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Effects of concentrate supplementation on growth, reproduction and milk yield of Black Bengal goats (*Capra hircus*)

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Abstract

Sixteen female Black Bengal goats (10 ± 0.6 months of age and 11.5 ± 1.3 kg live weight) were divided into four groups having four goats in each. In a completely randomized design, A, B, C and D were given 150, 200, 250 and 300g concentrate mixture with *ad libitum* green grasses. Total dry matter (DM) intake (333.6, 374.7, 416.3 and 456.5g/day in groups A, B, C and D, respectively) was significantly (P<0.01) influenced by the level of concentrate in the diet. Crude protein (CP) intake (45.2, 57.0, 66.4 and 75.7g/day) was significantly (P<0.01) higher in group D and lower in group A. Daily weight gain of kids did not differ significantly between groups. Feed and protein conversion efficiency was not significantly influenced by the concentrate level in the diet. Milk yield was significantly (P<0.01) increased (206.8, 233.4, 359.3 and 374.7 mL/day for groups A, B, C and D, respectively) with the supplementation of concentrate. It is suggested to supplement 250g of concentrate daily to female goats in addition to *ad libitum* roughage. (*Bangl. vet*. 2012. Vol. 29, No. 1, 7 – 16)

Introduction

Bangladesh has 20.6 million goats, representing 58.8% of the livestock population, of which >90% comprise Black Bengal goats. According to BBS (2001) landless and small farmers keep 52.4% of the goats and medium and large farmers keep the rest. The Black Bengal goat is renowned for its high prolificacy, quality skin and tasty meat (Husain *et al*., 1998). The breed is early-maturing with first kidding occurring at about 12 months of age. Does kid twice a year or thrice in two years. Goats are efficient users of grasses, shrubs and tree leaves, and by-products of human foods, but this cannot satisfy their requirements. The productivity of goats may be increased by concentrate feeding (Madibela and Segwagwe, 2008) or supplying good quality forage (Muri and Jordao, 1991). The importance of concentrate supplementation on growth and productivity of goats is well recognized (Kochapakdee *et al*., 1994). Live weight of dams affects the weight gain of the kids, more obviously during the second and third month after birth (Romagesa Vila, 1981).

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Although, the Black Bengal is a dwarf goat, at 12 months of age live weight gain was 15 kg (Husain *et al.,* 1998). The present study was undertaken to evaluate common grasses available for feeding and the effect of concentrate supplementation on voluntary feed intake, and productive and reproductive performance.

Materials and Methods

Sixteen female goats of live weight 11.5 ± 1.3 kg at 10 ± 0.56 months of age were used for a 240-day feeding trial. Goats were assigned to four dietary treatments in a completely randomized design with four goats in each treatment. All animals received *ad libitum* green grass as the basal diet. They received concentrate mixture 150, 200, 250 and 300g/day per goat for group A, B, C and D, respectively: 100 kg of concentrate mixture contained 30 kg crushed maize, 50 kg wheat bran, 19 kg mustard oil cake, 0.1 kg vitamin mineral premix and 1 kg salt. Concentrate mixture contained 15.7g crude protein (CP) and 13.2 megajoule (MJ) of metabolisable energy (ME)/kg dry matter (DM). All goats were housed in a tin shed having wooden slatted floor raised above the ground with sufficient space to keep them comfortable. Goats were allowed free movement in a paddock daily from 8 to 10 AM. Before grazing, all the animals were supplied with 50% of the concentrate mixture and the remaining 50% was supplied at 4 PM. After grazing, the animals were supplied chopped green grass *ad libitum*. The feed was offered individually in plastic pans and fresh drinking water was available at all times. Kids were kept with their mother for the whole study period and no additional feed was provided to the kids. Feed samples were mixed and sub-samples were dried in the sun. After drying, grasses were ground. Crushed maize, mustard oil cake and wheat bran were purchased from the local market, and representative samples were collected at the time of their procurement for proximate analysis following the methods of AOAC (1980).

The weight of goats was recorded every 30 days in the morning. The birth weight (kg) of kids was taken by digital weighing balance within one hour after birth and fortnightly. Kids were separated from their does overnight (8 PM - 6 AM). In the morning, kids were weighed by weighing balance and allowed to suck. After sucking, kids were weighed again and milk production was calculated.

Data on reproductive performance including number of services per pregnancy, gestation length, litter size, birth weight of kids, postpartum doe weight and placenta weight were recorded. Data were compiled, tabulated and analysed using Statistical Package for Social Sciences (SPSS 11.5). Least significant difference (LSD) test were performed for comparison with SPSS (version 11.5).

