

BODY WEIGHT GAIN, FEED CONVERSION AND FEED COST OF KOREAN NATIVE GOATS FED CORN-MANURE SILAGES

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Summary

This study was carried out to investigate feed cost of corn-manure silage and growth performance of Korean native goats which was fed corn-manure silage. The average weight about 11.6 kg of twenty one Korean native male goats (4 months) used to determine the effect of the feeding trial. The goats were individually reared in metabolism cages and fed diet daily of 2% of the body weight on the dry matter basis. The treatments were divided into whole crop corn silage (CS silage), whole crop corn ensiled with cage layer manure (CLM; Corn-manure silage or MS silage) and whole crop corn silage supplemented with urea at feeding time (US silage). The content of crude protein, lactic acid and the ratio of ammonia nitrogen to total nitrogen (NH₃-N/Total N) in MS silage were increased from 7.7 to 14.9%, 5.7 to 7.5% and 8.2 to 16.6%, and the differences were significantly ($p < 0.05$) different in all observations. Total body weight gain of those goats for 90 days was 6.0 kg (66.7 g/day; MS silage), 4.3 kg (47.8 g/day; US silage) and 3.9 kg (43.4 g/day; CS silage), and feed conversion of MS silage (5.98) for 90 days was increased by far the best in the other groups and decreased about 30% in proportion to CS silage. Feed cost per 1 kg MS silage (1,606 won) was the lowest ($p < 0.05$) in the body weight gain and cut down expenses than fed CS silage by 37% of feed cost.

(Key Words : Corn Silage, Corn-Manure Silage, Weight Gain, Feed Conversion, Feed Cost)

Introduction

The availability of the silage to promote feeding value is depends on the composition of nutrients in the plant, the ability of ruminants to utilize these nutrients and the amount eaten by the animal. In general, whole crop corn silage is an important dietary feed for ruminants in many countries.

Although the whole crop corn silage is an important roughage for ruminant, it contains low level of crude protein, low amount of dry matter intake and low digestibility of protein due to zein.

On the other hand, the cage layer manure (CLM) was a waste product in the poultry industry and has known to be a good resource of dietary crude protein for ruminants because CLM contains nitrogenous compounds. Recently, due to the high cost of feeds and the insufficiency of feed resources for conventional ruminant feed, the poultry manure have been the growing interest for ruminant feed.

CLM is considered as the useful feed resource for ruminants in the developing countries. There is, however, a need of additional information on the relative nutritive value of poultry manures and on the most effective usage in ruminant feeding. Whole crop corn ensiled with CLM was showed the higher palatability and the better digestibility in ruminants due to the deodorization and the aerobic stability by lactic acid fermentation (Spoelstra et al., 1985a; 1985b; Ko and An, 1987, 1988; Ko et al., 1990a; 1990b; Ko et al., 1991; Kim et al., 1993a).

Also Ko and An (1988) studied that the whole crop corn ensiled with 30% broiler manure was the good feed which offered the better digestibility, the enhanced intake and the palatability. These results confirm that the whole crop corn ensiled with 30% of broiler manure will improve feed quality enhancing the digestibility, intake and palatability.

Besides, utilization of CLM for a feed addition to ruminants might offer other advantages, such as decrease of environmental pollution by CLM (Spoelstra et al., 1985a).

Despite of these advantage, no data were available on the feeding trial using the Korean native goats fed whole

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crop corn ensiled with cage layer manure.

For these point of view, in the present experiment quality of the whole crop corn ensiled with 30% CLM were studied, and discussed about the effect of body weight gain, feed conversion and feed cost with using Korean native goats.

Materials and Methods

Materials of silage

The crop corn raised at the stock farm of Gyeongsang National University, and was harvested at yellow stage, and was cut into 2-3 cm length with the forage cutter to prepare the corn-manure silage.

The cage layer manure (CLM) used in this study was collected from local poultry house and dried by sunlight to attain more than 80% of dry matter content, and the feathers and foreign materials in the CLM were removed manually. The CLM was ground to less than 1 mm of size through hammer mill prior to use in silage preparation.

Preparation of silages

One portion of the whole crop corn weight about 300 kg was directly packed in a plastic silo as CS (corn silage) silage, the other portion of the whole crop corn was well mixed with 30% CLM based on dry matter of corn forage and packed in the same way as MS (corn-manure silage) silage.

