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Chemical Quality of Silage Mixture of Sorghum Bicolor (*Andropogon Bicolor* L. Roxb) and Gamal (*Gliricidia Sepium*) Leaves with Different Ratios

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ABSTRACT: The purpose of this study was to evaluate the chemical quality of silage mixture of sorghum bicolor (Andropogon bicolor L. roxb) and gamal leaves with different ratios. A completely randomised design (4x4) was applied with four different ratios tried, namely, P_0: sorghum bicolor silage without gamal leaves; P_1: mixed silage 80% sorghum bicolor + 20% gamal leaves, P_2: mixed silage 70% sorghum bicolor + 30% gamal leaves and P_3: mixed silage 60% sorghum bicolor + 40% gamal leaves. The variables studied included crude protein (CP), crude fibre (CF), nitrogen free extract (NFE) and gross energy (GE) content. The study showed the silage characteristics of P_0, P_1, P_2 and P_3 for CP (%) 11.38; 13.71; 14.83 and 15.10; CF (%) 22.53; 21.47; 20.54 and 20.43; NFE (%) 43.56; 42.37; 42.26 and 42.22; GE (kcal/kg DM) 3491.18; 3540.60; 3580.37 and 3588.86, respectively. The results of variance analysis showed that the treatment had a very significant effect ($P<0.01$) on CP and CF content but not significant ($P>0.05$) on NFE and GE. It was concluded that silage mixture of sorghum bicolor and gamal leaves up to 60:40 increased CP content and decreased CF and gave the same NFE and GE content compared to sorghum bicolor silage without gamal leaves.

KEYWORDS: chemical quality, gamal leaves, mixed silage, sorghum

INTRODUCTION

The availability of sustainable and quality forage feed to meet the needs of livestock is the main prerequisite for achieving productivity in livestock businesses including ruminant businesses. The longer dry season in the East Nusa Tenggara (NTT) area causes limited quantity and quality of feed as well as fluctuating continuity, which is abundant during the rainy season and lacking during the dry season. Hambakodu et al. (2021) reported that the crude protein content of some types of field grass in pasture areas in East Sumba was in the range of 3.21 - 4.59%. One of the strategies for providing feed for ruminants is to utilise the abundance of forage during the rainy season through silage technology. Silage is the result of preserving forage in fresh conditions stored in silos under anaerobic conditions. Which lasts for a long time so that it can overcome the shortage of forage for ruminant livestock in the dry season. Jasin (2014) states that making complete silage is basically intended to maintain and even improve the quality of forage. According to Purwadi (2012) the principle of making complete silage such as the fermentation process in general the material used consists of a group of forage materials, concentrates and additives.

One source of forage that is commonly found in NTT is sorghum (*Andropogon bicolor* L. Rox). Sorghum is a cereal crop that has the potential to be cultivated and developed as partial animal feed, especially in marginal and dry areas in Indonesia with its adaptation advantages and requires relatively less water (Sutrisna et al., 2014). The reported nutritional values of forage sorghum are crude protein 10.54%, crude fibre 23.32%, crude fat 2.55%, NFE 52.41% and gross energy 3434.95 kcal/kg DM (Bira et al., 2020). On the other hand, one of the potentially available forage legumes is gamal (*Gliricidia sepium*). The very high nutrient content in gamal is very suitable for supplementing low quality forage, but the quality of nutrients in gamal has different content in each part of the plant. Daning and Foekh (2018) reported that gamal leaves contain 24.68% crude protein and 15.70% crude fibre.

Related to these problems, the existence of these two types of forage is not impossible to be utilised on a wide scale through the application of silage technology to overcome feed shortages for rumninia livestock. Wati et al. (2018) stated that the combination of sorghum forage and gamal leaves by utilising lactic acid bacteria during the ensilage process will increase the shelf life of the forage so that it can be used for a long time, especially during the dry season. Based on these considerations, a study was conducted to evaluate the chemical quality of complete silage mixture of sorghum bicolor (*Andropogon bicolor* l. Roxb) and gamal leaves (*Gliricidia sepium*) with different ratios.

