the rate of 1% of their body weight during late gestation, early lactation and entire last quarter of pregnancy to early quarter of lactation, respectively. The herbage yield of the community rangeland was 0.82 metric ton dry matter/hectare. The diet consisted of (%) Guar (*Cyamopsis tetragonoloba*) bhusa, (59.2), Babool pods and leaves (17.2), Bajra (*Pennisetum typhoides*) stubbles (8.8), Doob (5.3), Aak (4.2) and others (5.3). The nutrient intake and its digestibility were higher ($p<0.01$) in G2, G3 and G4 as compared to G1 because of concentrate supplementation. The intakes of DM (g/kg $W^{0.75}$), DCP (g/kg $W^{0.75}$) and ME (MJ/kg $W^{0.75}$) were 56.7, 5.3 and 0.83; 82.7, 12.2 and 1.16; 82.7, 12.1 and 1.17 and 83.1, 12.3 and 1.18 in G1, G2, G3 and G4, respectively. The per cent digestibility of DM, OM, CP, NDF, ADF and cellulose was 57.9, 68.8, 68.7, 52.3, 37.5 and 68.4; 67.6, 76.1, 82.3, 60.6, 44.5 and 73.4; 67.6, 76.1, 81.5, 60.6, 44.8 and 74.5 and 67.6, 76.1, 82.3, 60.6, 44.7 and 73.3 in G1, G2, G3 and G4, respectively. The nutrient intake of G2, G3 and G4 ewes was sufficient to meet their requirements. The ewes raised on sole grazing lost weight at lambing in comparison to advanced pregnancy. However, ewes raised on supplementary feeding gained 1.9-2.5 kg at lambing. The birth weight of lambs in G2 (3.92) and G4 (4.07) was higher ($p<0.01$) than G1 (2.98), where as in G1 and G3 it was similar. The weight of lambs at 15, 45 and 60 days of age were higher in G2, G3 and G4 than in G1. Similarly, the average daily gain (ADG) after 60 days was also higher in G2, G3 and G4 than in G1. The milk-yield of lactating ewes in G2, G3 and G4 increased up to 150-250 g per day in comparison to G1. The birth weight, weight at 15, 30, 45 and 60 days, weight gain and ADG at 30 or 60 days was similar both in male and female lambs. It is concluded from this study that the biomass yield of the community rangeland is low and insufficient to meet the nutrient requirements of ewes during late gestation and early lactation. Therefore, it is recommended concentrate supplementation at the rate of 1% of body weight to ewes during these critical stages to enhance their production performance, general condition as well as birth weight and growth rate of lambs. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 7 : 983-987)***

Key Words : Supplementary Feeding, Nutrient Utilization, Production Performance, Ewes, Community Rangeland, Gestation, Lactation

INTRODUCTION

In India, sheep are reared mainly on community rangeland and/or stubble grazing on cropped land after harvesting the crops. They are supplemented with top feeds during lean season to meet their nutritional requirements. These rangeland are covered with a wide variety of vegetation mainly grasses, bushes, shrubs and trees. The biomass yield of community rangeland is low and stocking density is high (Sankhyan et al., 1999a) and sheep grazing on such land are underfed for most part of the year. Majority of the sheep farmers in semi-arid region do not supplement concentrate to their sheep 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). The information on the effect of supplementary feeding on nutrient utilization and performance of ewes under farmers' field is scanty. Therefore, the present study was undertaken to demonstrate the beneficial effects of concentrate supplementation to ewes during late gestation and early lactation on their production performance at farmers' doorstep.

MATERIALS AND METHODS

A demonstration study was carried out on farmers' sheep flock maintained on natural rangeland at Soda village of district Tonk, Rajasthan, about 20 km from the Central Sheep and Wool Research Institute, Avikanagar, located in hot semi-arid region. The experiment was conducted for 108 days extending from late monsoon season to winter (22 September 1998 to 8 January 1999). Malpura and Kheri ewes (76), 2-3 years old, in their late gestation and weighing 34.40±0.95 kg were randomly selected and divided into 4 groups of 19 each (G1, G2, G3 and G4).

