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Effect of Dietary Energy Supplementation on Feed Intake, Growth and Reproductive Performance of Sheep under Grazing Condition

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Abstract: Six female sheep were used in a 90 day trial to study the effect of dietary energy supplementation to grazing on feed intake, growth and reproductive performance of female sheep. Animals were blocked according to live weight and blocked groups were assigned at random into two feeding regimes i.e. low and high energy (10.02 and 11.98 MJ ME/kg DM). Each sheep received 250 grams of supplemental diet in addition to grazing. Results showed that, feeding of sheep with increased levels of dietary energy supplementation did not have significant (P>0.05) differences for daily average dry matter and crude protein intake. However, daily average ME intake significantly (P<0.05) increased in a linear fashion and the mean values were 4.67 and 5.76 MJ/d for low and high energy supplemented diets respectively. The digestibility of dry matter (DM), organic matter (OM) and crude fibre (CF) significantly (P<0.05) increased as the level energy supplementation was increased. However, the digestibility of crude protein (CP), nitrogen free extract (NFE) and ether extract (EE) was similar (P>0.05) for all dietary energy regimes. Average daily live weight gain significantly (p<0.05) increased from 34.8 to 48.5 g/d as the level of supplement energy increased from 10.02 to 11.98 MJ ME/Kg DM. The birth weight of lambs was highest i.e. 0.71 kg fed high energy diet and lowest i.e. 0.50 kg fed low energy diet. These results indicate that, increasing levels of supplemental energy improve growth and reproductive performance of female sheep. Therefore, supplementation of higher level of dietary energy (11.98 MJ ME/kg DM) may be suggested for optimizing growth and reproductive performance of female sheep under grazing condition.

Key words: Sheep, energy supplementation, digestibility, live weight gain, reproductive performance

Introduction

In Bangladesh sheep production is reputed due to their early maturity, high prolificacy, delicacy of meat, superior skin quality, extreme disease resistance and wide range of acceptability under adverse agro climatic condition (Devendra and Burns, 1983). Higher reproductive efficiency, better capacity to subsist on harsh nutritional regime and low risk of death make a viable proposition for increasing the productivity of sheep. In fact, relatively short breeding cycle, better reproductive efficiency, rapid growth rate, efficient heat balance mechanism, critical water turnover rate, simple behavioral pattern and anatomical characteristics combine to give the species its obliquity (Carles, 1987). Major constraints related to massive production of sheep are low energy intake (McGregor, 1984). The genetic potentiality of sheep in our country is deteriorating day by day due to indiscriminate breeding, lack of improved quality feeds and proper management practices. In many tropical countries, productivity of sheep are very poor and has been related to the limitations of disease, nutrition, genotype and management practices. Most of the farmers in Bangladesh rear sheep with tethering as well as traditional system of grazing without any supplementation. This system of production causes reduced growth and poor reproductive performance. Studies conducted by various authors reflect the facts that, grazing alone may not be sufficient for optimizing live weight gain and reproductive performance of sheep. Therefore, if scavenging type of rearing can be supplemented with minimum level of concentrate as an additional source of dietary energy then the level of production can be increased at minimum cost. Limited works have been done for overall improvement sheep. Therefore, present investigation was aimed at predicting the effect of dietary energy supplementation on feed intake, growth and reproductive performance of female sheep under grazing condition.

Materials and Methods

Location and climatic condition: The experiment was conducted at Bangladesh Agricultural University Animal Nutrition Field Laboratory, Mymensingh during the period from April 2001 to June 2001 for a period of 90 days. This region has a subtropical humid climate with an average annual rainfall of 210.3 cm having dry period extending from November to March with marked incidence of rainfall during May to October. Ambient temperature varies from 21.52 to 30.55 ^{o}C with an average relative humidity of 80.72%.

Establishment of pasture and management: An estimated area of approximately 0.12 ha. was surrounded by protective fancy materials to establish

Table 1: Experimental design and dietary treatments

Block	Sheep	
Initial live weight (kg)	Low energy	High energy
I	12.0	12.9
II	10.4	9.5
III	8.5	8.7
Mean±sd	10.3±1.75	10.4±2.23

pasture in the grazing land. After completing establishment of the pasture, it was allowed for the animals to graze during day. Naturally grown grasses available in the grazing land were identified as *Axonopus compressus*, *Panicum repens*, *Imperata cylindrica, Cynodon dactylon* and *Cyperus roturdus*. Intercultural operations like proper irrigation, removal of undesirable plants and weeds had been accomplished to make the land ready for grazing sheep. Urea (45 kg/ha.) was applied in two weeks interval to accelerate proper growth potentials of the grasses.

