



Growth Performance of Black Bengal Goats by Feeding Different Levels of Mustard Oilseed Cake

M K Das^{1*}, J K Chatterjee², B Das¹ and K Paul¹

¹Krishi Vigyan Kendra Jalpaiguri, West Bengal University of Animal and Fishery Sciences, Ramshai, Jalpaiguri- 735219, West Bengal, India.

ABSTRACT

Black Bengal Goat farming business in one of the most profitable and promising entrepreneurship venture for rural youths and livestock farmers in Jalpaiguri district. The goat farmers make their earnings through trading of castrated male goats. However, they normally do not include mustard oilseed cake in the feed of these goats to enhance their body weight. This study included twenty-four (24) randomly selected Black Bengal castrated male goats from the farmer's field of uniform age and weight. The objective of the study was to find out the effect of four types of formulated concentrate feeds containing varying proportions of mustard oilseed cakes (MOC) on average body weight growth of goats. Four groups T1, T2, T3 and T4 based on MOC inclusion level (0%, 12%, 18% and 24%) in formulated concentrate feed were prepared. The goats were fed the feed for 90 days period. The consumption of prepared feed was significantly ($p \leq 0.05$) higher (205.36 g/ day) in T3 group than other groups. The dry matter intake (DMI) during the study period was increased in T1, T2, and T3 groups but decreased for the T4 group with no significant variation. Daily Crude Protein Intake (CPI) and total live weight gain were found significantly ($p \leq 0.05$) higher in T3 group of goats. The result explained that the Black Bengal castrated goats might have better body weight gain average when fed with 18% mustard oilseed cake included in specific concentrate mixture.

Key Words: Black Bengal goats, Body weight, Concentrate feed, Mustard oilseed Cake, Growth.

INTRODUCTION

Goat farming stands as the predominant livestock rearing practice among rural farmers across India, spanning various socio-economic classes. Integral to a sustainable rural economy, goat husbandry plays a crucial role in providing affordable nutrition, serving as an important source of protein. Goats constitute a significant portion of India's total livestock population, accounting for 148.88 million, or 27.70%, as per 20th Livestock Census in 2019. In West Bengal alone, the total goat population amounts to 16.30 million, with the Black Bengal goat comprising nearly 51% of this figure.

Goat farming holds significant importance as it provides essential resources such as milk, meat, skin, and manure, fulfilling crucial human needs. In developing countries, it serves as a vital

tool in poverty alleviation and offers A sustainable source of income for rural communities and landless farmers (Hassan *et al*, 2007, Singh *et al*, 2016, Mahfuz *et al*, 2018). In Jalpaiguri district, goat farming is primarily conducted by marginal and small farmers, with land holdings which usually range from 0.05 to 1 ha. On average, each family owns 2 to 3 castrated male goats. However, the escalating market price and demand for Black Bengal goat meat are driving unemployed rural youths and livestock farmers towards goat farming as a means of livelihood and entrepreneurship development. Major part of profit through goat husbandry comes from trading of castrated male goats. The most of the farmers in this district rear their castrated male goats primarily through free grazing, supplemented with only a small amount of concentrate feed provided by a minority of farmers. However, this practice often prolongs the

Corresponding Author's Email - das.manasvet2011@gmail.com

¹Krishi Vigyan Kendra Jalpaiguri, West Bengal University of Animal and Fishery Sciences, Ramshai, Jalpaiguri- 735219, West Bengal, India.

²Dept. of Animal Science, Palli Siksha Bhavana, Visva Bharati Biswavidyalaya, Bolpur- 731204, West Bengal, India.

Growth Performance of Black Bengal Goats

Table 1. The composition of experimental concentrate mixtures (per 100 kg basis).

Sr. No.	Ingredient	C1 (0% MOC)	C2 (12% MOC)	C3 (18% MOC)	C4 (24% MOC)
1	Crushed Maize	42	31	28	28
2	Wheat bran	26	26	24	25
3	Rice bran	28	27	26	19
4	Mustard Oilseed Cake	0	12	18	24
5	Salt	02	02	02	02
6	Mineral mixture	02	02	02	02
	Total	100 kg			

time required for castrated male goats to reach marketable weight, thereby delaying returns for the farmers.