Results and Discussion

Composition of feed

The chemical composition of grasses and concentrates is shown in Table 1. Daulat (1988) observed wheat bran and mustard oil cake contained 88.0 and 90.7%

DM; and 12.0 and 31.2% CP, similar to the present findings. Misbah (2007) found that wheat bran contained 87.5% DM and 13.8% CP. Napier, German and roadside grass contained 24.3, 23.9 and 21.1% DM; and 8.7, 8.3 and 9.2% CP. On the other hand, Mahfuz (2004) found that German grass contained 15.9% and 8.5% of DM and CP, respectively. Alam (1990) observed 19.7% and 8-10% of DM and CP in roadside grasses, similar to the present findings.

Table 1. Chemical composition (g/100g DM) of grasses and concentrates

Feed items	DM	g/100g DM (mean±sd)					
		OM	CP	CF	EE	NFE	Ash
Maize crushed	90.9 ± 1.5	96.6 ± 1.3	8.9 ± 1.0	2.4 ± 0.4	4.7 ± 1.9	80.6 ± 4.5	3.4 ± 1.3
Mustard oil cake	92.5 ± 3.3	90.1 ± 1.1	33.0 ± 3.1	11.8 ± 0.3	11.4 ± 2.8	33.9 ± 4.7	9.9 ± 1.1
Wheat bran	87.6 ± 1.8	94.1 ± 0.4	16.4 ± 0.9	10.2 ± 2.0	3.3 ± 0.5	64.3 ± 2.8	5.9 ± 0.4
Conc. mix	89.6 ± 1.7	93.6 ± 1.0	15.7 ± 1.7	11.6 ± 0.9	6.5 ± 1.5	59.9 ± 3.9	6.4 ± 0.7
Napier grass	24.3 ± 5.5	90.3 ± 2.8	8.7 ± 1.8	29.2 ± 4.0	2.7 ± 0.7	50.3 ± 18.1	9.7 ± 2.8
German grass	23.9 ± 6.7	90.0 ± 2.9	8.3 ± 1.0	33.7 ± 0.6	2.1 ± 0.2	45.9 ± 22.9	10.1 ± 3.0
Roadside grass	21.1 ± 4.0	90.3 ± 1.4	10.9 ± 1.6	21.4 ± 0.8	2.0 ± 0.2	55.9 ± 10.3	9.7 ± 1.4

Effects of concentrate supplementation on intake and growth

The effect of concentrate supplementation on intake and growth of goats is shown in Table 2.

Dry matter (DM) intake

Feeding goats concentrate as supplement significantly ($P<0.01$) increased intake of DM expressed as total voluntary intake (333.6, 374.7, 416.3 and 456.5g/day), percentage of live weight (2.7, 2.9, 3.0, 3.5%) and percentage of metabolic body size (54.1, 57.3, 61.7, 71.8g/day) in groups A, B, C and D, respectively. Dry matter intake from grasses decreased with the increasing level of supplementation of concentrate, but the differences between groups were not significant ($P>0.05$). Dry matter intake from concentrate was significantly ($P<0.01$) higher in group D than in group A. Devendra and McLeory (1983) observed that DM intake in meat-type goats hardly exceeded 3% of live weight. Ranjhan (1980) reported that DM intake in goats varied from 1.5 to 3.7% of live weight. Kabir *et al.* (2002a) mentioned that DM intake of goat was 3.5% of live weight. The present finding on DM intake corresponds well with the above observations.

Crude protein (CP) intake

Total CP intake (kg) and daily CP intake was significantly higher in D than in A. Kabir *et al.* (2002a) observed CP intake of 76.1g/day in goats supplemented with 250g concentrate per day, slightly higher than the present findings. Similarly, Salim *et al.*

(2002) observed that CP intake of supplemented group was higher (63.7g/day) than that of the control group (26.5g/day).

Table 2. Effects of concentrate supplementation on growth performance of Black Bengal does

