Research article

Effects of Different Percentages of Sorghum Silage and Napier Grass on Nutrient Intake and Growth Performance of Goats

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Abstract This study was to evaluate the growth performance of goats fed different proportions of sorghum silage and Napier grass. A total of fifteen local male goats were divided into five groups on the basis of Completely Randomized Design (CRD). The dietary treatments were: T_1 (100% Napier grass); T_2 (75% Napier grass + 25% sorghum silage), T_3 (50% Napier grass + 50% sorghum silage); T_4 (25% Napier grass + 75% sorghum silage); and T_5 (100% sorghum silage).The experiment ran for 98 days. The average daily nutrient intake of dry matter, crude protein, organic matter, neutral detergent fibre, acid detergent fibre and cumulative live weight gain of the goats fed on T_1, T_2, T_3, T_4 and T_5 diets were not significantly different ($p > 0.05$) from each other throughout the experimental period. Based on these results, regardless of the inclusion of Napier grass in the diet, 100% sorghum silage could be favourable feed for local goat in Myanmar especially dry zone area where goats are populated and sorghum is available in planting.

Keywords sorghum silage, Napier grass, feed intake, growth performance, goats

INTRODUCTION

Ruminant production is largely limited by the availability and the high cost of quality feed. Low quality feeds are considered to be a major constraint in farm animal production. The availability of feed significantly decreases in the dry season when natural pastures are mature and highly fibrous and has low nutritive value due to low crude protein content (Moyo et al., 2012). Silage, anaerobically fermented green fodder, is widely valued as a source of animal feed. The primary goal of silage making is to maximize the preservation of original nutrients in the forage crop for later food for livestock (Stewart, 2011). Thus, surplus and cultivated quality forage is conserved during the wet season for use during the dry season. Kung and Shaver (2001) reported that corn silage can be used not only as a main source of feed for cattle but also in combination with other forage types, including pasture grass. Silage, which is anaerobically fermented green fodder, is valued throughout the world as a source of animal feed. Thus, feeding of ruminants with conserved forage has become an important feeding strategy since this can be made available throughout the year. Napier grass (*Pennisetum purpureum*) is recommended as a basal forage for intensive cattle production because of its high biomass fresh dry matter yield of 40 t/ha compared to other grasses (ILRI 2001).Tesfaye et al. (2016) observed that 100% *Pennisetum purpureum* silage had better feeding value as compared to the natural grass hay fed *ad libitum* in crossbred lactating dairy cows. In Myanmar, locally available crop residues such as rice straw, sorghum stover, maize stover, groundnut straw and pigeon pea residues, sesame residues, butter bean residues, chick pea residues are used as feed resources for ruminant in central dry zone area (CDZ) (Min Aung et al., 2015; Soe Min Thein et al., 2016). Among these crop residues, sorghum stover is used as common based feed mixture for ruminant because sorghum stover production is higher than other crop residues. The dry sorghum stover production was 800-3200kg/acre depend on soil type and nutrient quality in CDZ area of Myanmar. Farmers in

CDZ area used three types of dried chopped sorghum stover based diets (50%, 60% and 70% dry chopped sorghum stover) (Soe Min Thein et al., 2016). Feeding value and animal performance of sorghum stover based diets were lower than that of Mombasa grass based diets because of low crude protein contents and high fiber contents (Soe Min Thein et al., 2019). Nowadays, the farmers in dry zone of Myanmar grew sorghum, which were fed to ruminant animals as both fresh and dry feed mixture (Soe Min Thein et al., 2014). There is still need to do research related to effective usage of fresh forage sorghum and sorghum silage for ruminant animal. There is a little information concerning with the effects on different percentage of sorghum silage on growth performance in goats**.**

OBJECTIVES

This study was undertaken to determine feed intake and growth performance of goats fed different proportions of sorghum silage to Napier grass.