Animals and their housing: Six female sheep aged about 10-months and weighing on average 10.35 kg were used for a 90 day trial. The animals were ear tagged and allowed for 10 days to adapt to the experimental conditions prior to onset of the study. Faeces of each sheep was examined initially for checking internal parasitic infestation and all animals were dewormed with suitable anthelmentic drugs immediately before starting of the experiment. Following adaptation, sheep were housed in individual pens in an animal house subjected to adequate natural ventilation and sunlight. The animals were allowed to graze for a particular period of 6 hours daily during day while at night they were individually penned.

Experimental design: Animals were blocked according to live weight (Table 1) and the blocked groups were assigned at random to supplemental diets having two different levels of energy i.e. low (10.02 MJ ME/kg DM) and high energy (11.98 MJ ME/kg DM). All animal groups were allowed to graze the newly established grazing land and supplemented with one of the two diets in addition to grazing.

Diet and method of feeding: Animals were grazed 6.0 hours daily (08:00 to 12:00 and 15.00 to 17:00 hours) in the newly established pasture and supplemented with 250 grams of concentrate mixture consisting of maize, wheat bran, rice polish and soybean meal. The chemical composition and ME content of the ingredients used in formulating supplemental diets are given in Table 2 .The supplemental diets were fed daily at night when the animals were kept in individual pen. The increment of supplemental diets was based on live weight gain and daily feed consumption. Free access of ample clean, cool drinking water was carefully ensured for all animals

Digestibility of energy supplemented diet: A conventional digestion trial was conducted for 10 days at the end of the experiment to assess the utilization of different dietary nutrients. During this period, animals were kept in individual pen and were fed with a measured quantity of grass every morning collected from the grazing land in which animals were raised during growth trial. In addition, supplemental diets (250 g/animal/day) of different energy level (low and high energy) were fed to animals. Representative feed, refusal and faeces samples collected over the period of 10 days were subjected to chemical analysis (AOAC, 1980).

Measurements and procedure

Grazing intake: Dry matter (DM) and other nutrients intake were estimated by animal weight gain method. Animals were weighed individually before access to the grazing land. The animals were allowed to graze and weighed at 2 hour interval from 08.00 to 16.00 hours. Average weight of each animal was recorded. The difference between two weights before and after grazing was considered as the amount of herbage consumed by individual animal of each group.

Live weight gain: Animals were weighed initially and then at 15 day interval throughout the experimental period. Immediately after parturition, weight of individual lamb was recorded. After completion of 90-day experimental period, final live weight of each animal was recorded in three consecutive days and the average weight was recorded. The animals were weighed at 07.30 hour prior to grazing.

Reproductive performance: As it was too difficult to detect heat in sheep, a ram was always kept along with the ewes to allow them for natural service. Special attention was given to pregnant animals and their gestation gain was recorded. Age at puberty, date of service, gestation period, litter size, sex, birth weight of lamb were also recorded after parturition.

Statistical analyses: The experimental data related to chemical composition of mixed grass, growth performance, dry matter intake and digestive efficiency were analyzed by using “MSTAT” statistical program to compute analysis of variance for a randomized block design (RBD).

Results and Discussion

Chemical composition of mixed grass: The chemical composition of mixed grasses at fortnight interval has been shown in the Table 3. The table showed that, dry matter (DM), ether extract (EE), and crude fibre (CF) content of green grasses differed significantly ($P<0.05$) with harvest time. No marked ($P>0.05$) differences were

Table 2: Chemical composition and ME contents of ingredients used for energy supplemented diet

Ingredients	Amount (g/100g)		Chemical composition (g/100g DM)						*ME (MJ/ kg DM)
	Low energy	High energy	CP	CF	EE	Ash	NFE	OM	
Maize	18	60	8.50	10.02	2.50	2.12	76.76	97.88	13.0
Wheat bran	60	12	10.2	15.88	2.24	8.23	63.65	91.77	11.3
Rice polish	10	15	12.4	16.00	7.15	12.9	51.52	87.01	9.90
Soybean meal	12	13	26.5	11.02	5.40	10.3	46.85	89.70	12.3*

ME values of feed ingredients were taken from Ranjhan (1980); Banerjee (1998); McDonald *et al*. (1988)

Table 3: Chemical composition of mixed grass (g/100 g DM)

