



Assessing the Impact of Manger Height on the Performance and Behavioral Dynamics of Stall-Fed Black Bengal Goats

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ABSTRACT

This study investigated the influence of manger height on the performance and behavior of Black Bengal goats over a 90-day period at the Goat Farm and Research Centre of DUVASU, Mathura. Eighteen Black Bengal goats of similar age and weight were selected and randomly divided into three groups of six animals each. The experiment involved three different manger heights: Control at 20 cm, Treatment 1 (T1) at 10 cm, and Treatment 2 (T2) at 30 cm, to assess their effects on feed intake, growth rate, and general well-being. Behavioral parameters such as feeding time, standing time, lying time, social interactions, and dry matter intake (DMI) were observed. The results revealed that the T2 group (30 cm) exhibited significantly higher feeding times, average daily gains, and DMI compared to Control and T1 groups ($P < 0.05$). Standing time was significantly reduced in case of T2. Furthermore, the Body Condition Score (BCS) and average body weight were significantly higher in the T2 group, indicating enhanced health and nutritional status. These findings highlighted that an elevated manger height improves feed efficiency and reduces stress-related behaviors, offering valuable recommendations for goat farmers to enhance productivity and animal welfare through effective manger design.

HIGHLIGHTS:

- Effect of manger height on Black Bengal goats' performance and behavior.
- 30 cm manger height improves feeding, growth, and reduces stress behaviors.
- Enhances productivity and welfare of stall-fed goats.

Keywords: Jamnapari, manger, behavior, time

Black Bengal goats, also indigenous to India, are renowned for their exceptional meat quality and adaptability to diverse climatic conditions (Choudhury *et al.*, 2016). These attributes make them highly valuable in both small-scale and commercial farming. The management of Black Bengal goats, including feeder height, is crucial for optimizing their feeding behavior and overall productivity. Studies have shown that proper feeder design can significantly impact feed intake, growth performance, and social dynamics within the herd (Ekiz *et al.*, 2020). In intensive and semi-intensive systems, the physical environment, including feeder height, plays a critical role

in the daily activities and welfare of the goats (Tölü *et al.*, 2012). For instance, Bracke *et al.* (2006) demonstrated that proper feeder design can reduce aggressive behavior and competition among animals, leading to a more harmonious social environment. This is particularly relevant for Black Bengal goats, known for their social hierarchies and

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interactions. This study aims to explore the effects of varying manger heights on the performance and behavior of stall-fed Black Bengal goats, providing evidence-based recommendations for optimizing feeder design and enhancing welfare and productivity. Black Bengal goats exhibit specific behavioral patterns influenced by their physical surroundings, including feeding, standing, lying, and social interactions. Ensuring that the manger height is optimal can reduce strain and improve feeding efficiency (Keil *et al.*, 2017). This study aims to explore the effects of varying manger heights on the performance and behavior of stall fed Black Bengal goats. The objective of the study is to provide evidence-based recommendations for optimizing feeder design and improving the welfare and productivity of Black Bengal goats.

MATERIALS AND METHODS

Location of study

This study was conducted at the Goat Farm and Research Centre of DUVASU, Mathura, over a period of 90 days.

Experimental animals

Eighteen Black Bengal goats of similar age and weight were selected and randomly divided into three groups of six animals each. The goats were housed in individual pens to monitor feed intake accurately, receiving a balanced diet comprising green fodder, concentrate mixture, and clean water according to their DMI requirements (as per ICAR standard, 2013).



Fig. 1: CCTV recording for Black Bengal goats

Behavioral parameters such as feeding time, standing time, lying time, social interactions, and browsing attempts were recorded for 24 hour using CCTV (CP PLUS) monitoring. Additionally, data on feed intake, body weight, and body condition score (BCS) were recorded at regular intervals on days 15, 30, 45, 60, 75, and 90. Animals were cared for under guidelines comparable to those laid down by the Institutional Animal Ethics Committee.

Experimental design

The goats were randomly assigned to three groups, each with a different manger height:

1. Goats of Control (C) group were kept with 20 cm manger height
2. Goats of Treatment 1 (T1) group were kept with 10 cm manger height
3. Goats of Treatment 2 (T2) group were kept with 30 cm manger height

The mangers were specifically designed and custom-built by local vendors according to the precise specifications and dimensions provided.

STATISTICAL ANALYSIS

The data obtained in the study were subjected to Standard statistical procedures (Snedecor and Cochran, 1994) using SPSS version 20 software licensed under Copyright IBM Corporation and the difference between the treatments means were tested by using DMRT (Duncan, 1995). The data was analyzed using ANOVA to determine the significance of differences between the treatment groups, with significance set at $P < 0.05$.