METHODOLOGY

Preparation of Napier Grass and Sorghum Silage

The sorghum forage and Napier grass were planted at the same time in the research field at Yezin Agricultural University. The sorghum was harvested at the stage of maturity around 60 days. Harvested and wilted green sorghum was cut into approximately 2-4 cm pieces, using a chaff cutter machine. The chopped green sorghum chaff was compacted in the pit silo. After filling the pit silo with sorghum chaff, it was tightly covered with plastic covers and weighted down with sand bags to keep the pit silo watertight and airtight. The silage remained sealed and in the pit silo, except to take food once daily for the goats. The Napier grass was harvested after 90 days. This was then cut into pieces around 2-4 cm by the chaff cutter machine and air-dried at room temperature until constant weight was obtained.

Experimental Animals and Diets

The experiment was carried out from April 2018 to August 2018 at the goat farm of Animal Science Department, Yezin Agricultural University. A total of fifteen (locally bred) male goats at a similar age of around six months and with weights ranging from12 kg to18 kg, were purchased from Myanmar C.P Livestock Production Co. Ltd. These animals were randomly assigned into five treatment groups, with three goats each group. Initially, Ivermectin was administered by subcutaneous injection to prevent internal and external parasites. The five treatment groups were based on the various proportions of Napier grass (G) and whole sorghum silage (SS): T_1 (100% G); T_2 (75% G + 25% SS), T_3 (50% G + 50% SS); T_4 (25% G + 75% SS); and T_5 (100% SS). The length of the feeding trial to determine the relationship between feed intake and growth performance was 84 days, with an initial adaptation period which lasted 2 weeks, in which no data was collected. The goats were fed with the treatment diets *ad libitum,* with feed replenished twice daily, at 08:00 am and 4:00 pm. Water was accessed freely by the animals. Feeding and drinking buckets were cleaned every morning to prevent contamination with detrimental microorganisms such as yeasts, moulds and the spread of undesirable bacteria that could have formed on the silage. During the feeding trial, the body weight (BW) of each goat was measured weekly, before that morning's feed was offered.

Chemical Analysis

The chemical analysis determined the value of dry matter (DM), organic matter (OM) and crude protein (CP) by the AOAC (1990) method. The levels of neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined as outlined in Goering and Van Soest (1970). The feed

samples were analyzed at the Department of Physiology and Biochemistry, University of Veterinary Science, Yezin, Nay Pyi Taw.

Statistical Analysis

The chemical composition of Napier grass and sorghum silage were analyzed by Students' t test. The data were subjected to the one-way analysis of variance (ANOVA) using SPSS software (version 16, SPSS Inc, Chicago. USA). Mean values were compared by Duncan's Multiple Range Test (DMRT). If $P<0.05$, the differences were considered as significance.

RESULTS

The chemical compositions of feedstuffs and experimental diets used in this experiment are shown in Tables1 and 2. The dry matter content of Napier grass was significantly higher ($p < 0.05$) than those of sorghum silage. The organic matter and crude protein of sorghum silage was significantly higher ($p < 0.05$) than those of Napier grass respectively. There was no statistically difference between Napier grass and sorghum silage for ADF, NDF and Ash. The feed intake and cumulative live weight gain of goats fed the experimental diets containing different proportions of Napier grass and sorghum silage at 84 days are shown in Tables 3 and 4. The nutrient intake of dry matter, crude protein, organic matter, neutral detergent fibre and acid detergent fibre by goats fed T_1, T_2, T_3, T_4 and T_5 diets were not significantly different ($p > 0.05$) within the five treatments at 84 days. The cumulative live weight gain of goats fed the experimental diets were not significantly different ($p > 0.05$) among the treatment groups during the experimental period.

