



## Rumen Fermentation of Local Grasses Fed to Native Goat

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### ABSTRACT

The aim of this research was to examine the feed fermentation characteristics in the rumen of goats fed 4 different local grasses. This study was designed based on the Latin Square Design which consists of 4 diet treatments with 4 replications in each diet treatment. A total of 4 male goats, with relatively the same weight and age, were randomly assigned to an individual metabolic cage fed with 4 diets. The four diets studied were R1: Elephant grass, R2: Mini elephant grass, R3: *Panicum maximum* grass and R4: *Brachiaria decumbens* grass. Each diet was supplemented with 20% rice bran. The result of this experiment indicated that there was no significant effect of different diets on the pH values, concentrations of VFA (Volatile fatty acids), and Ammonia (NH<sub>3</sub>) in the rumen of goat. The pH values in the rumen of goats treated with R1, R2, R3, and R4 were 7.17, 7.12, 7.07, and 7.0, respectively. The concentration of ammonia (mM) in the rumen of goats treated with R1, R2, R3, and R4 were 4.6, 3.3, 4.5, and 4.1, respectively. Whereas the level of VFA (mM) in the rumen of goats treated with R1, R2, R3, and R4 were 40.4, 43.6, 48.7, and 49.9, respectively. There was no significant difference ( $p > 0.05$ ) in the characteristic of rumen fermentation between the diet treatment. This might be due to the similarity in the nutrient content of those grasses studied. The characteristic of rumen fermentation was in the range of optimal growth of rumen microbes. It is concluded that those four grasses studied are edible, acceptable and contain a good nutrient as a feed resource for goat. It is suggested that the supplementation of protein-source forage or higher level of concentrates to increase the ammonia and VFA levels to meet the suggested optimum concentration.

Keywords: Rumen fermentation, grasses, rice bran, goat

### INTRODUCTION

Establishment of a good rumen environment is very important for better utilization of roughages in the diet of ruminants. A good indicator of the rumen environment was pH, concentrations of ammonia and also volatile fatty acids (VFA). A good rumen environment will support the optimum growth of rumen microbes which have an important role in the process of

feed degradation and feed fermentation in the rumen. The level of rumen pH for optimum feed fermentation in the rumen is 6 to 7 [1], [2], [3]. Whereas the concentration of ammonia for better feed degradation and fermentation is 85-300 mg/l or 6-21 mM [4]. VFA is the end product of fermentation of feed carbohydrate in the rumen which consists of mostly acetic acid, propionic acid, and butyric acid. VFA will be used as the main energy source for production in ruminants [5], [6]. The total concentration of VFA in the rumen of ruminant fed general purpose diet is 2 to 15 grams per litre rumen fluid. The higher the VFA production in the rumen the higher the organic content likely in the diet fermented in the rumen [7]. This optimum rumen environment depends on the nutrient content of the diet consumed by ruminants. Diet of ruminant is usually consisted of forages or roughages as basal diet which is low in protein content and concentrate which contain high protein content. Local grasses such as Elephant grass (*Pennisetum purpureum*), Mini elephant grass, *Panicum maximum* grass, and *Brachiaria decumbens* grass commonly used as feed resources for ruminants. Farmers are usually feed their goat with one of the grasses alone and or in a mixed diet consisted of the four grasses. The grasses are available any time at all season since the grasses are planted and easily grown around the farmer house [8]. Proximate analysis of four grasses from previous researcher showed that all four grasses contain a good nutrient for ruminant. Nutrient content of Elephant grass was dry matter (DM) 19.9% crude protein (CP) 10.12%, ether extract (EE) 1.6%, crude fiber (CF) 34.2%, ash 11.7%, and nitrogen-free extract (NFE) 42.3% [9], [10]. Nutrient content of Mini elephant grass was DM 16.59%, CP 12.72%, CF 32.35%, and EE 2.28% [11]. *Panicum maximum* grass contains DM 21% and CP 13% [10], whereas *Brachiaria decumbens* grass contains DM 27.5%, CP 9.84%, EE 2.36%, and CF 28.9%. In the present study, four local grasses namely elephant grass, mini elephant grass, *Panicum maximum* grass, and *Brachiaria decumbens* grass were examined for their nutritive value. It is well known that those four grasses are commonly fed to ruminants as a basal diet in Indonesia. This paper will discuss the results of the study, especially focusing on the effect of feeding those four grasses on the characteristics of feed fermentation in the rumen of goat.

