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Research Article

Changes in Goat productivity and Economical Efficiency at Feeding Systems by Castrated Growing Korean Native Goat(*Capra hircus coreanae*)

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ABSTRACT

This study was conducted to determine grazing intensity of growing Korean native goats(*Capra hircus coreanae*) on mountainous pasture. It was carried out to obtain basic information for improvement of mountainous pasture management and establishing feeding system of Korean native goat. A total of 20 goats were grouped by feeding systems [A mountainous pasture grazing group (Concentrated feed of 1.5% body weight, treatment 1, T1, n=10) and a barn feeding group (TMR, treatment 2, T2), n=10] to conduct study from April to September. The average forage productivity of the mountain pasture was 500.9 ± 61.41 kg/ha. The average dry matter intake in T1 was 0.64 and the calculated grazing intensity was 21 head/ha. In productivity, when the two treatments(T1, T2) were compared, the dry matter intake was about two to three times the difference. The average daily gain per day during the experiment was 63.3 in the mountain pasture and 120 g in barn feeding. When grazing, considering mountainous pasture productivity it is necessary to increase the productivity through proper feeding. The feed costs of black goats raised by grazing on the grassland in the same period showed an average 75% reduction compared to barn feeding. As a result of this study, it can be expected that a considerable reduction of feed costs can be expected in the breeding of Korean native black goat using the mountain pasture.

(**Key words** : Black goat, Mountainous Pasture, Feed Value, Forage Productivity, Grazing Intensity)

Ⅰ. INTRODUCTION

The consumption of Korean black goats, which has traditionally been known as a health food, has increased significantly during recent years. The common goat farming system is multiple farming in which large areas of plant resources are available for grazing within fences. And the goats returned to barns where their diet was supplemented with concentrates and this system allows more utilization of grass within the forest (Shahjalal, et al., 1992). Especially, goats differ from other ruminants in their feeding habits, and they appear to have more efficiency in digestion of crude fiber and being better utilizers of poor roughages (Gihad et al, 1980). Geographically, Korea is a mountainous country with 64 percent of its terrain consisting of hills and peaks. In addition, Korea having such distinctive four seasons. Also, in Korea, which depends on import grain for feed grain, feed cost is about 60% of livestock production expenses, due to rise in grain worldwide. Against this backdrop, grazing using livestock production areas is determined by means which can be done to reduce feed costs. In the case of constructing grasslands only in part of the grassland of the producing area or appropriately controlling and transporting it, it is thought that the self-sufficiency rate of feed for ruminant livestock can rise greatly (Moon et al., 2016). Hence, goats are highly adaptable with good production potential in the Korea mountainous country. However, little information is available on the seasonal changes in forage and livestock productivity at different pasture types. Therefore, farms are left with grasslands and grazing rearing such as grazing livestock in a conventional way. Consequently, the objective of this study was to provide a grazing availability assessment of Korean goat in the mountain pasture.

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Ⅱ. MATERIAL AND METHODS

1. Animals and diets

Field studies were conducted from the months April to September in order to determine the seasonal forage and animal productivity. Two treatments were selected as experimental farms. A total of 20 goats were grouped by feeding systems. [A mountainous pasture grazing group (Concentrated feed of 1.5% body weight, treatment 1, T1) and a barn feeding group (TMR, treatment 2, T2), n=10] All experiment groups has a ten growing wethers of Korean native black goats (*Capra hircus corenae*) aged 4 months. The starting weight was 12.3±4.4kg in T1, which was 18.63±2.19kg with T2. T1 was a form consisting mostly of mountain grass. Grazing was grazed for 8 hours from 9 am to 5 pm in Tanyoun-ri, Chungju, Chungcheongbuk-do. Finish the grazing, supplementary feed was added to 1.5% of body weight. Supplied supplementary feed is commercially available goat concentrate feed at crude protein level of 15%, T2 supplied TMR feed twice in the morning and afternoon and measured the feed quantity and amount during the period. The feed uses commercially available goat TMR diet with a crude protein level of 13%. The chemical composition of feed is shown in Table 1.

2. Chemical analysis

Forage samples were analyzed for crude protein (CP), ether extract (EE), crude fiber (CF) and ash according to the methods of the Association of Official Analytical Chemists(AOAC, 1990). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) was analyzed by the procedures of Van Soest et al. (1970).