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Table 1. Botanical composition of the range (roughage) consumed by the ewes

Local name	Botanical name	Percentage in the diet
Aak	*Calotropis procera*	4.20
Doob	*Cynodon dactylon*	5.30
Kukreli	*Celosia argentia*	0.80
Kagler (pods)	-	0.26
Dab	*Desmostachya bipinnata*	N
Bharbhut	*Cenchrus biflorus*	N
Babool (pods & leaves)	*Acacia nilotica*	17.24
Khejri	*Prosopis cineraria*	0.69
Ker	*Capparis decidua*	N
Pala	*Zizyphus nummularia*	1.59
Ber	*Zizyphus jujuba*	0.80
Bajra stubbles	*Pennisetum typhoides*	8.75
Guar bhusa	*Cyamopsis tetragonoloba*	59.15
Neem	*Azardirachta indica*	1.06
Jojhoru	*Tephrosia purpuria*	N

N=Negligible in quantity.

Ewes in all the groups were grazed on natural rangeland from 07.00 to 18.00 h followed by night shelter in side open improvised animal shed. G1 ewes were maintained on sole grazing while ewes in G2, G3 and G4, in addition to grazing received concentrate mixture at the rate of 1% of their body weight during late gestation, early lactation and entire last quarter of pregnancy to early part of lactation, respectively. The body weight of ewes at the start and at parturition was recorded. Birth weight of lambs and fortnightly changes in body weight up to 60 days were also recorded.

The biomass yield of the community rangeland was assessed (Papanastasis, 1977). Six ewes from each treatment were randomly selected for digestibility trial. For five consecutive days, the diet samples were collected through hand picking method (Sankhyan et al., 1999b), while the faecal samples were collected from rectum at 08.00 h. Subsequently, samples were properly mixed and pooled for 5-day collection period for individual ewes. Representative samples of concentrate mixture, range, diet and faeces were analysed for dry matter (DM) by drying them in oven at 60°C till constant weight. The above samples were subsequently ground to pass through 1 mm sieve in a Willey mill and were analysed for crude protein (CP) and ash (AOAC, 1990), neutral detergent fibre (NDF), acid detergent fibre (ADF), 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) except that the second stage was avoided. The rumen liquor used in IVDMD estimation, was obtained from fistulated rams maintained on a Cenchrus (*Cenchrus ciliaris*) straw based diet (roughage to concentrate ratio, 65:35). The faecal outgo was estimated by following formula and 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.

RESULTS AND DISCUSSION

Biomass yield

The mean biomass yield of the community rangeland was 0.82 metric ton DM/hectare, which is similar to the earlier reports (Chaturvedi et al., 2000, 2001). Sankhayn et al. (1999a) reported a lower biomass yield (1.57). These differences in biomass yield are attributed to the fertility of land, type of pasture, type of grazing and stocking density on the rangeland.

Botanical composition of the range and diet

The vegetation cover of community rangeland consisted *Cynodon dactylon*, *Desmostachya bipinnata*, *Celosia argentia*, *Cenchrus biflorus*, *Tephrosia purpuria* and *Kagler* grasses. *Zizyphus nummularia*, *Calotropis procera* and *Capparis decidua* shrubs and *Zizyphus jujuba*, *Acacia nilotica*, *Azardirachta indica* and *Prosopis cineraria* fodder trees (Table 1). However, the diet consisted mainly of *Cyamopsis tetragonoloba* straw (59.2%) followed by Acacia pods and leaves (17.2%). *Pennisetum typhoides* stubbles (8.8%) and *Cynodon dactylon* (5.3%).

Chemical composition of range and diet

The range samples contained (Table 2) 10.24 CP, 66.67 NDF, 49.25 ADF and 22.47 ADL (% DM basis) whereas the diet contained higher proportion of CP (13.21) and lower contents of fibre (61.28 NDF, 41.27 ADF) and ADL (13.69). This reflects the selective grazing behaviour of sheep (Ramirez et al., 1995). Thirteen per cent CP in the diet agrees with the reports of Shinde et al. (1994) who reported that sheep grazing on silvipasture also maintained 13-16% CP in their diets. The calculated values of digestible crude protein (DCP) and total digestible nutrient (TDN) contents of concentrate mixture were about 13 and 68 per cent, respectively.

Table 2. Ingredient and chemical composition of concentrate mixture, range (roughage) and diet consumed by ewes

Item	Composition (%)
Ingredient composition (%)	
Barley	12
Damaged wheat	15
Deoiled rice bran	20
Wheat bran	25
Groundnut cake	25
Urea	1
Mineral mixture	1
Common salt	1

Chemical composition (%)

Component	DM	OM	CP	NDF	ADF	Hemi-cellulose	Cellulose	ADL
Concentrate mixture	92.0	90.00	18.94	43.25	19.00	24.25	12.35	5.25
Range (roughage)	69.50	80.37	10.24	66.67	49.42	17.25	18.02	22.47
Diet	32.57	91.22	13.21	61.28	41.27	20.01	25.20	13.69