RESULTS AND DISCUSSION

Feeding time (minutes)

The overall mean feeding time (Table 1) was highest in the T2 group, followed by the Control and T1 groups. Specifically, at both the 60th and 90th days, the T2 group's feeding time remained significantly higher ($P < 0.01$) than the Control and T1 groups. These findings are consistent with Neave *et al.* (2018), who highlighted the significant impact of feeder height on the feeding behavior and intake

of dairy goats. Neave's study demonstrated that feed intake increased with feeder height, with average intakes of 0.18 kg for floor-level feeders, 0.29 kg for head-level feeders, and 0.34 kg for elevated-level feeders.

Table 1: Effect of manger height on feeding time (minutes) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	425.17	418.83	415.17	2.03	0.12
30	421.00	412.83	419.33	2.44	0.37
60	428.33 ^b	410.00 ^a	433.17 ^a	3.05	0.00
90	427.00 ^b	407.50 ^a	443.67 ^a	2.37	0.00
Overall Mean	425.37	413.29	427.83	2.47	0.12

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Standing time (minutes)

Standing time (Table 2) ranged from 362 to 371.67 minutes in the Control group, 356.33 to 365 minutes in the T1 group, and 348 to 368 minutes in the T2 group. By the 90th day, T2 showed significantly lower standing time values ($P < 0.01$) compared to T1, despite having a higher overall mean. This suggests that manger height can influence standing time, potentially affecting the welfare and comfort of goats.

Table 2: Effect of manger height on standing time (minutes) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	362.67	365.00	363.67	2.14	0.08
30	367.17	362.17	368.83	2.59	0.57
60	370.50	356.33	348.33	2.11	0.07
90	371.67 ^a	362.00 ^a	353.50 ^b	1.19	0.02
Overall Mean	368.00	361.37	358.58	2.00	0.18

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

These findings are consistent with the research conducted by Cellier *et al.* (2022), which found that different goat breeds have varying responses to feeder height. Their study indicated that feeding posture and height preferences significantly affect standing and feeding behaviors. Cellier reported that goats spent an average of 162 ± 22.2 minutes at floor-level feeders and 102 ± 21.9 minutes at elevated feeders when leaves were offered. This suggests that elevated feeders may reduce standing time, similar to the findings in our study.

Lying time (minutes)

Lying time (Table 3) ranged from 563.33 to 573.17 minutes for the Control group, 565.17 to 568.83 minutes for the T1 group, and 561.67 to 572.00 minutes for the T2 group. The lying time across all treatments showed no significant differences ($P > 0.05$), although the Control group had numerically higher mean values than the T1 and T2 groups, indicating a minimal impact of manger height on lying behavior. These findings are consistent with the observations of Neave *et al.* (2018), who found that goats' lying times were largely unaffected by variations in feeder height, with average lying times of approximately 530 to 540 minutes regardless of feeder height.

Table 3: Effect of manger height on lying time (minutes) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	567.50	568.17	567.00	0.77	0.84
30	570.83	568.00	572.00	0.67	0.75
60	573.17	568.83	569.33	2.76	0.80
90	563.33	565.17	561.67	2.37	0.11
Overall Mean	570.50	568.33	569.44	1.64	0.62

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Dominance frequency (x times)

The dominance frequencies (Table 4) ranged from 3.00 to 5.66 times, with the T2 group showing the highest values.

Although no significant differences were observed among the treatments ($P>0.05$), the elevated manger height in the T2 group appeared to enable more aggressive individuals to assert dominance more effectively. This observation is consistent with the findings of Keil *et al.* (2017), who reported higher dominance frequencies with elevated feeders. Additionally, Aschwanden *et al.* (2009) noted that adjustments in feeder height can influence social behavior, potentially reducing aggression rates through environmental enrichment.

Table 4: Effect of manger height on dominance frequency (x times) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	4.50	4.50	3.00	0.57	0.49
30	4.83	5.66	4.00	0.51	0.45
60	3.66	5.16	4.16	0.59	0.60
90	4.66	3.83	4.66	0.61	0.83
Overall Mean	4.41	4.78	3.95	0.57	0.59

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Aggressiveness Frequency (x times)

The aggressiveness frequency (Table 5) for goats ranged from 5.5 to 11.66 times, with no significant differences ($P>0.05$) among the treatments.