Inadequate feed availability round the year through grazing is another limiting factor for shortfalls in animal production level in sub tropical region of India. Rashid *et al* (2016a) also reported goats which are reared on natural browsing only cannot fulfill their nutrient requirements for growth and productivity. Ferdous *et al* (2011) reported relying solely on grazing may not be adequate for achieving weight gain in goats. They suggested that supplementing with concentrates proportionately according to the dry matter could enhance goat productivity. Tiwari *et al.* (2015) also revealed that protein content in ruminant diets is critical for their growth and productivity. Mustard oilseed cake (MOC) is an easily accessible and protein-rich feed option for animals.

Mustard oilseed cake contains 30-35% oil and 34-39% crude protein (CP), with a reasonable balance of essential amino acids and a comparatively high methionine concentration (Kumar *et al.*, 2002). Mustard oilseed cakes are frequently utilized in the diet of cattle by the farmers of Jalpaiguri district but the report of feeding of Mustard oilseed cake in goats is not available. Considering this scenario, the current study aimed to explore the impact of incorporating varying levels of protein through inclusion of Mustard Oilseed Cake (MOC) in concentrate feed. The research focused on assessing the growth performance of castrated Black Bengal male goats to determine the most suitable level of MOC inclusion for achieving optimal feeding outcomes and enhancing production efficiency.

MATERIALS AND METHODS

Area of study

The study was conducted at one adopted village of Jalpaiguri KVK at Salbari area (26.5615° N, 89.0830° E) of Dhupguri block in Jalpaiguri district. Eight resourceful farmers from this village which were randomly selected on the basis of criteria who were having required castrated male goats. These farmers were provided proper training to develop the skill for participation in this experiment.

Experimental animals

Twenty four Black Bengal castrated male goats (approximately 7- 9 m of age weighing at an average 10.25 ± 0.76 kg) were taken under study. These castrated goats were physically sound and out of any kind of sickness and were maintained in their respective farms under similar housing and other managerial practices. Using a complete randomized design, these animals were divided randomly and equally into four groups with 6 animals in each group each, based on the diet they were permitted to consume. The goats were tagged through neck and were properly dewormed with anthelmintics before vaccination with PPR vaccines. The experimental animals were allowed to stride for exercise in a fenced area for 2-3 hours during day time.

Concentrate mixture formulation

The concentrate mixture used as experimental diet was prepared by mixing proportionate amount of maize, wheat bran, rice bran, mustard oilseed cakes, salt and mineral mixtures designed to incorporate varying (0%, 12%, 18% and 24% inclusion) levels of Mustard Oilseed Cake (MOC). These prepared concentrate mixtures were iso-energetic with difference in their crude protein value. The composition of

Table 2. The chemical composition of local feed components and Napier grass

Feed ingredient	DM	g/ 100 gm DM (Mean $\pm$ SD)				
		OM	CP	CF	EE	TA
Crushed Maize	90.48 $\pm$ 0.89	96.34 $\pm$ 0.81	8.86 $\pm$ 0.58	2.52 $\pm$ 0.37	4.59 $\pm$ 0.66	2.83 $\pm$ 0.72
Wheat Bran	86.87 $\pm$ 0.65	94.72 $\pm$ 1.20	16.52 $\pm$ 0.95	10.64 $\pm$ 1.17	3.27 $\pm$ 0.59	5.56 $\pm$ 0.94
Rice bran	87.90 $\pm$ 0.83	89.72 $\pm$ 2.62	10.87 $\pm$ 0.76	5.25 $\pm$ 0.57	4.87 $\pm$ 0.79	9.89 $\pm$ 0.66
Mustard Oilseed Cake	90.57 $\pm$ 1.47	90.61 $\pm$ 1.59	33.28 $\pm$ 1.14	10.28 $\pm$ 0.45	9.65 $\pm$ 0.84	9.63 $\pm$ 1.67
Napier grass	25.37 $\pm$ 0.34	91.21 $\pm$ 1.98	8.34 $\pm$ 0.73	30.41 $\pm$ 1.15	2.37 $\pm$ 0.34	9.87 $\pm$ 1.17

prepared experimental concentrate mixtures is provide in following (Table 1).