Table 3. Intake and digestibility of nutrients in four groups of ewes

Item	G1	G2	G3	G4	SEM	Level of significance
Body weight (kg)	31.17	37.08	34.42	36.50	1.84	NS
Nutrient intake						
Roughage intake (g/d)	771.67	859.67	830.17	868.50	35.48	NS
Concentrate intake (g/d)	-	370.83	344.17	365.00	ND	ND
Dry matter (g/d)	771.67^{a}	1230.50^{b}	1174.33^{b}	1233.50^{b}	48.36	**
Dry matter (g/kg B.W)	24.85^{a}	33.24^{b}	34.25^{b}	33.84^{b}	0.45	**
Dry matter (g/kg $W^{0.75}$)	58.56^{a}	82.68^{b}	82.74^{b}	83.11^{b}	1.02	**
DCP (g/d)	70.05^{a}	183.12^{b}	172.28^{b}	182.08^{b}	7.32	**
DCP (g/d B.W)	2.26^{a}	4.95^{b}	5.01^{c}	4.99^{bc}	0.01	**
DCP (g/d $W^{0.75}$)	5.31^{a}	12.17^{b}	12.12^{b}	12.26^{b}	0.04	**
ME (MJ/d)	10.92^{a}	17.42^{b}	16.63^{b}	17.47^{b}	0.69	**
ME (MJ/kg B.W)	0.35^{a}	0.47^{b}	0.48^{b}	0.48^{b}	0.002	**
ME (MJ/kg $W^{0.75}$)	0.83^{a}	1.16^{b}	1.17^{b}	1.18^{b}	0.003	**
Nutrient digestibility (%)						
Dry matter	57.90^{a}	67.60^{b}	67.58^{b}	67.59^{b}	0.004	**
Organic matter	68.78^{a}	76.10^{b}	76.10^{b}	76.09^{b}	0.36	**
Crude protein	68.68^{a}	82.34^{b}	81.45^{b}	82.25^{b}	0.43	**
Neutral detergent fibre	52.34^{a}	60.58^{b}	60.63^{b}	60.61^{b}	0.97	**
Acid detergent fibre	37.49^{a}	44.51^{b}	44.82^{b}	44.71^{b}	1.08	**
Cellulose	68.41^{a}	73.38^{b}	74.46^{b}	73.31^{b}	0.91	**

ND=Not detected, NS= Not significant, ** ($p<0.01$)

Intake and digestibility of nutrients

Although the roughage intake was similar among different groups (Table 3), there was significant ($p<0.01$) difference in total DMI between supplemented (G2, G3 and G4) and non-supplemented groups. The DMI (2.91% of body weight) recorded in G1 was lower than the requirement (ICAR, 1985). The trend observed in the intakes of DCP and ME were similar to that of DMI, because of the supplementation schedule. DCP and ME intakes recorded in G2, G3 and G4 were higher than the recommended standard for pregnant ewes (ICAR, 1985). In general, the digestibility of DM, OM, CP, NDF, ADF and cellulose was similar and higher ($p<0.01$) in supplemented groups (G2, G3 and G4) as compared to non-supplemented group, G1 (Table 3). It is well established that supplementation in the form of concentrate mixture improves the nutrient digestibility of the total diet (McDonald et al., 1988). Although the digestibility of nutrients recorded in G1 ewes was similar to that of earlier reports in sheep (Shinde et al., 1998) and in goats (Bhatta et al., 2002), the nutrient intake was not sufficient to meet their requiremnts.

Production performance of ewes

The ewes raised on sole grazing either lost weight (G1) or gained very less (G3) at lambing in comparison to that of advanced pregnancy. However, ewes raised on supplementary feeding besides grazing gained 1.92 (G2) and 2.47 (G4) kg at lambing as compared to advance pregnancy (Table 4). The present findings indicate that the