Parameters	Groups				SEM	Level of sig.
	A	B	C	D		
Initial live weight (kg)	11.4	11.5	11.5	11.6	0.6	NS
Final live weight (kg)	15.5	16.8	18.0	18.2	0.8	NS
Average live weight gain (g/day)	27.6	35.1	43.2	43.8	6.5	NS
Total live weight gain (kg)	4.1	5.3	6.5	6.6	0.5	NS
DM intake from grass (g/day)	203.2	201.0	197.4	194.5	19.0	NS
DM intake from concentrate (g/day)	131.5^{a}	173.7^{b}	218.9^{c}	262.0^{d}	7.1	**
Total CP intake (kg)	6.8^{a}	8.5^{b}	10.0^{c}	11.4^{d}	2.2	**
Total DM intake (g/day)	333.6^{a}	374.7^{b}	416.3^{c}	456.5^{d}	19.5	**
Total DM intake (kg)	50.2^{a}	56.5^{b}	62.4^{c}	68.4^{d}	2.2	**
DM intake (% live weight)	2.7^{a}	2.9^{a}	3.0^{a}	3.5^{b}	0.3	**
DM intake (g/kg$^{0.75}$/day)	54.1^{a}	57.3^{a}	61.7^{a}	71.8^{b}	4.4	**
Crude protein intake (g/day)	45.2^{a}	57.0^{b}	66.4^{c}	75.7^{d}	2.0	**
Feed conversion efficiency (DMI/LWG)	12.1	10.7	9.6	10.4	0.6	NS
Protein conversion efficiency (CPI/DMI)	1.6	1.6	1.5	1.7	0.4	NS

NS-Not significant; **P>0.01

^{abcd}Data having dissimilar superscripts differ significantly (P<0.01)

Weight gain of dam

The average daily growth rate of dams is shown in Table 2. In the present result, the growth rate did not differ significantly between groups; it increased with the level of concentrate supplementation. Kochapakdee *et al*. (1994) reported that female growing goats receiving concentrate diet (0.8% BW) gained 36g/day, while goats on control diet (grazing only) gained 14g/day, which partially agrees with the present findings. Kabir *et al*. (2002b) found that the growth rate of Black Bengal goats ranged from 37.5 to 40.3g/day and mentioned that high level of protein in the diet significantly (P<0.05) influenced the live weight gain. Supplementation of concentrate increased growth rate (Sikosana and Maphosa, 1995), which corresponds to the present results.

Feed and protein conversion efficiency (PCE)

In the present trial, feed conversion efficiency (FCE) was not influenced by the level of concentrate (Table 2). Hossain *et al.* (2003) in his experiment with 250g concentrate supplementation observed FCR of 10.8, which corresponds well with the group B and D. Similar FCR value was observed by Rahman *et al.* (1991).

Protein conversion efficiency (PCE) in the present study did not differ significantly between groups. Hossain *et al.* (2003) found higher efficiency of utilization of protein [CP/g live weight gain (LWG)] with increased dietary energy supplementation.

Reproductive performance

Reproductive traits of does fed different levels of concentrate supplementation are presented in Table 3.

Number of services per pregnancy

The numbers of services per pregnancy in group A, B, C and D are presented in Table 3 and did not differ significantly between groups. Hossain *et al.* (2004) reported that Black Bengal goats required 1.2 - 1.4 services per pregnancy. Chowdhury *et al.* (2002) found 1.7 services per pregnancy in Bengal goats fed high levels of concentrate, and 1.2 in goats fed low levels. Similarly, Alam (1992) found 1.4 services per pregnancy in Black Bengal goats under farming conditions.

Litter size

Litter size did not differ significantly between groups (Table 3). Litter size of Black Bengal goats varies from one to four (Hassan *et al.*, 2007). Hossain *et al.* (2004) stated that parity had great influence on litter size: in the 1st, 2nd and 3rd parity and it was 1.1, 1.8 and 2.0, respectively. On the other hand, Moulick *et al.* (1996) reported an average litter size of 2.1 in Black Bengal goats.

Table 3. Effects of concentrate supplementation on reproductive performance of Black Bengal goats

Parameters	Groups				Level of sig.
	A	B	C	D	
Number of service per pregnancy	2.8 ± 0.4	2.2 ± 0.3	1.8 ± 0.3	1.7 ± 0.2	NS
Gestation length (day)	151.6 ± 8.4	150.1 ± 7.2	149.2 ± 6.1	149.3 ± 7.1	NS
Litter size [number (no.)	1.6 ± 0.1	1.7 ± 0.3	1.9 ± 0.1	1.9 ± 0.2	NS
Birth weight of kids (kg)	1.0 ± 0.1	1.0 ± 0.2	1.3 ± 0.0	1.3 ± 0.1	NS
Post-partum weight of does (kg)	13.2 ± 0.7	14.5 ± 0.8	15.0 ± 0.9	14.8 ± 0.4	NS
Placental weight (g)	175.0 ± 12.3	187.5 ± 15.6	230.0 ± 11.5	197.5 ± 13.7	NS

NS-Non-significant

Birth weight of kids

Average birth weights of kids did not differ significantly between groups (Table 3). Dam body weight and sex of the kid are influence by the birth weight of kids. Male kids are heavier than females (Hafez, 1962).