Table 1 Chemical composition of feedstuffs (DM basis) except DM

Item	DM %[1)]	OM (%)	CP (%)	NDF (%)	ADF (%)	Ash (%)
Napier grass	56.63*	88.67	3.49	69.48	41.83	11.33
Sorghum silage	23.39	91.70*	7.56*	67.73	39.07	8.30

1) Fresh basis

*All values except DM are on DM basis. DM = dry matter, OM = organic matter, CP = crude protein, NDF = Neutral detergent fibre, ADF = Acid detergent fibre, *Comparison within each column and $p<0.05$ tested by Students' t test*

Table 2 Chemical composition of experimental diets (DM basis)

Parameters	T1	T2	T3	T4	T5
Dry matter %	94.38	76.63	58.89	41.14	23.39
Organic matter %	88.67	89.43	90.19	90.94	39.07
Crude protein %	3.49	4.51	5.53	6.54	7.56
Neutral detergent fibre %	69.48	69.04	68.61	68.17	67.73
Acid detergent fibre %	41.83	41.14	40.45	39.76	39.07
Ash %	11.33	10.57	9.82	9.06	8.30

T_1; Napier grass: Sorghum silage (100: 0), T_2; Napier grass: Sorghum silage (75: 25), T_3; Napier grass: Sorghum silage (50: 50), T_4; Napier grass: Sorghum silage (75: 25), T_5; Napier grass: Sorghum silage (0: 100)

Table 3 Effect of experimental diets on average daily nutrient intake at 84 days of goats

Nutrient Intakes	T1	T2	T3	T4	T5	SEM	p (value)
Dry matter intake (kg/day)	0.54	0.72	0.80	0.68	0.44	0.03	1.00
Crude protein intake (kg/day)	0.02	0.03	0.04	0.04	0.03	0.002	0.38
Organic matter intake (kg/day)	0.48	0.64	0.72	0.61	0.17	0.05	0.20
Neutral detergent fibre intake (kg/day)	0.38	0.49	0.55	0.46	0.29	0.02	0.08
Acid detergent fibre intake (kg/day)	0.23	0.30	0.32	0.27	0.17	0.01	1.00

All mean values are not significant different 5% level ($p>0.05$).

Table 4 Effect of experimental diets on cumulative live weight gain at 84 days of goats

Live Weight Changes	T_1	T_2	T_3	T_4	T_5	SEM	p (value)
Initial body weight (kg)	18.33	18.33	17.33	18.33	16.33	0.87	0.57
Final body weight (kg)	24.07	23.97	23.98	24.11	23.36	0.58	0.75
Total live weight gain(kg)	5.64	5.74	6.65	6.72	7.03	0.35	0.31

All mean values are not significant different 5% level (p>0.05).