Table 4. Production performance of ewes and their lambs

Item	G1	G2	G3	G4	SEM	Level of significance
Production performance of ewes						
Body weight at beginning of the experiment (kg)	33.62	34.44	34.47	35.00	1.02	NS
Body weight at parturition (kg)	33.23^{a}	36.36^{b}	34.97^{ab}	37.47^{b}	0.99	*
Gain/loss in body weight at parturition	-0.39	1.92	0.50	2.47	0.76	NS
Body conformation at beginning (cm)						
Length	64.08	62.78	62.06	63.13	0.92	NS
Height	71.88	71.44	69.74	72.30	0.91	NS
Heart girth	79.58	79.56	77.82	80.33	0.92	NS
Paunch girth	90.15	93.14	90.65	92.30	1.39	NS
Body conformation at parturition (cm)						
Length	66.08^{b}	61.83^{a}	61.32^{a}	64.37^{ab}	1.00	**
Height	67.81	69.94	69.72	69.37	1.08	NS
Heart girth	81.08	83.03	83.85	84.30	1.62	NS
Paunch girth	89.85	93.92	92.88	92.27	1.72	NS
Body weight of lambs (kg)						
At birth	2.98^{a}	3.92^{bc}	3.50^{ab}	4.07^{c}	0.14	**
15 days	5.79^{a}	7.34^{bc}	6.76^{b}	7.99^{c}	0.22	**
30 days	7.92^{a}	9.67^{b}	9.27^{ab}	11.13^{c}	0.38	**
45 days	9.46^{a}	12.53^{bc}	11.23^{b}	13.14^{c}	0.41	**
60 days	11.02^{a}	14.71^{c}	13.05^{b}	15.26^{c}	0.38	**
Body weight gain of lambs in 30 days	4.93^{a}	5.74^{ab}	5.77^{ab}	7.06^{b}	0.38	**
Body weight gain of lambs in 60 days	8.04^{a}	10.79^{bc}	9.55^{b}	11.19^{c}	0.37	**
Average daily gain 0-30 days (g)	164.49^{a}	191.48^{ab}	192.35^{ab}	235.33^{b}	12.69	**
Average daily gain 0-60 days (g)	134.04^{a}	179.81^{bc}	159.22^{b}	186.44^{c}	6.20	**

NS= Not significant, * ($p<0.05$), ** ($p<0.01$)

Table 5. Sex-wise growth performance of lambs born from experimental ewes

Item	Male	Female	SEM	Level of significance
Birth weight (kg)	3.69	3.62	0.10	NS
Body weight at 15 days (kg)	7.13	6.94	0.15	NS
Body weight at 30 days (kg)	9.86	9.32	0.27	NS
Body weight at 45 days (kg)	12.25	11.28	0.29	NS
Body weight at 60 days (kg)	14.02	13.34	0.27	NS
Body weight gain 30 days (kg)	6.17	5.70	0.27	NS
Body weight gain 60 days (kg)	10.33	9.72	0.26	NS
Average daily gain 0-30 days (g)	205.56	189.86	8.97	NS
Average daily gain 0-60 days (g)	172.16	162.06	4.39	NS

NS= Not significant.

ewes in G1 group were not able to meet their nutrient requirements from sole grazing. As a result they mobilized their body reserves to meet the additional nutrient requirements of growing foetus, leading to reduction in their body weight (Santra and Pathak, 1999). These findings of body weight changes of the ewes without and with concentrate supplementation corroborate the earlier reports (Chaturvedi et al., 2001). Except body length, the body conformations viz. height, heart girth and paunch girth did not differ at the beginning of the experiment and at lambing among the four treatments. The length of ewes at lambing was higher in G1 than in G2 and G3.

The birth weights of lambs in G2 (3.92 kg) and G4 (4.07 kg) were higher ($p<0.01$) than that in G1 (2.98 kg), whereas the birth weight of lambs in G1 and G3 did not differ statistically (Table 4). The weight of lambs at 15, 45 and 60 days of age was higher in G2, G3 and G4 than that in G1. Similarly, the average daily gain (ADG) at 60 days was also higher in G2, G3 and G4 than that in G1. The average daily gain (g) of lambs at 60 days of age was highest in G4 followed by G2, G3 and G1 (Table 4).

Higher birth weights in G2 and G4 lambs were due to concentrate supplementation of ewes during pregnancy (Shinde et al., 1996; Chaturvedi et al., 2001). The higher weight of lambs at 15, 45 and 60 days of age and also their higher ADG in case of G2, G3 and G4 were due to increased milk yield of ewes up to 150-250 g per day due to concentrate supplementation in comparison to that of without concentrate supplementation.

Further, the birth weight, weight at 15, 30, 45 and 60

days, weight gain and ADG in 30 or 60 days were higher in case of male than that of female lambs, but the differences were statistically not significant (Table 5). These findings of body weight changes of male and female lambs are similar to those of earlier reports (Chaturvedi et al., 2001).

CONCLUSION

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 ewes during late gestation and early lactation. However, concentrate supplementation at the rate of 1% of body weight to ewes during these critical stages enhanced their production performance, general condition as well as birth weight and growth rate of lambs.

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