Experimental diet

The goats involved in the research were equally and randomly divided into four treatment groups T1, T2, T3 and T4. The experimental concentrate mixtures namely C1, C2, C3 and C4 were given to the goats of each treatment group for their intake in the order at the rate of 3% average body weight. The goats were also allowed to take ad lib. Hybrid Napier grass along with concentrate mixtures (Rashid *et al*, 2016a).

The goats under study were allowed to stall fed twice a day with ad lib. napier grass during day time. The experimental diet was offered 50 % after first forage feeding in day time and the rest 50% was offered after 4 pm when they returned to their respective sheds after their exercise. Individual separate feeders for both roughages and concentrates were used for each goat. These castrated goats were allowed to adapt with the experimental feeds for 7 days prior to initiation of the trial.

Observation recording

After seven days of adaptation period the left over feeds in the feeders for all treatment groups were recorded on next morning for estimation of daily feed intake during 90 days trial period. The goats' body weights were recorded in the morning before the feeding trials began, and their body weights were measured each day in the morning before feeding. The dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE) and total ash (TA) in

the trial feed mixtures were determined using proximate analysis (AOAC 2004) and the average was recorded for data.

Statistical analysis

The experimental data of body weights with feed intake and other relevant data were critically analyzed using SPSS version 23. The difference among groups was then calculated by one-way ANOVA analysis in completely randomized design (Snedecor and Cochran, 2004). The levels of significance were defined at $p \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of the green forage and prepared concentrate feed

The result of proximate analysis of the locally accessible feed ingredients utilized for preparing the concentrate mixtures is provided in (Table 2).

Analysis of Treatment Diets

These four treatments category of concentrate mixtures during the trial was formulated based on the studies reported by Ullah *et al* (2009), Khandaker *et al* (2011) and Rashid *et al* (2016b). In these studies the formulated experimental diets were iso-energetic with different CP content for observing the effect of CP on performance and digestibility of goats and cattle as well.

The analyzed mean proximate values of the prepared concentrate mixtures have been presented in (Table 4). The price of raw materials like crushed maize, wheat bran, rice bran, mustard oil cake, salt and mineral mixture used for preparing the concentrate feed were Rs. 28.00, Rs. 34.00, Rs. 12.00, Rs. 38.00, Rs. 10.00 and Rs.

Growth Performance of Black Bengal Goats

Table 3. Chemical composition of formulated concentrate mixture (% DM basis)

Particular	Concentrate mixtures (Mean $\pm$ SD)			
	C1	C2	C3	C4
DM (g/100gm)	85.20 $\pm$ 2.23	85.24 $\pm$ 1.56	85.34 $\pm$ 2.10	85.49 $\pm$ 1.24
OM ((g/100gm)	90.21 $\pm$ 1.52	89.59 $\pm$ 1.86	89.35 $\pm$ 1.88	89.45 $\pm$ 1.12
ME (MJ/ Kg. DM)	11.66 $\pm$ 1.14	11.69 $\pm$ 1.28	11.53 $\pm$ 1.11	11.24 $\pm$ 1.74
CP (g/ 100 gm DM)	11.06 $\pm$ 2.09	13.89 $\pm$ 1.75	15.15 $\pm$ 1.94	16.51 $\pm$ 1.84
CF (g/ 100 gm DM)	5.29 $\pm$ 1.25	6.20 $\pm$ 1.79	6.47 $\pm$ 1.36	6.83 $\pm$ 1.57
EE (g/ 100 gm DM)	4.14 $\pm$ 1.87	4.75 $\pm$ 1.34	5.07 $\pm$ 1.36	5.34 $\pm$ 1.66
TA (g/ 100 gm DM)	5.40 $\pm$ 0.87	6.15 $\pm$ 0.94	6.43 $\pm$ 1.71	6.37 $\pm$ 1.48
Cost (Rs./ kg)	30.40	32.36	32.40	32.56