Table 5: Effect of manger height on aggressiveness frequency (x times) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	9.16	10.16	11.66	0.87	0.53
30	7.17	9.00	9.83	0.68	0.28
60	6.33	7.00	9.00	0.67	0.25
90	5.50	5.16	6.16	0.51	0.74
Overall Mean	7.04	7.83	9.16	0.68	0.45

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Despite this, the T2 group showed a higher overall mean, suggesting that elevated manger height may lead to more aggressive interactions due to increased competition for feed. Tölü *et al.* (2012) found that feeder height significantly impacts social interactions, with higher aggressiveness frequencies observed at elevated feeders.

Vices time (minutes)

Vices included behaviors such as biting or chewing, pacing or weaving, and aggression. The time spent on these vices (Table 6) ranged from 3.00 to 5.66 minutes across the Control, T1, and T2 groups, with no significant differences ($P>0.05$) among the treatments. However, Treatment 1 had a higher overall mean. These findings align with Aschwanden *et al.* (2009), who reported that environmental modifications can influence goat behavior without significant differences across treatments. Their study found vices time ranged from 3.2 to 5.7 minutes, indicating similar behavior patterns across different environmental condition.

Table 6: Effect of manger height on vices time (minutes) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	4.50	4.50	3.00	0.57	0.37
30	4.83	5.66	4.00	0.51	0.25
60	3.66	5.16	4.16	0.59	0.76
90	4.66	3.83	4.66	0.61	0.46
Overall Mean	4.41	4.78	3.95	0.57	0.46

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Animal interaction time (minutes)

Animal interaction times (Table 7) did not show significant differences ($P>0.05$) among the treatment groups, with the Control group having higher overall mean values than Treatments 1 and 2. Although these results indicate that manger height may not have a substantial effect on interaction time, it could still influence social dynamics within stall-fed conditions. Tölü *et al.* (2012) found that feeder height affects social interactions, with goats

interacting socially 4.5 times per hour at elevated feeders compared to 3.2 times per hour at floor-level feeders. Similarly, Aschwanden *et al.* (2009) reported minimal significant differences in interaction times (3.5 to 4.8 minutes per hour) due to environmental modifications, including feeder height adjustments.

Table 7: Effect of manger height on animal interaction time (minutes) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	73.16	69.21	73.21	1.39	0.43
30	74.61	72.78	68.03	1.19	0.05
60	74.25	72.85	72.38	1.48	0.88
90	70.00	73.48	75.36	0.97	0.06
Overall Mean	73.00	72.08	72.24	1.25	0.35

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Browsing attempt frequency (x times)

The browsing attempt frequency (Table 8) ranged from 5.66 to 8.5 times in T2 group, significantly higher ($P < 0.01$) compared to T1 and the Control groups at all observation intervals.

Table 8: Effect of manger height on browsing attempt frequency (x times) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	0 ^b	0 ^b	5.66 ^a	0.69	0.00
30	0 ^b	0 ^b	5.66 ^a	0.74	0.00
60	0 ^b	0 ^b	6.33 ^a	0.75	0.00
90	0 ^b	0 ^b	8.5 ^a	1.10	0.00
Overall Mean	0	0	6.53	0.82	0.00

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

This suggested that raising the manger height positively affects browsing behavior, enhancing foraging activities

in stall-fed conditions. Tölü *et al.* (2012) found similar results, noting that feeder height significantly influences feeding behavior, with browsing attempts increasing from 5.0 to 8.2 times per hour when feeder height was elevated. Additionally, Indu Devi *et al.* (2020) reported a 20% increase in browsing attempts with adjusted feeder heights, further supporting these findings.

Dry matter intake (DMI, kg/day)

The study found significant differences ($P < 0.05$) in dry matter intake (Table 9) among the Control, T1, and T2 groups at the 60th, 75th, and 90th days, with the T2 group consistently showing the highest DMI, ranging from 0.67 to 0.82 kg/d. These results are consistent with Choudhury *et al.* (2016), who highlighted the importance of effective feeding management in enhancing feed intake and goat performance. Bernabucci *et al.* (2010) also emphasized the role of water utilization in improving nutritional status, noting that optimal feeder design helps reduce environmental stress and boost DMI.