Then the plastic bag silo was tied with a string after removing air by suppressing the upside of the silo, and stored in the dark room at ambient temperature for 2 months, when the feeding trial was undertaken.

Experimental design

Three types of experimental feeds, 1) Corn silage, 2) Silage prepared by 70% corn forage and 30% of manure, and 3) Corn silage supplemented with urea at feeding time was prepared to adjust the nitrogen content to MS silage (US silage), were allocated to 21 Korean native male goats body weighting average of 11.6 kg.

The Korean native goats were individually reared in metabolism cages and fed diet daily of 2% of the body weight on the dry matter basis. The concentrate with the amount of 1% of body weight and 100 g of hay per head were fed daily in addition to the experimental silages of three types.

Methods of feeding trial

Half of daily experimental diet was given at 8 A.M. and the other half at 4 P.M. Water and mineral blocks

were freely accessed.

The experimental animals of 21 Korean native male goats were purchased from the private goat raiser in the vicinity of Chirju area, Korea.

The goats were reared by group feeding in the small paddock with 10.0 m × 2.5 m area and the amount of silage fed to the animals was the 110% of total daily dry matter intake (DDMI) which is 2.0% of body weight daily on DM basis.

During the preliminary period of 20 days, animals were fed the early stage corn silage and wild grass hay which contain 5.7% crude protein and a ratio of 3:7. The ratio of silage to hay was gradually changed up to 9:1 at the final stage of the preliminary period and for the final 3 days animals were adopted in the silage feeding.

The period of feeding trial was during 90 days. Everydays residual feeds was collected and measured just before the morning meal and were summed for 1 month. Body weight was measured and recorded monthly.

Chemical analysis

The pH values of silage were determined by the glass rod electric pH meter. Lactic acid was analyzed photometrically by the method of Barnett (1951). Chemical compositions of silages were analyzed by A.O. A.C. (1990) method using the freeze dried samples. $\text{NH}_3\text{-N}$ content in the fresh silage was determined by the method described by Morimoto (1971).

Statistical analysis

Data were analyzed by analysis of variance as described by Stell and Torrie (1960). Significant differences among means were detected by least significant difference.

Results and Discussion

Chemical content of silage

Chemical composition of the whole crop corn ensiled with or without 30% cage layer manure for feeding trial is shown in table 1.

Dry matter content of silage increased significantly ($p < 0.05$) from 23.2 to 29.1% by CLM addition. The addition of CLM caused to increase ($p < 0.05$) pH value of the silage from 3.74 to 4.77.

Organic matter content of 92.3% in the CS silage was significantly ($p < 0.05$) higher than the MS silage of 85.0%.

The content of crude protein, lactic acid and the ratio of ammonia nitrogen to total nitrogen ($\text{NH}_3\text{-N/Total N}$) in MS silage increased from 7.7 to 14.9%, 5.7 to 7.5% and

8.2 to 16.6%, and the differences were significant ($p < 0.05$) in all observations.

Spoelstra et al. (1985a), and Ko et al. (1990b) and Kim et al. (1993a) reported that 20% CLM, and 30% broiler manure addition increased pH value of the silage from 3.9 to 4.2, from 3.82 to 4.49, and from 3.78 to 4.85, respectively. These results supported the present research that the buffering capacity of acids such as lactic and acetic acids in silages caused to reduce pH values up to 4.0 with the addition of CLM to corn silage.

Ko and An (1987) found that the lactic acid content of corn silage increased with broiler manure addition, but Kim et al. (1993a) reported that the lactic acid content of corn silage decreased with broiler manure addition. These scientists proposed the pattern of fermentation.

TABLE 1. CHEMICAL COMPOSITION OF THE WHOLE CROP CORN ENSILED WITH OR WITHOUT 30% CAGE LAYER MANURE (DM BASIS)

	CS ²⁾	MS
Dry matter (%)	23.23 ^b ± 0.20 ¹⁾	29.14 ^{ab} ± 0.28
Organic matter (% DM)	92.31 ^a ± 0.19	84.98 ^b ± 0.08
pH	3.74 ^b ± 0.02	4.77 ^a ± 0.03
Crude protein (% DM)	7.66 ^b ± 0.11	14.86 ^a ± 0.16
Lactic acid (% DM)	5.68 ± 1.06	7.51 ± 1.12
NH ₃ -N/Total N (%)	8.17 ^b ± 0.32	16.56 ^a ± 0.59

¹⁾ Mean ± S.E. (n = 3).