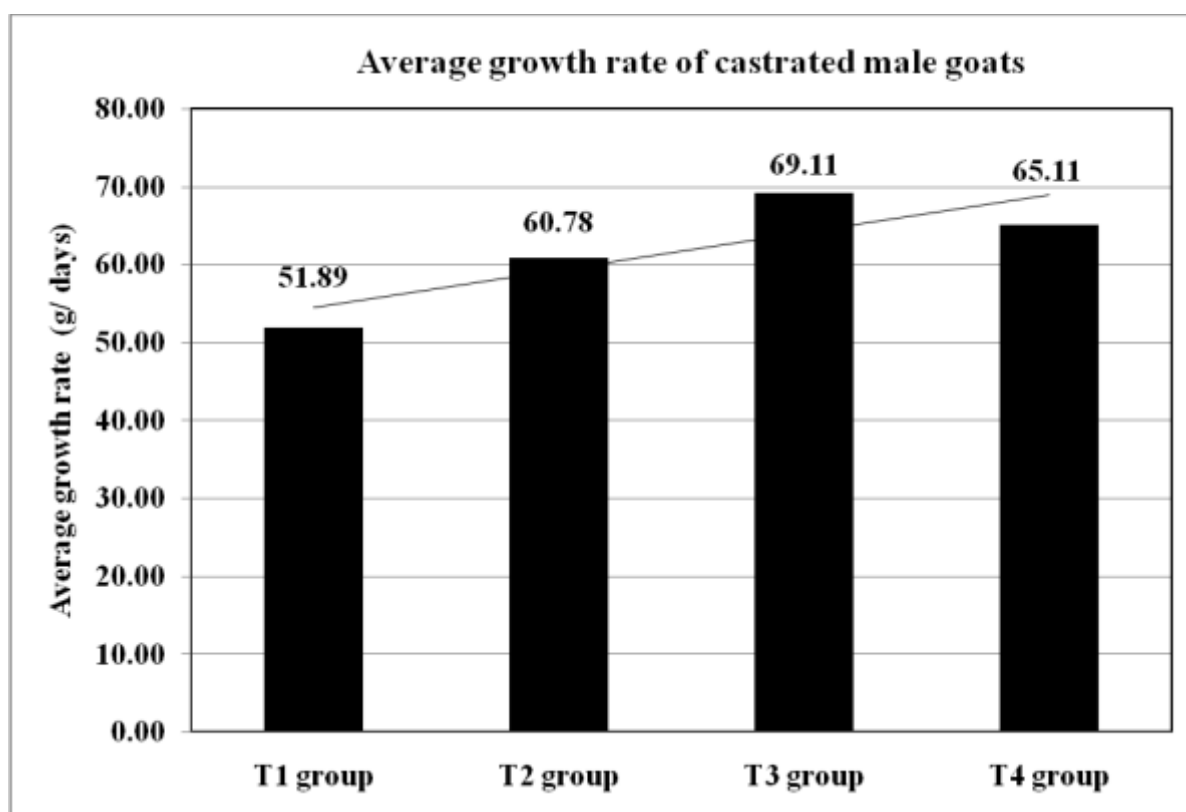


Fig 1. Average Growth rate (g/ day) of Castrated Black Bengal male goats

200.00 per Kg respectively. The average cost of prepared concentrate mixtures was found to be Rs. 31.93 per kg.

The estimated DM, CP, CF, EE and Total Ash value of different ingredients like crushed maize, wheat bran, rice bran, mustard oilseed cake (MOC) which were used for preparing the concentrate feed mixture in this experiment were much close to the reports of Mahfuz *et al* (2018), Tiwari *et al* (2015), Sarker *et al* (2015), Sultana *et al* (2012) & Moniruzzaman *et al* (2002). Tiwari *et al* (2015) reported high CP value in mustard oilseed cake

along with lower DM, CF and TA. The present data of Napier grass (Table 3) in this study was similar to the results of Mahfuz *et al* (2018). The noticed effect of the study showed a few minor changes in some parameters that may be expected due to the effect of geographical location, climate and other environmental factors.

Growth performance of castrated male goats

The dry matter intake (DMI) by the goats in those four trial groups, the final live weight of these castrated goats along with their total live

Table 4. Feed intake and growth performance of the castrated male goats.