DISCUSSION

The dry matter content of the Napier grass used in this experiment was 56.63%, which is higher than that of 23.4 % (Khaing et al., 2015). The CP content of Napier grass was 3.49% which is a lot lower than that of 7.3% (Rahman et al., 2013). A possible reason for these variations might be that in previous, trials the Napier grass was harvested about 45-60 days after planting, when the grass was about 1m high. In this experiment, the maturation stage of Napier grass was around 90 days and the whole plant was cut. The harvesting time is, therefore, an important factor for the nutritional management of forage such as grasses and leguminous trees. The amount of OM in the Napier grass was 88.67% which was in the same range with the values of 89.8% (Rahman et al., 2013) .The Ash content of Napier grass was 11.3% which is higher than 10.2 % (Rahman et al., 2013). The NDF and ADF contents of Napier grass were 69.48% and 41.83% respectively. In this case, for these detergent fibres, the values were lower than those of 74.8 % and 42.6 % (Khaing et al., 2015). In respect to the sorghum silage, the dry matter (DM) content in this study was 23.39%, which is similar to Khaing et al. (2015) at 23.30%, while lower than that of 56.3% in the (Muhamad et al., 2018) trial. The crude protein (CP) value of sorghum silage was 7.56% which is lower than those of 12.6% in Muhamad et al. (2018) and 8.1% (Khaing et al., 2015). The contents of NDF and ADF in sorghum silage were 67.73% and 39.07%, which is higher than those of Khaing et al. (2015) at 58.60% and 35.10%, but lower than those of Muhamad et al. (2018) at 81.4% and 42.5% respectively. The content of organic matter in sorghum silage was 91.70% which is higher than the 88.5% obtained by Muhamad et al. (2018) but lower than that of 96.10% reported by Khaing et al. (2015). In the current study, Ash content in sorghum silage was 8.30% which is lower than that of value 11.5% (Muhamad et al., 2018).Von Keyserlink et al. (1996) reported that chemical composition and mineral content of feedstuffs are affected by many factors such as growth, maturity, species or variety, drying method, growth environment and soil type. Similar factors would explain the variation in this experiment. The Napier grass contained higher NDF and ADF content than the whole sorghum silage although other chemical parameters were relatively similar. The inclusion of increased proportions of sorghum silage relative to Napier grass has thus contributed to a reduction in NDF and ADF contents in the experimental diets. Intake of dry matter, crude protein, organic matter, neutral detergent fibre and acid detergent fibre by goats fed T_1, T_2, T_3, T_4 and T_5 diets were not significantly different ($p > 0.05$) across the five treatments at 84 days. The goats fed the T_2, T_3, T_4 and T_5 diets showed high values for the intake of dry matter, crude protein, organic matter, neutral detergent fibre and acid detergent fibre, than those of the goats fed the T_1 diet. The increase in the DM content of the feed might be due to the chemical composition of the whole sorghum silage. This has a lower cell wall content resulting in increased the dry matter composition of the sorghum silage compared to Napier grass. Okoruwa et al. (2012) reported that the fermentation process by rumen microorganisms of high fibre diets takes longer compared to low fibre diets. Similar results were obtained by (Khaing et al., 2015). They reported increased growth performance of goats fed diets with a higher proportion of corn silage to Napier grass, when the various proportion of Napier grass (G) and whole corn plant silage (CS) were as follows: 100:0 G: CS, T2/75:25 G: CS, 50:50 G: CS, 25:75 G: CS and 0:100 G: CS and this was fed to male Boer cross goats. This is because sorghum silage contains high amounts of fermentable carbohydrate that increase nutrient intake by animals. The diets with a greater proportion of sorghum silage have a lower content of indigestible fibre portion due to the fermentation process involved in the silage production, compared to a diet solely of Napier grass. In contrast, Browne et al. (2004) stated that voluntary intake and growth performance were negatively affected by the substitution of high amounts of corn silage to the basal diet of the grass silage, due to the accumulation of high level

of fermentation acid which depressed the activity of cellulolytic bacteria in the rumen. However, in the current experiment, the basal diet was not grass silage but Napier grass. Widiawati and Thalib (2009) and Kariuki et al. (2001) stated that cell wall content of Napier grass degraded slowly in the rumen and was more resistant to rumen microbial fermentation. Inclusion of corn silage to the grass silage had a positive effect on feed intake as observed by (Browne, 2000). In addition, high concentration of lactic acid in silage may be metabolized into propionic acid by rumen microorganisms (Abedol et al., 2013). The soluble carbohydrate can be used by the animal as an energy source for maintenance and production activities (Hariadi and Santoso, 2010). The goats fed the T_2, T_3, T_4 and T_5 diets showed higher numerical values for total weight gained than the goats fed T_1 diet. The results also mirror those of Khaing et al. (2015). They reported increased growth performance of goats fed diets with a higher proportion of corn silage to Napier grass when the various proportion of Napier grass (G) and whole corn plant silage (CS): 100:0 G:CS, T2/75:25 G:CS, 50:50 G:CS, 25:75 G:CS and 0:100 G:CS fed to male Boer cross goats. Generally, the diets containing a higher percentage of sorghum silage and which had higher CP content result in higher weight gain as the animal performance is the product of nutrient concentration, intake and digestibility of absorbed nutrients.

CONCLUSION

According to this finding, 100% sorghum silage could be fed to goats without detrimental effect on the growth performance. Since Myanmar farmers could not access Napier grass easily, making sorghum silage for small ruminant will be advantages for small and large scaled farmers. Family labour would be used to keep costs for feeding. Sorghum silage could be fed to form a balanced ration. Therefore, it can be concluded that sorghum silage is a high potential feed comparable with Napier grass and with positive growth response when fed to small ruminants.

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