²⁾ CS; Whole crop corn silage. MS; Whole crop corn ensiled with 30% cage layer manure (DM basis).

³⁾ Means with different superscripts in the same row are significantly different ($p < 0.05$).

Feed intake and feed conversion

The data of feed intake and feed conversion for 3 months are shown in table 2.

No residual feeds were found by feeding concentrate of 1% of body weight and hay of 100 g per head per day during the feeding period. The amount of MS silage intake of 167.5 g per head per day was significantly ($p < 0.05$) higher than those of US silage of 147.1 g and CS silage of 140.7 g. No differences were found between US and CS silages. From the table 2, it could be easily found that there was an improvement of feed conversion in MS silage which was 5.98. There were no differences between US of 7.79 and CS silage of 8.47.

The values of 70.6 and 92.0 for MS and US silages in the present research suggested that about low 30% and 8% of feed cost for three months were shown by feeding MS and US silages, respectively, compare to that of CS silage alone.

TABLE 2. FEED CONVERSION OF KOREAN NATIVE GOATS FED WHOLE CROP CORN ENSILED WITH OR WITHOUT CAGE LAYER MANURE AND UREA SUPPLEMENTED WHOLE CROP CORN SILAGE IN 3 MONTHS (G/HEAD/DAY, DM BASIS)

Feed	CS ²⁾	MS	US
Silage	140.7 ^b ± 2.85 ¹⁾	167.5 ^{ab} ± 4.03	147.1 ^b ± 2.21
Concentrate	125.0 ± 1.62	131.0 ± 2.96	125.3 ± 1.48
Hay	100.0 ± 0.00	100.0 ± 0.00	100.0 ± 0.00
Total DDMI	365.7 ^b ± 4.57	398.5 ^a ± 6.83	372.4 ^b ± 4.99
Weight gains	43.4 ^b ± 5.43	66.7 ^a ± 6.45	47.8 ^b ± 5.51
Feed Conversion ⁴⁾	8.47 ^b ± 0.39	5.98 ^a ± 0.47	7.79 ^b ± 0.32
Index	100.0	70.6	92.0

¹⁾ Mean ± S.E. (n = 90).

²⁾ CS; Whole crop corn silage. MS; Whole crop corn ensiled with 30% cage layer manure (DM basis). US; Urea was supplemented at feeding time to adjust the nitrogen content to MS silage.

³⁾ Means with different superscripts in the same row are significantly different ($p < 0.05$).

⁴⁾ Intake/gain.

Ko et al. (1990c) reported that the gross income was higher with the addition of cage layer excreta up to 30% of corn silage.

No unapparent reasons at present for the fact that there was no beneficial effect of urea addition to corn silage on either the feed intake or body weight gain which might have expected by the use of supplemented nitrogen by urea.

This trend was in an agreement to the results of Ko et al. (1990c) who reported that the gross income of 331 won per head per day was achieved by addition of cage layer excreta up to 30% of corn silage.

This trend was also in an agreement to the results of Ra et al. (1977) who reported that the feed conversion of Korean native goats fed high and low level of nutrition were 5.15 and 7.74, respectively.

Body weight gain

The body weight gains for 90 days of experimental period are shown in table 3.

Average initial body weight about 11.6-11.7 kg of twenty one Korean native goats was allocated to three groups.

Total body weight gains (6.0 kg) of korean native goats fed MS silage was significantly ($p < 0.05$) higher than those of animals fed US (4.3 kg) and CS (3.9 kg)

silages. Average daily weight gain of MS silage of 66.7 g/d was significantly ($p < 0.05$) higher than those of US silage of 47.8 g/d and CS silage 43.4 g/d. No differences were found between US and CS silages.

