

Effects of Concentrate With Varying Protein Levels on Growth and Structural Development in Female Korean Crossbred Goats

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단백질 수준이 다른 농후사료가 급여 수준에 따른 암컷 교잡염소 암컷의 성장 및 구조적 발달에 미치는
영향

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Abstract

This study evaluated the effects of concentrate at different protein levels on growth performance and structural traits in 12 female Korean crossbred goats (7 months old; 31.0 ± 0.6 kg BW). Goats were assigned to three treatments based on crude protein (CP) intake: low CP(15%), medium CP (18%), and high CP (21%) levels. Higher protein levels led to improved final body weight and average daily gain (ADG), with 21% level showing the highest final weight (34.9 kg) and ADG (82.0 g/d). Dry matter intake (DMI) was significantly greater in medium and high levels ($p < 0.05$), but high level demonstrated superior feed efficiency with the lowest DMI/ADG ratio (20.3). Structural development also improved under high protein level, with significantly greater body length (66.9 cm), body depth (62.8 cm), and chest width (19.3 cm), while chest girth remained consistent across treatments. Overall, increasing protein levels enhanced both growth and skeletal traits, providing insights for improving feeding strategies in female Korean crossbred goat production systems.

1. Introduction

Optimizing concentrate feeding is crucial for enhancing growth performance and structural development in small ruminants, particularly in crossbred goats. Crossbreeding has been shown to increase birth weight (+24%) and growth rate (+32%), resulting in lower mortality and better feed conversion efficiency [1]. Additionally, concentrate supplementation improves reproductive outcomes such as kidding rates and litter size [2], and supports higher kid growth through improved maternal nutrition [3]. This study investigates the impact of three dietary protein levels on growth and morphological traits in female Korean crossbred goats.

2. Materials and Methods

12 female Korean crossbred goats (7 months old; 31.0 ± 0.6 kg BW) were used in a randomized block design with three dietary protein treatments over 5 months. Goats were individually housed in iron pens (1.2 m \times 0.9 m) to facilitate precise monitoring of feed intake and health status and were assigned to one of three dietary protein levels: Low CP (15%), Medium CP (18%), and High CP (21%). The ingredients and their proportions for each treatment are presented in Table 1. Growth parameters included initial and final body weight (BW), body weight gain (BWG), average daily gain (ADG), dry matter intake (DMI), and feed conversion ratio (FCR). Structural traits measured were body length, body depth, chest width, and chest girth.

The statistical analysis was conducted using SAS (version 9.1, SAS institute, Cary, NY, USA) and significance was established at a 5% probability level ($p < 0.05$).

3. Results

3.1 Growth performance and feeding availability

In Table 2, increasing the dietary protein levels led to improved final body weights and daily weight gain in female Korean crossbred goats. The highest dietary protein resulted in the greatest final weight (34.9 kg) and ADG (82.0 g/d). Although DMI was significantly higher in medium and high compared to low concentration ($p < 0.05$), high CP showed the most efficient feed utilization with the lowest DMI/ADG ratio (20.3), indicating better growth per unit of intake. Notably, FCR was highest in high concentration, suggesting a trade-off between intake efficiency and gain.

3.2 Growth performance and feeding availability

Structural traits such as body length and depth, and chest width responded positively to increased CP concentration levels (Table 3). Goats in high concentration showed significantly greater body length (66.9 cm) and withers height (62.8 cm) compared to other groups, indicating enhanced skeletal development. Chest width also tended to increase with concentration level, with high diet achieving the widest chest (19.3 cm). However, chest girth remained relatively stable across treatments, suggesting that some structural traits may be less sensitive to dietary concentration variation.

[Table 1] Ingredients and chemical composition of the experimental diets

Items	Dietary Treatments			IRG
	Low	Medium	High	
Ingredients (kg)				
Corn (large particles)	880.0	800.0	720.0	
Soybean meal	151.3	291.2	439.2	—
Rapeseed meal	64.0	64.0	64.0	—
Corn distillers' dried grains	160.0	160.0	138.5	—
Fresh rice bran	80.0	22.9	—	—
Wheat bran	80.0	80.0	80.0	—
Lupin bran	129.9	126.6	103.4	—
Limestone	37.6	36.4	35.4	—
MCP (monocalcium phosphate)	2.00	3.76	4.24	—
Salt	8.00	8.00	8.00	—
Sodium bicarbonate	1.60	1.60	1.60	—
Vitamin premix	1.60	1.60	1.60	—
Mineral premix	1.60	1.60	1.60	—
Permixon OS	2.40	2.40	2.40	—
Total	1,600	1,600	1,600	—
Chemical composition (%)				
Dry matter	89.1	89.3	89.6	90.0
Crude ash	5.3	5.7	7.4	7.3
Crude fiber	6.1	5.4	5.7	26.8

Crude protein	15.0	18.0	21.0	8.4
Ether Extract	3.6	3.1	3.0	1.6
Moisture content	10.9	10.7	10.4	10.0
Acid Detergent Fiber	8.6	7.4	7.1	31.3
Neutral Detergent Fiber	17.7	15.6	15.0	54.0
Non-fiber carbohydrates	57.7	59.3	51.9	28.7

Non-fiber carbohydrates (%) = 100 - (ash + CP + EE + NDF), Low, CP concentration level of 15%; Medium, CP concentration level of 18%; High, CP concentration level of 21%.

[Table 2] Effect of feeding levels on performance and feeding availability in female goats

Items	Dietary Treatments			SEM	p-value
	Low	Medium	High		
Initial BW, kg	29.9	31.0	32.2	0.60	—
Final BW, kg	32.1	33.2	34.9	0.59	—
BW gain, kg	2.2	2.2	2.8	0.12	0.2193
DMI, g	949.3 ^b	1029.0 ^a	1031.4 ^a	20.68	0.0001
ADG, g/d	64.8	63.4	82.0	6.15	0.2215
DMI/ADG ratio	23.8	38.5	20.3	5.29	0.3196
FCR	0.07	0.06	0.09	0.01	0.1690

^{ab} Superscript letters indicate significant differences between dietary treatments ($p < 0.05$); Low, concentrate level of 15%; medium, concentrate feeding of 18%; and high, concentrate level of 21%; BW, body weight, DMI, dry matter intake, ADG, average daily gain; FCR, feed conversion ratio, SEM, standard error of the means ($n = 12$)

Table 3. Effect of feeding levels on morphological traits in female goats

Items	Dietary Treatments			SEM	p-value
	Low	Medium	High		
Body length, cm	65.0 ^b	64.9 ^b	66.9 ^a	0.39	0.0404
Body depth, cm	61.4 ^{ab}	60.6 ^b	62.8 ^a	0.55	<.0001
Chest width, cm	18.7 ^b	19.2 ^{ab}	19.3 ^a	0.18	<.0001
Chest girth, cm	78.5	79.5	78.6	0.70	0.3491

^{ab} Superscript letters indicate significant differences between dietary treatments ($p < 0.05$); Low, concentrate level of 15%; medium, concentrate feeding of 18%; and high, concentrate level of 21%; SEM, standard error of the means ($n = 12$)

4. Conclusion

Feeding higher CP concentration levels improves both growth performance and skeletal development in female Korean crossbred goats.

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