3. Investigation of forage productivity and livestock productivity

In order to measure the productivity of the forage, a 50 × 50 cm quadrate was set at three places so as to avoid goat vegetarians in the pasture. Samples were taken at the same place in the month, after measuring the weight at the site, after drying for 48 hours at 65 ° C. in dry oven, the productivity of the forage was measured.

The productivity of livestock was measured by measuring the weight of after experiments.

4. Grazing intensity

In the grassland, we investigated the forage productivity and the feed intake of the goat for te proper grazind intensity of the goat. Investigate goats intake was sought through the pasture weight before and after grazing. Grazing intensity was calculated based on the feed utilization rate, 80%(Amanda, 2006) of livestock at grazing.

5. Economic analysis of feed costs

The study was conducted to analyze the cost of black goat feed by feeding system.

In the case of grazing, the supplementary feed costs(400 won/kg) and forage productivity cost(100.5 won/kg) were calculated. And barn feeding system, the TMR feed cost(495 won/kg) were calculated. The total production cost was calculated by multiplying the unit price of the feed by the total intake of the black goat.

Table 1. The chemical compositions of the experimental feed

Items	Concentrate	TMR
Dry matter (%)	84.9±0.46	90.35±0.22
Crude protein (% in DM)	15.2±0.89	13.38±0.06
Crude fiber (% in DM)	8.1±0.65	16.76±0.78
Ether extract (% in DM)	7.4±0.8	4.41±0.19
Neutral detergent fiber (% in DM)	38.5±0.50	47.46±0.63
Acid detergent fiber (% in DM)	13.6±0.86	22.64±0.84
Ash (% in DM)	7.0±0.23	6.95±0.10

6. Statistical analysis

Data were expressed as means and standard errors and were statistically analyzed with Tukey multiple range tests using the SAS package (2009) general linear models (GLM) procedure.

Ⅲ. RESULTS AND DISCUSSION

1. Changes in feed value evaluation of mountainous pasture and nutritional comparison with TMR Feed

The result of the change of monthly feed value of grassland in black goat grazing is shown in Table 2. Increase in the dry matter content of the farms with wild grasses from spring to fall (Moon et al., 2015) was significantly higher in June and September, 19.6 ± 0.12% and 19.04 ± 0.92%, respectively($p<0.05$). Crude protein content was significantly higher in July and August, 19.3% and 19.1%, respectively ($p<0.05$). In this study, higher than TMR feed with 13.38% crude protein level used in T2 and it is judged that protein supply important for livestock growth has been sufficiently carried out. These results were about CP contents in 16% higher, unlike reports that the content of crude protein in Native grassland was 5.98% and 12.49%. These differences are the difference between the grasses of the native and mountain, and in the case of mountainous pasture, it is judged as having possessed quality pulls. There was no significant difference in the crude fat content by season. Mountainous pasture and TMR feed were similar in crude fat content. The content of crude fiber was significantly higher in August 29.5 ± 0.84% ($p<0.05$). NDF and ADF contents were significantly higher in June, 48.0 ± 0.31% and 40.2 ± 0.49%, respectively, and were lower in April and September($p<0.05$). Comparison with TMR feed NDF content showed the same trend, but showed a difference in ADF content. In Mountainous pasture, The content of ash was significantly affected by the seasons passing through($p<0.05$).

However, it was about twice as high as TMR feed. The productivity of existing grazing land was estimated to be high in April but, showed the highest trend in August.

2. Changes in forage productivity of mountainous pasture grazing on black goat

The result of the change of monthly forage productivity of mountainous pasture in black goat grazing was Table 3. Forage productivity was measured by seasonal sampling (April to September) using the quadratic sampling method. From April to September, the average forage productivity of mountainous pasture was 500.9 ± 61.41 kg/ha. The productivity was estimated to be high in April and showed the highest trend in August. In the case of April, it is judged to be caused by the persistent pasture in mountain before the experiment. Lee (1992) reported that the C - 4 type plants were dry but the productivity was high. Even in this study, the forage productivity showed high results in August. However, there was no significant difference depending on the seasonality. Unlike the report that forest grass sage and productivity are 292.2, 291.9 406.0 kg/ha, respectively, based on the density level(Lee et al., 2005), these results showed a high tendency. In