TABLE 3. BODY WEIGHT GAIN OF KOREAN NATIVE GOATS FED WHOLE CROP CORN ENSILED WITH OR WITHOUT CAGE LAYER MANURE AND UREA SUPPLEMENTED WHOLE CROP CORN SILAGE IN 3 MONTHS (G/HEAD/DAY)

Item	CS ²⁾	MS	US
Number of animals	7	7	7
Initial body wt. (kg)	11.7 ± 0.28 ¹⁾	11.6 ± 0.30	11.6 ± 0.26
Final body wt. (kg)	15.6 ^{b3)} ± 0.10	17.6 ^a ± 0.17	15.9 ^b ± 0.13
Body wt. gain (kg)	3.9 ^b ± 0.31	6.0 ^a ± 0.52	4.3 ^b ± 0.33
Daily wt. gain (g)	43.4 ^b ± 5.43	66.7 ^a ± 6.45	47.8 ^b ± 5.51
Relative index	100	154	110

¹⁾ Mean ± S.E. (n = 7).

²⁾ CS; Whole crop corn silage. MS; Whole crop corn ensiled with 30% cage layer manure (DM basis). US; Urea was supplemented at feeding time to adjust the nitrogen content to MS silage.

³⁾ Means with different superscripts in the same row are significantly different ($p < 0.05$).

No data is available at present about the performance of the Korean native goats fed whole crop corn ensiled with CLM. However, when Orchardgrass hay and formula feed were fed *ad libitum* for 182 days, the average daily

gain of Korean native goats was reported to be of 52.5 g, while those of animals grazed on the native grass at mountain region showed the daily gain of 56.8 g by Ra et al. (1977).

Kim et al. (1993a; 1993b) reported that Korean native goats fed MS silage showed the high body weight gain because MS silage improved the higher values in digestibility and palatability and ruminal propionic acid concentration than those of CS and US silages. On the other hand, Kim et al. (1993a) reported that ammonia formed in the rumen of goat feed a urea supplemented silage was not utilized efficiently because the rate of production of ammonia was higher than that of microbial utilization of it, and may be related to the lower digestibility of crude protein and the negative nitrogen retention in CS silage. These results were accompanied with higher body weight gain in MS silage.

The results of this study could lead us to draw a conclusion that the CLM could partially be replaced some of NPN by ruminants. However, there needs, certainly, more details about the use of CLM or urea which added in the corn silage by ruminant feeding.

Feed cost

Results on the feed cost about the present research are shown in table 4.

It assigns a cost to whole crop corn silage according to TDN content (66.8%) based on the cost on TDN content (40.3%) in rice straw. And the prices of concentrate, hay and cage layer manure were made a calculation at the market price. The prices of feeds used in this experiment were based on the farm price of October of 1993.

The US silage showed the highest total feed cost of 10,164 won compare to the lowest cost of 9,634 won for MS silage. The estimated feed cost per body weight gain

TABLE 4. FEED COST OF KOREAN NATIVE GOATS GIVEN WHOLE CROP CORN ENSILED WITH OR WITHOUT CAGE LAYER MANURE AND UREA SUPPLEMENTED WHOLE CROP CORN SILAGE IN 3 MONTHS

Item	Silage intake (kg)	Feed cost ²⁾			Total feed cost (A) (Won)	Body weight gain (B) (kg)	A / B (Won)	Index
		Silage (Won)	Concen. (Won)	Hay (Won)				
CS ¹⁾	53.74	5,799	2,475	1,620	9,894	3.9	2,537	100.0
MS	55.82	5,420	2,594	1,620	9,634	6.0	1,606	63.3
US	56.19	6,063	2,481	1,620	10,164	4.3	2,364	93.2

¹⁾ CS; Whole crop corn silage. MS; Whole crop corn ensiled with 30% cage layer manure (DM basis). US; Urea was supplemented at feeding time to adjust the nitrogen content to MS silage.

²⁾ Feed costs : 800 won is calculated at 1 dollar. Rice straw; 65 won/kg, whole crop corn silage; 107.9 won/kg, cage layer manure silage; 97.1 won/kg, concentrate; 220 won/kg, hay; 180 won/kg. Price of goat; 150,000 won/18 kg.

kg of experimental diets were in the order of the lowest value of 1,606 won for MS silage 2,364 won for US silage and 2,537 won for CS silage.

No profitable results was obtained by urea addition due to the increased silage intake compare to those of the other two silages.

This results suggested that feed cost could be cut down by feeding MS silage because there was a trend in this study that showed more body weight gain rather than the increases of silage intake.

When considering body weight gain over the feed expense, it could be concluded that the silage consumption and the feed conversion were able to be lowered by about 37% when MS silage was fed compered with CS silage.

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