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MATERIALS AND METHODS

This research was conducted in East Baumata Village, Taebenu Subdistrict, Kupang Regency and Faculty of Animal Science Marine and Fisheries Laboratory from 6 March to 9 May 2022. The materials used in making silage are: sorghum (Andropogon bicolor L. Roxb) and gamal leaves, rice bran and sugar water. The tools used in this study, namely: coper machine, sitting scales with a capacity of 100kg with a sensitivity of 0.1kg thermometer, pH meter, and fibre drum as an ensilage container.

The study used a completely randomised design consisting of 4 treatments and 4 replications, namely:

P0: complete silage of sorghum bicolor without gamal leaves
P1: complete silage mixture of 80% sorghum bicolor + 20% gamal leaves.
P2 : complete silage mixture of 70% sorghum bicolor + 30% gamal leaves
P3 : complete silage mixture of 60% sorghum bicolor + 40% gamal leaves.

Silage making procedure

Sorghum bicolor and gamal leaves were chopped about 2-3cm, then weathered to reduce the moisture content to 30%. The two materials were mixed according to the treatment and added 3% water sugar, and 5% rice bran, from the weight of the silage material 100 for each treatment unit until the mixture was homogeneous. The mixture is put in a silo (fibre drum) and compacted until full and there are no air cavities, then closed tightly and using plastic and given ballast in the form of stones. The material in the silo is allowed to stand (fermentation process) for 21 days, after which samples are taken for laboratory tests.

Variables observed

1. Crude Protein content was determined using the Kjeldahl method (AOAC, 2005), with the formula:

$$\text{Crude Protein content } \% = \frac{(X-Y) \times N \times 0{,}014 \times 6{,}25}{z} \times 100\ \%$$

Description
X= Amount of ml of litre solution for sample
Y= The number of ml of blank paniter solution
Z= Western sample (gram)
N = Normality of the titre solution

2. Crude Fibre content, determined using the Henneberg and Stohmann method (Soeyono, 1991), with the formula:

$$\text{Crude Fibre content } (\%) = \frac{(b-c-a)}{x} \times 100$$

Description:
x= sample weight
a = dry paper weight
b= weight of dry paper+sample after oven
c= weight of dry paper + sample after planting

3. Nitrogen Free Extract (NFE), calculated mathematically (Soeyono, 1991) with the formula:
NFE (%) = 100% - (%ash + % Crude Protein + % Crude Fibre + % Crude Fat)

4. Gross Energy
Determination of energy value content (gross energy) using a Bomb Calorimeter (Soeyono, 1991).

Data analysis

Data were processed with variance analysis according to the experimental design used and continued with Duncan's test (Sastrosupadi, 1994).

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RESULTS AND DISCUSSION

The quality characteristics of the silage mixture of sorghum bicolor and gamal leaves obtained from this study are presented in Table 1.

Tabel 1. Crude Protein (CP), Crude Fibre (CF), Nitrogen Free Extract (NFE) and Gross Energy (GE) of Silage

Variable	Treatment				*P-value*
	P_0	P_1	P_2	P_3	
CP (%)	11.38^a	13.71^b	14.83^b	15.10^b	0.00
CF (%)	22.53^a	21.47^{ab}	20.54^b	20.43^b	0.00
NFE (%)	43.56^a	42.37^a	42.26^a	42.22^a	0.65
GE (kcal/kg DM)	3491.18^a	3540.60^a	3580.37^a	3588.86^a	0.28

Description: P_0= sorghum bicolor silage without gamal leaves; P_1= sorghum bicolor 80% + gamal leaves 20% mixed silage; P_2= sorghum bicolor 70% + gamal leaves 30% mixed silage; P_3= sorghum bicolor 60% + gamal leaves 40% mixed silage.