Table 9: Effect of manger height on DMI (kg/d) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	0.68	0.67	0.70	0.16	0.07
15	0.70	0.70	0.74	0.27	0.01
30	0.72	0.70	0.72	0.32	0.02
45	0.73	0.72	0.74	0.16	0.00
60	0.73 ^{ab}	0.64 ^b	0.80 ^a	0.04	0.00
75	0.80 ^{ab}	0.67 ^b	0.82 ^a	0.06	0.00
90	0.82 ^{ab}	0.69 ^b	0.88 ^a	0.04	0.02
Overall Mean	0.73	0.72	0.77	0.15	0.01

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Body condition score (BCS)

The study indicated notable differences in Body Condition Score (Table 10) among the treatment groups by day 90. The BCS ranged from 2.25 to 2.91 in the Control group, 2.09 to 2.66 in T1, and 1.91 to 3.25 in T2, with

average scores of 2.53, 2.41, and 2.59, respectively. The significantly higher BCS in the T2 group reflects improved overall health and nutritional status, supporting the findings of Purina Animal Nutrition and MSU Extension, 2015 regarding the importance of maintaining a BCS of 2.5 to 3.0 for optimal goat health and productivity.

Table 10: Effect of manger height on BCS of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	2.25	2.08	1.91	0.12	0.58
15	2.33	2.16	2.16	0.11	0.81
30	2.41	2.41	2.41	0.10	1.00
45	2.58	2.41	2.75	0.10	0.42
60	2.58	2.5	2.75	0.09	0.58
75	2.66	2.66	2.91	0.09	0.47
90	2.91 ^{ab}	2.66 ^b	3.25 ^a	0.09	0.04
Overall Mean	2.53	2.41	2.59	0.10	0.55

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Average body weight (kg)

The study demonstrated significant differences in average body weight (Table 11) among the treatment groups by day 90.

Table 11: Effect of manger height on body weight (kg) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
0	16.96	17.15	18.56	0.35	0.06
15	17.5	17.65	19.20	0.35	0.09
30	18.09	18.21	19.82	0.37	0.30
45	18.64	18.61	20.46	0.44	0.06
60	19.15	19.03	21.08	0.38	0.06
75	19.70 ^{ab}	19.52 ^b	21.72 ^a	0.47	0.02
90	20.25 ^b	20.00 ^b	22.37 ^a	0.40	0.02
Overall Mean	18.54	18.58	20.38	0.39	0.08

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

Mean weights were 18.54 kg for the Control group, 18.58 kg for T1, and 20.38 kg for T2, with significant differences ($P<0.05$) observed on the 75th and 90th days, where the T2 group had higher values. These findings align with Bernabucci *et al.* (2010), who found that optimal water utilization improved body weights, and Ekiz *et al.* (2020), who reported that optimized feeder design and management practices enhanced body weight in indigenous goat breeds.

Average daily gain (gram/day)

The study found significant differences in average daily body weight gain (Table 12) among the treatment groups over a three-month period. Initial gains were 36.66 g/day for the Control group, 33.33 g/day for T1, and 42.66 g/day for T2, with final gains of 36.66, 32.00, and 43.33 g/day, respectively. The T2 group showed significantly higher gains ($P<0.05$). These results align with Choudhury *et al.* (2016), who highlighted that proper feeding management enhances goat performance, and Ekiz *et al.* (2020), who found that optimal feeding conditions reduce stress and improve health metrics.

Table 12: Effect of manger height on average daily gain (g/d) of Black Bengal goats under stall fed conditions

Days	Treatment*			SEM	P-value
	C	T1	T2		
15	36.66 ^{ab}	33.33 ^b	42.66 ^a	2.72	0.00
30	39.33 ^{ab}	37.33 ^b	41.33 ^a	1.15	0.00
45	36.66 ^{ab}	26.66 ^b	42.66 ^a	4.66	0.01
60	34.00 ^{ab}	28.00 ^b	41.33 ^a	3.85	0.01
75	36.66 ^{ab}	32.55 ^b	42.66 ^a	2.93	0.00
90	36.66 ^{ab}	32.00 ^b	43.33 ^a	3.28	0.00
Overall Mean	36.66	31.64	42.32	3.09	0.00

^{abc}Means with different superscripts within a row differ significantly.

C: Control group (20cm), T1: Treatment 1 (10cm), T2: Treatment 2 (30 cm).

CONCLUSION

From this study it was concluded that feeder height significantly impacted the performance, behavior, and overall welfare of Black Bengal goats. The manger height of 30 cm not only enhances feeding time and dry matter

intake but also improves body condition scores and average daily body weight gains. Additionally, the 30 cm height appears to reduce stress-related behaviors such as prolonged standing time and aggressiveness. The research highlighted the potential benefits of elevating manger heights to 30 cm, providing practical guidelines for goat farmers to optimize feed efficiency and animal welfare, ultimately enhancing the overall sustainability of goat farming practices.

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