Table 2. Seasonal changes in chemical compositions of mountainous pasture

Month	DM[1)]	CP[2)]	CF[3)]	EE[4)]	NDF[5)]	ADF[6)]	ASH
	%	---------- % in DM ----------					
April	14.3±0.80^{b}	13.5±0.64^{b}	15.1±0.76^{c}	6.6±0.50	32.7±0.76^{c}	22.1±0.85^{c}	10.5±0.32^{c}
May	11.9±0.87^{c}	14.9±0.79^{b}	22.7±0.67^{b}	6.7±0.06	44.0±0.83^{b}	32.9±0.80^{b}	13.2±0.69^{c}
June	19.6±0.12^{a}	13.7±0.31^{b}	23.1±0.85^{b}	6.0±0.27	48.0±0.31^{a}	40.2±0.49^{a}	12.8±0.26^{c}
July	13.3±0.21^{b}	19.3±0.69^{a}	17.7±0.76^{a}	6.8±0.42	42.0±0.59^{b}	32.8±0.64^{b}	17.5±0.17^{b}
August	14.7±0.48^{b}	19.1±0.89^{a}	29.5±0.84^{a}	6.8±0.38	42.9±0.86^{b}	30.1±0.78^{b}	13.8±0.68^{c}
September	19.0±0.92^{a}	15.3±0.49^{b}	16.4±0.62^{b}	7.1±0.87	34.9±0.85^{c}	25.4±0.47^{c}	21.7±0.13^{a}

[1)]DM: Dry matter, [2)]CP: Crude protein, [3)]CF: Crude fiber [4)]EE: Ether extract [5)]NDF: Neutral detergent fiber [6)]ADF: Acid detergent fiber
[a-c] Means with different superscript in the same column are different ($p<0.05$).

the mountainous pasture grazing, it was considered that adequate supplement feed were needed to feed the shortage in the dry matter intake of black goats.

3. Grazing intensity of black goat in mountainous pasture

Table 3 shows the results of monthly grazing intensity based on the forage productivity of the mountain pasture and the intake of the black goat. The average dry matter intake of black goats during the experiment was 0.64 ± 0.2 kg/d. These results were similar to those of the study in which the dry matter intake was 346.1 ~ 549.2g/d when grazing in black goats at native pasture. As the season passed, the dry matter intake of black goats tended to increase($p > 0.05$). Therefore, proper grazing intensity control and feed supplementation will be necessary. The average grazing intensity of black goats was calculated as 21 head/ha. Seong et al. (2016) reported 37 grazing intensity when grazing 4 months old black goats in mixed grassland. The difference of the study is judged as the difference of forage productivity according to grassland composition. Therefore, sufficient research on the composition of grassland before grazing will be needed.

4. Comparison of livestock productivity by black goat feeding systems

The result of the compares the productivity differences according to feeding systems was Table 4. Initial weights were 12.3 kg for mountain grazing and 21.8 kg for barn feeding. Also, as the season passed, the amount of dry matter intake tended to increase. There was no significant difference in dry matter intake of each treatments. Also, as the season passed, the amount of dry matter intake tended to increase. However, when the two treatments were compared, the dry matter intake was about two to three times the difference. There was no significant difference in average daily gain between the two treatments. The average daily gain per day during the experiment was 63.3 in the mountain pasture and 120 g in barn feeding. These differences are judged to be based on dry matter intakes. Unlike the report of Hwangbo (2014), in which the daily gain of 7-month-old male black goats was 50.6 g/d for grazing and 52.3 g/d for breeding,

Table 3. Estimated grazing intensity (head/ha) affected by forage productivity and dry matter intake

Item	April	May	June	July	August	September	Average
Forage productivity (kg/ha)	552±239.8	410±237.3	460±20.0	494.7±28.0	574.7±237.3	506.7±298.0	500.9±61.41
Dry matter intake (kg/d)	0.51±0.1	0.54±0.4	0.69±0.6	0.66±0.4	0.72±0.5	0.75±0.4	0.64±0.2
Estimated grazing intensity (head/ha)	30	20	18	19	21	18	21

Table 4. Comparison of productivity of black goat by feeding systems.