Post-partum doe weight and placental weight

Level of concentrate did not significantly affect the post-partum weights of does or placenta weight (Table 3). Mellado *et al.* (2005) suggested that higher post-partum weight indicates the higher birth weight of kids. On the other hand, placenta weight is mainly influenced by the litter size (Hafez, 1962).

Growth performance of kids

The growth rates of kids fed different levels of concentrates are presented in Table 4, with no significant differences among groups. Kabir *et al.* (2002b) found higher daily growth rate (62.4g/day) in kids that received the high protein diet (16% CP) than those fed the low protein diet (10% CP; 45.4g/day) and the effect continued up to weaning. Tiwari *et al.* (1983) suggested that better growth rate could be achieved by maintaining kids in smaller groups and under better feeding and management conditions. Growth rate is also influenced by the litter size (Husain *et al.*, 1998).

Table 4. Fortnightly growth rate of Black Bengal kids

Days	Groups				Level of sig.
	A	B	C	D	
0-15	33.3 ± 6.2	43.3 ± 6.3	34.2 ± 9.3	33.3 ± 5.7	NS
16-30	36.7 ± 7.5	40.0 ± 7.2	48.3 ± 6.9	46.7 ± 7.1	NS
31-45	36.7 ± 5.1	36.7 ± 8.3	40.3 ± 11.4	36.7 ± 5.2	NS
46-60	37.3 ± 9.3	36.3 ± 8.1	38.3 ± 8.6	37.7 ± 6.3	NS
61-75	50.7 ± 7.7	45.0 ± 6.7	42.3 ± 4.9	56.0 ± 13.4	NS
76-90	46.7 ± 12.3	40.3 ± 15.6	44.3 ± 11.5	51.3 ± 13.7	NS
Average	40.2 ± 12.9	40.3 ± 12.5	41.3 ± 12.4	43.6 ± 15.6	NS

NS-Non-significant

Sadullah (1991) reported daily gains of 41.0g/day from birth to six months of age. Bhuiyan *et al.* (1996) suggested that higher level of concentrate supplementation increased daily live weight gain of kids. Similarly, Sharma and Ogra (1990) stated that supplementation of concentrate feed significantly ($P<0.05$) improved total DM intake, growth rate and FCR of kids. Paul *et al.* (1990) found that goats given a supplementation of concentrates were heavier from 4 to 6 months of age than goats that were only allowed to browse (13.8 vs 8.0 kg; $P<0.01$).

Milk Yield

Milk yield of Black Bengal does increased significantly (P<0.01) with the increased level of concentrate supplementation (Table 5). Average milk yields were 206.8, 233.4, 359.3 and 374.7g/day for groups A, B, C and D, respectively. Chowdhury *et al*. (2002) found that the average milk yield of Black Bengal does was 334g/day when fed 200-300g concentrates per day: the NRC (1981) recommendation is 556g/day.

Table 5. Milk yield of Black Bengal does

Months	Milk yield (g/day)				Level of sig.
	Group A	Group B	Group C	Group D	
1st	$222.0^{a} \pm 12.2$	$271.0^{a} \pm 19.4$	$390.5^{b} \pm 16.1$	$413.0^{b} \pm 28.2$	**
2nd	$219.5^{a} \pm 26.2$	$240.8^{a} \pm 13.8$	$367.8^{b} \pm 27.4$	$395.5^{b} \pm 29.2$	**
3rd	$179.0^{a} \pm 17.2$	$188.5^{a} \pm 23.4$	$319.5^{b} \pm 21.7$	$315.5^{b} \pm 31.8$	**
Average	$206.8^{a} \pm 18.5$	$233.4^{a} \pm 18.9$	$359.3^{b} \pm 21.8$	$374.7^{b} \pm 29.7$	**

**P<0.01

In lactating goat, Kawas *et al*. (1991) found that milk production was not significantly affected by the forage-to-concentrate ratio (75 : 25, 60 : 40 and 45 : 55) but tended to increase with an increase in concentrate feeding: this might be due to energy being diverted into body fat by infusion of propionic acid, whereas acetic acid infusion shifts energy output to milk production. Reverdin and Sauvant (1991) suggested that milk composition and yield are influenced by type of forage but not by type of concentrate.

Conclusions

Concentrate supplementation increased feed intake of does, live weight gain of kids in the first month and milk yield of does, but the positive effect was not correlated with the level of supplementation. Daily supplementation of 250g concentrate to suckling goats in addition to *ad libitum* roughage feeding could be recommended.

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