Parameters	Time of harvest						SEM	Level of significance
	7 April	22 April	7 May	22 May	6 June	21 June		
Dry matter (DM)	20.32	20.40	20.95	21.25	22.50	22.50	0.15	*
Organic matter (OM)	87.10	89.50	89.20	89.05	87.95	87.85	0.84	NS
Crude protein (CP)	9.25	9.06	8.95	9.15	10.05	9.20	0.75	NS
Crude fibre (CF)	25.04	25.50	24.90	26.10	26.04	25.38	0.24	*
Ether extract (EE)	2.50	2.40	2.30	2.45	2.25	2.15	0.02	*
Nitrogen free extract (NFE)	50.31	51.54	53.05	50.35	49.6	51.12	0.86	NS
Ash	12.90	11.50	10.80	11.95	12.05	12.15	0.96	NS

observed in organic matter (OM), nitrogen free extract (NFE) and ash content. This observation clearly indicates that, the proximate components of green grasses are affected at fortnight intervals. Various factors may affect the chemical composition of green grass. Tareque (1987) observed that, dry matter content of plant materials tend to decline during dry season. Similarly, Norton (1984) demonstrated that, NFE content of plant materials may be affected markedly by grass species, environmental condition, stage of maturity, region of the world and leaf stem ratio. Other factors may also affect the chemical composition of plant i.e. soil fertility, stage of maturity, light intensity, season and other macro and micro environmental factors (Ranjhan, 1980). Singh *et al*. (1988) reported that, stage of maturity put a vital impact in changing the chemical composition of plants. Similarly, Rahman *et al*. (1991) and Tareque (1987) reported that, season may alter the production and chemical composition of green grass. Wilson (1960) remarked that, crude protein content of forage materials can be drastically changed with the application of N fertilizer in the soil. This is due to the reason that, nitrogenous materials stimulate growth and multiplication of new tissues and tend to accumulate NPN components in different soft regions of the plants.

Digestibility and nutritive value of energy supplemented diets: The effect of feeding different levels of supplemental energy on apparent digestibility of proximate components in sheep raised under grazing condition is shown in Table 4. The digestibility of crude protein (CP), nitrogen free extract (NFE) and ether extract (EE) was similar in sheep (P>0.05) for all dietary energy regimes. However, the digestibility of dry matter (DM), organic matter (OM) and crude fibre (CF) increased significantly (P<0.05) as the level of dietary energy supplementation was increased. Similar to digestibility, nutritive value of different diets was almost similar (P>0.05) for sheep (Table 4) except for 'D' value which significantly increased (P<0.05) from 66.58 to 71.05% in sheep when supplemental energy level increased from 10.02 to 11.98 MJ ME/kg DM. ME content (MJ ME/Kg DM) of low and high energy supplemented diets was 9.42 and 11.36 MJ ME/Kg DM. These results are similar with those reported by Salim (1999) who found that, ME content of grass was 9.76 MJ ME/Kg DM for sheep.

Energy supplementation, intake and growth performance of sheep: Supplementation of concentrate having two different energy levels i.e. low and high energy (10.02 and 11.98 MJ ME/Kg DM) as an additional source of dietary energy exerted multiple effects on voluntary feed intake, total dry matter intake and growth potentials of sheep raised under grazing condition (Table 5). It was observed that, sheep received low and high levels of dietary energy supplementation did not show any significant (P>0.05) difference on green grass dry matter intake (327.8 vs. 313.4 g/d) and daily average dry matter intake (504.4 vs. 498.5 g/d). It is revealed that, (Table 5) dry matter intake from grazing in sheep was 327.8 g/d for low energy diet and 313.4 g/d for high energy diet. Similarly, average total dry matter intake in sheep was 504.4 g/d and 498.5 g/d for low and high energy diets, respectively. This result of the present study is not in agreement with that, of Salim (1999) who reported that, dry matter intake in sheep was 287.77 g/d and Kabir (2000) who also recorded higher dry matter intake in sheep and it was 542.7 g/d). Dry matter intake

Table 4: Effect of energy supplementation on digestibility and nutritive value in sheep

Parameter	Sheep		SEM	Level of significance
	Low energy	High energy		
Apparent digestibility (g/100g):				
DM	62.63	75.16	2.20	*
OM	63.88	77.86	2.66	*
CP	63.45	67.00	2.97	NS
CF	42.66	51.24	2.65	*
NFE	74.31	81.91	2.48	NS
EE	64.95	71.28	3.93	NS
Nutritive value (g/100 g DM):				
DCP	7.39	7.8	0.63	NS
DCF	7.12	8.56	1.02	NS
DEE	2.62	2.87	0.68	NS
DNFE	43.97	48.47	1.97	NS
"D" value	66.58	71.05	1.09	*
ME (MJ/kg DM)#	9.42	11.36	0.83	NS