Effect of treatment on crude protein

The average crude protein content of mixed silage obtained from this study ranged from 11.38 - 15.10%. The results of variance analysis showed that the treatment had a very significant effect (P<0.01) on the crude protein content of silage. This means that the mixture of sorghum bicolor and gamal leaves in different proportions produced silage with different protein content. The decreasing proportion of sorghum bicolor along with the increasing proportion of gamal leaves showed an increase in silage protein content. This is due to the difference in protein content of the two ingredients mixed, where gamal leaves are higher than sorghum bicolor. Thus, the more gamal leaves used in the mixture, the higher the silage protein content. As reported by Daning and Foekh (2018) that gamal leaves contain crude protein 24.68% and crude fibre 15.70%. while sorghum in the vegetative phase according to Mayasari et al. (2012) contained crude protein 13.76% - 15.66% and crude fibre 26.06% - 31.815.

Table 1 shows the lowest crude protein content of 11.38% in P0 (sorghum silage without gamal leaf mixture) and continued to increase with the use of gamal leaves in the mixture where the highest was 15.10% in P3 (silage mixture of sorghum 60% and gamal leaves 40%). The results of the Duncan test showed that the crude protein content of sorghum bicolor silage without gamal leaves (P0) showed a difference (P<0.01) with the silage mixture of gamal leaves (P_1, P_2 and P_3), while the three mixed treatments of sorghum bicolor and gamal leaves showed insignificant differences (P>0.05) in terms of crude protein content. This indicates that the utilisation of gamal leaves in the preparation of mixed silage can increase the crude protein content.

The crude protein content of silage obtained from this study was higher than previously reported, namely 6.98% in Paspalum dilatatum silage treated with brown sugar as an additive (Yonathan, 2018), 7.8% in corn stalk silage (Mustika and Hartutik, 2021), 7.48 - 9.56% in mixed silage of kume grass and meltak (Mucuna sp) (Darmin et al., 2022) and 10.68% in mixed silage of kume grass and gamal leaves (Boko et al., 2022), 2022) and 10.68% in mixed silage of kume grass and gamal leaves (Boko et al., 2022), 9.94 - 13.81% in complete silage of mixed forages (Bira et al., 2020), 11.43 - 11.84% in Odot grass silage (Wati et al., 2018). This shows that gamal leaves have good potential in increasing the crude protein value of silage using Soghum bicolor forage.

Effect of treatment on crude fibre content

The average crude fibre content of mixed silage obtained from this study ranged from 20.43-22.53%. The results of variance analysis showed that the treatment had a very significant effect (P<0.01) on the crude fibre content of silage. This means that the mixture of sorghum bicolor and gamal leaves in different proportions produced silage with different crude fibre content. The increase in the proportion of gamal leaves as the proportion of sorghum bicolor decreased caused a reduction in the crude fibre content of silage.

Table 1 shows that the highest crude fibre content was 11.38% in P0 (sorghum silage without gamal leaf mixture) and continued to decrease until the lowest was 20.43% in P3 (silage mixture of sorghum 60% and gamal leaves 40%). Duncan's test showed that sorghum bicolor silage without gamal leaves (P0) showed significant differences (P<0.01) with silage mixture of sorghum and gamal leaves at 30% and 40% levels (P2 and P3) in terms of crude fibre content. However, the crude fibre content of sorghum silage without gamal leaves showed insignificant differences (P>0.05) with the silage mixture of 20% gamal leaves (P1),

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as well as the silage mixture of sorghum bicolor and gamal leaves at 20% (P_1), 30% (P_2) and 40% (P_3). The results showed that the use of gamal leaves with a portion of 20%, 30% and 40% was able to reduce the crude fibre content of silage by 1.06%, 1.99% and 2.10% respectively from without gamal leaves. This indicates that the use of gamal leaves in making mixed silage can reduce the crude fibre content of the silage produced.

The crude fibre content of silage obtained from this study was lower than some previous reports, namely 30.71% in silage of a mixture of kume grass and gamal leaves (Ndun et al., 2015), 22.98-25.20% in complete feed silage (Asmoro, 2017) and 28.37-31.27% in elephant grass silage given rice bran and ground corn (Naif et al., 2016) and 22.9-23.94% in Odot grass silage (Wati et al., 2018).