Parameter	Dietary Treatment groups				Level of Significance @ 0.05
	T1	T2	T3	T4	
Mean Initial live weight (Kg)	10.30 ± 0.72	10.26 ± 0.83	10.24 ± 0.95	10.21 ± 0.78	NS
Final live weight (Kg)	14.97 ± 1.25	15.73 ± 1.86	16.46 ± 1.43	16.07 ± 1.64	NS
Total Live weight gain (Kg)	4.67 ± 0.33 ^c	5.47 ± 0.68 ^b	6.22 ± 0.32 ^a	5.86 ± 0.26 ^b	*
Average Live Weight gain (g/day)	51.89 ± 2.75 ^d	60.78 ± 2.76 ^c	69.11 ± 3.28 ^a	65.11 ± 3.14 ^b	*
Concentrate Feed Intake (g/ day)	165.69 ± 11.62 ^c	179.35 ± 14.87 ^b	205.36 ± 15.98 ^a	182.68 ± 12.84 ^b	*
Fodder grass intake (Fresh) (g/day)	1258.63 ± 164.24	1241.87 ± 137.27	1239.65 ± 163.41	1236.42 ± 158.23	NS
Dry Matter Intake (DMI) (g/day)	460.48 ± 25.31	467.93 ± 15.56	489.75 ± 20.34	469.85 ± 18.74	NS
Total Dry Matter Intake (90 days) (TDMI) (Kg)	41.44 ± 2.74	42.11 ± 2.15	44.08 ± 3.25	42.29 ± 3.17	NS
Dry Matter intake from grass (g/day)	319.31 ± 12.65	315.06 ± 14.47	314.50 ± 13.74	313.68 ± 15.24	NS
Dry matter intake from concentrate feed (g/ day)	141.17 ± 10.35 ^c	152.87 ± 9.54 ^b	175.25 ± 12.30 ^a	156.17 ± 11.65 ^b	*
Crude Protein Intake (g/ day)	42.24 ± 2.14 ^c	47.52 ± 4.25 ^b	52.78 ± 3.87 ^a	51.95 ± 4.14 ^b	*
Total Crude protein Intake (Kg)	3.80 ± 0.12	4.28 ± 0.34	4.75 ± 0.45	4.68 ± 0.26	NS

Different Superscript within a row indicates significant variation ($p \leq 0.05$)

weight gain (90 days) and average live weight gain (g/ day) is illustrated in (Table 4). The result showed significant ($p \leq 0.05$) variation of the gain in total live weight among the four treatment groups. The maximum growth in weight was observed for T3 group followed by T4, T2 and T1 groups. The average live weight gain (g/ day) of the goats for four treatment dietary groups was presented in figure 1. The growth rate of the goats in different groups depicted increasing pattern from T1 to T3 treatment groups. Although the growth rate of T4 group of goats was higher than T1 and T2 group, yet it was lesser than T3 treatment group that might be due to higher intake of crude protein and dry matter intake of T3 dietary cluster goats than others.

The average live weight gain for castrated Black Bengal male goats in present study was found higher than results reported by Ullah *et al*, (2009) and Ferdous *et al*, (2011). Kumar *et al*, (2002) reported significantly higher ($p \leq 0.05$) daily and total body weight gain with 50% mustard oilseed cake replacement in concentrate mixture in growing lambs. The present study also confirmed the reports according to Rashid *et al*, (2016b) that higher weight gain average for Black Bengal goats was found significantly high ($P \leq 0.01$) due to standard and high energy diets.

Dry Matter Intake (DMI) and Crude Protein intake (CPI)

The concentrate feed intake (g/day), fresh fodder grass intake (g/ day), DMI from grass (g

Growth Performance of Black Bengal Goats

/day) and from prepared concentrate feeds (g/day), total DMI for 90 days (kg) along with Crude Protein Intake per day (g/day) and Total crude protein intake (Kg) for different treatment groups were presented in (Table 4) above. The total dry matter intake in this experiment was found to be 4.02, 4.10, 4.30 and 4.14% (DM% of live weight) for these Black Bengal castrated goats under T1, T2, T3 and T4 treatment groups respectively. There was significant ($p \leq 0.05$) variation among treatment diets for DMI from concentrate feed (g/day). The highest DMI from concentrate feed (g/day) was found for T3 group with 18% MOC inclusion that may be because of the enhanced palatability and flavor with improved acceptability of feed. The highest Dry matter intake from concentrate feed for different treatment diets by Black Bengal goats found in this trial was nearly similar to the findings of Ullah *et al* (2009) and Tiwari *et al* (2015). The DMI from fodder roughage was found closely similar to the findings of Rashid *et al* (2016b) but the same differed from the result reported by Ullah *et al* (2009) and Tiwari *et al* (2015). The TDMI found in this experiment for four types of concentrate feed for different treatment diets was found almost similar to the findings of Ullah *et al* (2009), Sultana *et al* (2012) and Rashid *et al* (2016b) but it was found less than the results reported by Kumar *et al* (2002) and Tiwari *et al* (2015).