Item	April	May	June	July	August	September
---------- Mountainous pasture ----------						
Body weight (kg)	12.3±4.4	14.7±3.4	16.4±2.7	17.2±2.8	18.9±2.2	19.6±1.9
Dry matter intake (kg/d)	0.51±0.1	0.54±0.4	0.69±0.6	0.66±0.4	0.72±0.5	0.75±0.4
Average daily gain (kg/d)	0.02	0.17	0.06	0.02	0.09	0.02
Feed conversion ratio	25.5	3.2	11.5	33	8	37.5
---------- TMR ----------						
Body weight (kg)	21.8±3.1	27.4±3.0	28.2±3.7	31.8±4.0	35.3±3.3	39.0±3.6
Dry matter intake (kg/d)	1.53±0.3	1.50±0.6	1.36±0.3	1.49±0.5	1.55±0.4	1.77±0.3
Average daily gain (kg/d)	0.05	0.21	0.09	0.11	0.11	0.15
Feed conversion ratio	30.6	7.2	15.2	13.6	14.1	11.84

this study was higher. However, the results of average daily gain of the mountainous pasture grazing experiment(T1) were similar to those of the study of the daily gain of 42.8~59.8 g/d at the time of pasture grazing in the black goats(Hwangbo et al., 2008) and the study of the daily weight gain of 51 g/d in the pasture grazing(Muir et al., 1995). The difference in weight gain is dependent on the breed, sex, growth stage and specification method of the growth of chlorine. It is thought that the difference occurs. The feed conversion ratios of T2 were better than that of T1. In case of grazing, considering mountainous pasture productivity it is necessary to increase the productivity through proper feeding.

5. Comparison of economical efficiency of black goat feed by feeding systems.

Total monthly intake of concentrated feed and mountain pasture (forage production cost: 100.5 won / kg), supplemented with supplementary feed (1.5% of body weight, 440won / kg). and TMR feed costs(495 won/kg) were calculated. Compares the feed cost of mountain pasture and barn feeding cost analysis of black goats was Table 5. In the case of black goats fed in the mountainous pasture, the monthly feed costs increased as the amount of feed increased. The cost was 4,392 won/head in April and 6,240 won/head in September. The difference (1,848 won/head). In the case of barn feeding, the dietary intake was increased with weight gain, so it showed a difference of 3,672 won/head in October at the end of the experiment compared to April. When the average feed cost of the treatments were compared, the difference between the production cost of T1 was 6,857 won/head and that of T2 was 27,007 won/head. The feed costs of black goats raised by grazing on the grassland in the same period showed an average 75% reduction compared to barn feeding. As a result of this study, it can be expected that a considerable reduction of feed costs can be expected in the breeding of black goats using the mountain pasture. The average forage productivity of mountainous pasture was 500.9 ± 61.41 kg/ha. The productivity was estimated to be high in April and showed the highest trend in August. In the case of April, it is judged to be caused by the persistent pasture in mountain before the experiment.

Ⅳ. CONCLUSION

This study was conducted to determine grazing intensity of growing Korean native goats(*Capra hircus coreanae*) on mountainous pasture. Field studies were conducted from the months April to September in order to determine the seasonal forage and animal productivity. Two treatments were selected as experimental farms. A total of 20 goats were grouped by feeding systems(T1, grazing group and T2, barn feeding group). Increase in the dry matter content of the farms with wild grasses from spring to fall (Moon et al., 2015) was significantly higher in June and September, 19.6 ± 0.12% and 19.04 ± 0.92%, respectively($p<0.05$). Crude protein content was significantly higher in July and August, 19.3% and 19.1%, respectively ($p<0.05$). In this study, higher than TMR feed with 13.38% crude protein level used in T2 and it is judged that protein supply important for livestock growth has been sufficiently carried out. These results were about CP contents in 16% higher, unlike

Table 5. Comparison of economical efficiency of black goat feed by feeding systems.

Item	April	May	June	July	August	September	Average
Mountainous pasture (won/head)	4,392	5,493	5,712	5,630	6,312	6,240	5,630
Barn feeding (won/head)	22,721	23,090	20,319	22,973	23,854	26,393	23,225
Feed cost reduction (%)	▼ 80	▼ 76	▼ 71	▼ 75	▼ 73	▼ 76	▼ 76

reports that the content of crude protein in Native grassland was 5.98% and 12.49%. The average grazing intensity of black goats was calculated as 21 head/ha. The average daily gain per day during the experiment was 63.3 in the mountain pasture and 120 g in barn feeding. When grazing, considering mountainous pasture productivity it is necessary to increase the productivity through proper feeding. The feed costs of black goats raised by grazing on the grassland in the same period showed an average 75% reduction compared to barn feeding. As a result of this study, it can be expected that a considerable reduction of feed costs can be expected in the breeding of Korean native black goat using the mountain pasture.

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