#ME value was estimated from digestible organic matter ('D' value) as ME (MJ/kg DM) = 0.16 ×'D' value (MAFF, 1984)

Table 5: Effect of energy supplementation on growth performance of sheep

Parameter	Sheep		SEM	Level of significance
	Low energy	High energy		
Initial live weight (kg)	10.30	10.36	0.37	NS
Final live weight (kg)	13.43	14.73	1.19	NS
Average live weight gain (g/d)	34.81	48.53	3.67	*
DM intake from grass (g/d)	327.8	313.4	4.70	NS
DM intake from concentrate (g/d)	183.3	183.8	2.67	NS
Total DM intake (g/d)	504.4	498.5	0.96	NS
DM intake (% live weight)	3.79	3.71	0.67	NS
DM intake ($g/kg^{0.75}/d$)	78.52	71.0	1.06	*
Crude protein intake (g/d)	58.88	48.77	0.17	NS
ME intake (MJ/d)	4.67	5.76	0.06	*
Feed conversion efficiency (DMI/LWG)	14.49	10.28	2.05	NS
Protein conversion efficiency PI/LWG)	1.67	1.21	0.07	*
Energetic efficiency (MEI/LWG kJME/g LWG)	134.2	118.7	1.20	**

Table 6: Effect of energy supplementation on reproductive performance of female sheep

Parameter	Sheep	
	Low energy	High energy
No. of pregnant animals	1	2
Litter size	1	2
Percentage born alive	100	100
Birth weight (kg)	0.50	0.71
Sex of lamb	Male	Female

expressed as per cent live weight was 3.75 kg/d and it non-significantly (P>0.05) decreased from 3.79 to 3.71 kg/d with increased levels of dietary energy supplementation (low and high energy). Daily average dry matter intake expressed as metabolic body size ($g/kg^{0.75}/d$) significantly (P<0.05) decreased from 78.52 to 71.00 $g/kg^{0.75}/d$ with increased levels of dietary energy supplementation. These findings are not similar with the observation of Salim (1999) who indicated that, dry matter intake in sheep was 52.7 $g/kg^{0.75}/d$. Similarly, Kabir (2000) also observed dry matter intake in sheep to be 31.8 $g/kg^{0.75}/d$ for control group and 78.2 $g/kg^{0.75}/d$ for supplemented group. The average daily ME intake in sheep decreased significantly (P<0.05) due to increased levels of dietary energy supplementation and the mean values were 4.67 and 5.76 MJ ME/Kg DM for low and high energy supplemented groups respectively. Average daily crude protein intake in sheep was 58.88 and 48.77 g/d and no significant (P>0.05) difference was observed between them. Average daily live weight gain in sheep was highest (48.53 g/d) received high energy supplemented diets and lowest (34.81g/d) received low energy diet. Feed required per kg live weight gain in sheep was 14.49 and 10.28 kg for low and high energy regimes, respectively. Kabir (2000) found superior FCR value in sheep and it was 10.9 in unsupplemented group and 18.9 in protein supplemented group. Rahman *et al*., 1991 observed better FCR value in sheep and it was 10.3. The efficiency of utilization of ME for growth (kJ ME/g LWG) in sheep was 134.2 and 118.7 for low and high energy supplemented diets, respectively and the difference among energy levels was significant ($P<0.01$). The efficiency of utilization of protein (CPI/LWG) improved significantly in sheep ($P<0.05$) with increased dietary energy supplementation and the mean values were and 1.21 for low and high energy supplemented diets, respectively.

Reproductive performance of sheep: Certain reproductive traits of female sheep raised under two feeding regimes i.e. low and high energy supplementation (10.02 and 11.98 MJ ME/kg DM) in addition to grazing have been shown in Table 6. The number of pregnant ewes were higher in high energy supplemented group compared to other group. Similarly, birth weight of lambs was also higher on high energy diet (0.71 kg) compared with that, on low energy diet (0.50 kg). It is speculated that, increased levels of dietary energy supplementation along with other nutrients from the concentrate mixture might increased the availability and proper balance of nutrients to the host animal. This in turn resulted in higher supply of nutrients to the fetus and reflected higher birth weight. However, size, weight and health status of ewe may be another important factors which may affect birth weight of lambs. Doney *et al*. (1982) observed that, provision of proper nutrition before mating is associated with complex interrelation between body weight gain and body condition of lambs. In contrast, Kochapakdee *et al.* (1994) reported that, better supplementary feeding did not always play potential role in attainment of birth weight or post weaning rate of gain of lambs. Hence, it is too difficult to draw a precise conclusion regarding why birth weight of lambs markedly increased with increased levels of dietary energy supplementation.

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