The significant variation in Crude protein intake observed in the study might be because of the presence of different CP content in the formulated dietary mixtures. However highest CPI found for T3 group (with CP content 15.15 ± 1.94 g/ 100g DM) of animals might be due to enhanced palatability and flavor of the feed for better feed preferences among other formulated feeds. Similar reports of daily crude protein intake for Black Bengal goats were reported by Ullah *et al* (2009) and Rashid *et al* (2016a). The non significant variation in Total CPI might be due to a fewer days of feeding period of the animals. Feeding of the same to the Black Bengal castrated goats for a longer period might bring significant variation in Total CPI. Ullah *et al* (2009), Sultana *et al* (2012) and Mahfuz *et al* (2018) found a lower

crude protein intake, whereas Tiwari *et al* (2015) reported higher occurrence of daily CPI in Black Bengal goats.

Feed and protein conversion efficiency

The best feed conversion efficiency (FCE) was found to be 7.09 ± 0.66 for T3 dietary group of goats followed by T4 (7.22 ± 0.71), T2 (7.70 ± 0.54) and T1 (8.87 ± 0.87) dietary groups. The best Protein conversion efficiency (PCE) was also found highest in T3 dietary group of goats (0.76 ± 0.012) followed by T2 (0.78 ± 0.009), T4 (0.80 ± 0.006) and T1 (0.81 ± 0.004) dietary groups. Feed conversion efficiency indicated that feeding of optimum crude protein through concentrate feed along with more DMI intake from both forage and feed may increase the feed conversion efficiency (FCE) and protein conversion efficiency (PCE) as well. The result also showed 18% inclusion of MOC in concentrate feed had excellent effect on FCE and PCE for the Black Bengal castrated goats. Similar report of FCE and PCE was found by Mahfuz *et al* (2018), whereas similar PCE was reported by Sultana *et al* (2012) in Black Bengal Goats. The higher FCE was reported by Rashid *et al* (2016a) and Sultana *et al* (2012) in goats.

CONCLUSION

The present experiment revealed that there was significant variation ($P \leq 0.05$) in average growth rate, total live weight gain, concentrate feed intake, dry matter intake from concentrate feed and daily crude protein intake by the Black Bengal castrated goats for different treatment groups. These traits were observed highest in T3 group of animals which were provided with C3 concentrate mixture with 18% mustard oilseed cake inclusion. Therefore, it may be suggested that the castrated Black Bengal male goats fed with ad lib. Napier grass and concentrate mixture made with 18% mustard oilseed cake inclusion at the rate of 4% of its average body weight may improve the average growth rate and total live weight gain of the animals.

ACKNOWLEDGEMENT

The authors of this manuscript are grateful to the support and responsiveness of the adopted farmers of Salbari area of Dhupguri block, Jalpaiguri district for their tireless effort to get field

data and the lab technician at Jalpaiguri KVK for providing all kind of technical and mechanical support for proximate analysis of the concentrate feeds.