Effect of treatment on NFE content

The average of nitrogen free extract (NFE) of mixed silage obtained from this study ranged from 42.22 - 43.56%. The results of variance analysis showed that the treatment had no significant effect ($P>0.05$) on the NFE content of silage. This means that the mixture of sorghum bicolor and gamal leaves in different balances tends to produce silage with the same NFE content.

The increase in the proportion of gamal leaves along with the decrease in the proportion of sorghum bicolor caused a decrease in the NFE content of the silage. Table 1 shows the highest NFE content of 43.56% in P0 (sorghum silage without gamal leaf mixture) and continued to decrease to the lowest of 42.22% in P3 (silage mixture of sorghum 60% and gamal leaves 40%). At first glance, there was a tendency to decrease the NFE content of the silage mixture of sorghum and gamal leaves, with the use of gamal leaves 20% (P_1), 30% (P_2) and 40% (P_3) by 1.06%, 1.99% and 2.10% respectively compared to silage without gamal leaves (P_0). This indicates that the utilisation of gamal leaves in the preparation of mixed silage caused a reduction in the NFE content of the silage produced. NFE of mixed silage of sorghum and gamal leaves decreased as the portion of gamal leaves increased because the NFE percentage of gamal leaves was lower than sorghum, so that microorganisms were more likely to utilise NFE from gamal leaves than sorghum.

The NFE value of silage obtained from this study is not much different from the previously reported results on complete silage of a mixture of natural grass and lamtoro, sorghum and lamtoro and elephant grass and lamtoro with NFE content of 44.33%, 52.16% and 44.69%, respectively (Bira et al., 2020).

Effect of treatment on gross energy

The gross energy content of mixed silage obtained from this study ranged from 3491.18 - 3588.86 kcal/kg DM. The results of variance analysis showed that the treatment had no significant effect ($P>0.05$) on the gross energy content of silage. This means that the mixture of sorghum bicolor and gamal leaves in different balances tends to produce silage with the same gross energy value.

The increase in the proportion of gamal leaves as the proportion of sorghum bicolor decreased caused not significant increase in the gross energy value of the silage produced. Table 1 shows the lowest gross energy value of 3491.18 kcal/kg DM in P_0 (sorghum silage without gamal leaves) and continued to decline to the highest of 3588.86 kcal/kg DM in P_3 (silage mixture of sorghum 60% and gamal leaves 40%). The results showed that the use of gamal leaves with a portion of 20%, 30% and 40% in a mixture with sorghum bicolor, resulted in a better gross energy value of silage at 3540.6; 3580.37 and 3588.86 kcal/kg DM, respectively, compared to silage without gamal leaves (3491.18 kcal/kg DM). This indicates that the use of gamal leaves in making mixed silage with sorghum bicolor tends to increase the gross energy value of the silage produced, although not significantly. The tendency of increasing gross energy of silage mixture of sorghum and gamal leaves with increasing portion of gamal leaves is due to the higher energy content of gamal leaves compared to sorghum. The gross energy value of gamal leaves is 3857.4 kcal/kg DM (Oloruntola, 2018) while the gross energy value of sorghum is 3434.95 kcal/kg DM (Bira et al., 2020).

The gross energy value of silage obtained from this study is not much different from the previously reported results on complete silage of a mixture of natural grass and lamtoro, sorghum and lamtoro and elephant grass and lamtoro with gross energy content of 3947.92; 4151.66 and 3957.22 kcal/kg dry matter respectively (Bira et al., 2020).

CONCLUSION

It was concluded that the use of gamal leaves up to 40% in mixed silage with sorghum bicolor (60:40) can increase the crude protein content and decrease the crude fibre of mixed silage, but the NFE content and gross energy value tend to be the same compared to sorghum bicolor silage without gamal leaves.

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