REFERENCES

- All India Report of 20th Livestock Census (2019). Department Of Animal Husbandry & Dairying (Animal Husbandry Statistics Division. Government of India, Ministry of Fisheries, Animal Husbandry & Dairying,)
- AOAC (2004). *Official Methods of Analysis* (13th edition). Association of Official Analytical Chemists. Washington, D.C.
- Ferdous M R, Khan M J, Rashid M A and Kamruzzaman M (2011). Effect of different levels of concentrate supplementation on the performance of Black Bengal goat. *Bangladesh J Anim Sci* **40**: 40-45. doi:10.3329/bjas.v40i1-2.10789.
- Hassan M M, Mahmud S M N, Islam S K M A and Miazi O F (2007). A comparative study on reproductive performance and productivity of the Black Bengal and crossbreed goats at Atrai, Bangladesh. *Univ J Zool Rajshahi University* **26**: 55-57. doi:10.3329/ujzru.v26i0.699.
- Khandaker Z H, Uddin M M, Sultana M S T N and Peters K J (2012). Effect of supplementation of mustard oil cake on intake, digestibility and microbial protein synthesis of cattle in a straw-based diet in Bangladesh. *Trop Anim Health Prod* **44**:791-800. doi:10.1007/s11250-011-9969-z.
- Kumar G K A, Panwar V S, Yadav K R and Sihag S (2002). Mustard cake as a source of dietary protein for growing lambs. *Small Rum Res* **44**(1):47-51. doi:10.1016/S0921-4488(02)00034-2.
- Mahfuz S U, Islam M S D, Chowdhury M R, Islam S, Hasan M K and Uddin M N (2018). Influence of concentrate supplementation on production and reproduction performance of female Black Bengal goat. *Indian J Anim Res* **52**(5):735-739. doi: 10.18805/ijar.v0iOF.8485.
- Moniruzzaman M, Hashem M A, Akhter S and Hossain M M (2002). Effect of feeding systems on feed intake, eating behavior, growth, reproductive performance and parasitic infestation of black bengal goat. *Asian Australas J Anim Sci* **15**: 1453 - 1457. doi:10.5713/ajas.2002.1453.
- Rashid M A, Khan M J, Khandoker M A M Y, Akbar M A and Monir M M (2016)a. Study on the effect of feeding different levels of energy in compound pellet on performance of growing black bengal goat. *J Agri Vet Sci* **9.2**(II): 43-50. doi: 10.9790/2380-09224350.
- Rashid M A, Khan M J, Khandoker M A M Y and Monir M M (2016)b. Feeding different forms of ration including compound pellet and performance of growing black bengal goat. *J Agri Vet Sci* **9.5**(I): 01-08. doi: 10.9790/2380-0905010108.
- Sarker A K, Saha D, Begum H, Zaman A and Rahman M M (2015). Comparison of cake compositions, pepsin digestibility and amino acids concentration of proteins isolated from black mustard and yellow mustard cakes. *AMB Express* **5**:22. doi:10.1186/s13568-015-0110-y.
- Singh P K, Bhat A S, Ganai A M, Sarkar T K, Khan H M and Isalm R (2005). Effect of substitution of groundnut cake with mustard cake on the growth performance and nutrients utilization of corriedale lambs. *Anim Nutr Technolo* **5**: 163-170.
- Singh S, Pathak A K, Khan M and Sharma R K (2016). Effect of tanniferous leaf meal mixture based multi nutrient blocks on nutrient utilization and biochemical profile of *Haemonchus contortus* infected goats. *Indian J Anim Res* **50** (5): 725-732. doi: 10.14202/vetworld.2015.572-579.

Growth Performance of Black Bengal Goats

- Snedecor G W and Cochran W C (2004). *Statistical Methods*. 8th Edition. Oxford and IBH publishing company, Kolkata, India.
- Sultana S, Khan M J, Hassan M R and Khondoker M A M Y (2012). Effects of concentrate supplementation on growth, reproduction and milk yield of Black Bengal goats (*Capra hircus*). *The Bangladesh Vet* **29(1)**: 7–16. doi:10.3329/bvet.v29i1.11884.
- Tiwari M R, Ghimire R P, Adhikari D, Adhikari D P and Ghimire S H (2015). Response of heat treated mustard cake feeding on growth performance of growing female goats in fodder-based basal diet. *Nep J Agri Sci* **13**: 14-20.
- Ullah M B, Islam K M S, Akbar M A, Khaleduzzaman A B M and Debi M R (2009). Effect of levels and sources of protein on the performance and nutrient digestibility in Black Bengal goat. *Bangladesh J Anim Sci* **38 (1&2)**: 53 – 60. doi:10.3329/bjas.v38i1-2.9912.
- Received on 7/5/2024 Accepted on 20/5/2024