## MATERIALS AND METHODS

An experiment in vivo was conducted to examine the effect of feeding four different grasses on characteristics of feed fermentation in the rumen of goats. The characteristics of rumen fermentation measured were pH level of rumen fluid, concentrations of rumen ammonia, and concentration of VFA in the rumen. A Latin Square Design experimental design was used in this study to allocate 4 goats and 4 diet treatments with 4 replications in each diet treatment. A total of 4 male goats, with relatively the same weight and age, were randomly assigned to an individual metabolic cage fed with 4 diets. The goat used in this experiment was about 2 years old average body weight of 14kg. The four diets studied were R1: Elephant grass, R2: Mini elephant grass, R3: *Panicum maximum* grass and R4: *Brachiaria decumbens* grass. Each diet was supplemented with 20% of rice bran. There was 4 period of investigation which consists of an adjustment period for a new diet 7 days then followed by an observation period of 5 days. Therefore, in each period investigation was 12 days, and the total length of the experiment was

48 days. In each period of observation feed intake of goat per head per day was measured by weighing feed offered at 7 am and weighing feed residue at 7 am in the next day.

Proximate analysis AOAC [12] was conducted to measure the nutrient content of those 4 grasses as well as rice bran studied. The nutrient contents measured were DM= dry matter, OM=organic matter, CP=crude protein, CF = crude fiber, EE=ether extract, NFE=nitrogen-free extract, and Ash. Using the method of Van Soest [13] the cell wall and cell content of the feedstuff studied was also measured. Four different diets consisting of grass and rice bran were fed to 4 goats in an individual metabolism crate. A sample of rumen fluid (100ml) of goat was taken 4 hours after morning feeding using a standard fluid pump, then a pH meter was employed for measuring the pH level of the rumen fluid. The rumen ammonia and the VFA production in the rumen of goats were measured using the method of General laboratory Procedure as described by Harahap [14]. Analysis of variance followed by Duncan's test was used to examine the significant difference between the diet treatment [15].

## RESULTS AND DISCUSSIONS

A proximate analysis was conducted to measure the nutrient content of four grasses and rice bran used in this investigation. The result of the proximate analysis is shown in Table 1.

Table1. The Nutrient Content of Grasses and Rice Bran Studied

Nutrient	Elephant Grass	Mini Elephant Grass	<i>Panicum Maximum</i> Grass	<i>Brachiariade Cumbens</i> Grass	Rice bran
Dry matter (%)	28.02	26.29	23.63	33.04	90.30
Organic matter (%)	83.23	82.82	88.41	90.81	85.32
Crude protein (%)	14.79	12.13	11.19	15.31	7.71
Crude fiber (%)	31.84	27.44	33.42	31.02	32.19
Crude fat (%)	3.95	6.00	5.75	4.65	3.03
Ash (%)	16.77	17.18	11.59	9.19	15.68
NFE (%)	32.65	37.25	33.50	39.83	31.68
NDF (%)	66.22	62.71	68.14	68.24	49.65
ADF (%)	41.23	36.90	42.24	39.70	38.80
Seluloce(%)	36.17	32.80	35.36	35.36	22.13
Hemiseluloce(%)	24.99	25.81	25.90	28.54	10.85
Lignin (%)	2.08	2.05	3.30	2.66	8.85

Source: Laboratorium of Feed Chemistry and Nutrition Hasanuddin University

Table 1 shows that the nutrient content of those 4 grasses studied was almost similar for all nutrient content measured. The result of nutrient content measurement of rice bran indicated that the nutrient content of the latter tended to be lower than those of 4 grasses investigated.

In order to examine the effect of feeding those four diets on the characteristic fermentation in the rumen of goat the characteristics of rumen fermentation were measured using a standard method as described by Harahap [14]. The results of the characteristic fermentation (pH, NH<sub>3</sub>, and VFA) measurements in the rumen of goat-fed four diets can be seen in Table 2.

Table 2. The pH, NH<sub>3</sub> and VFA Concentrations in the Rumen of Goat

Characteristics Fermentation	Diet Treatment			
	R1	R2	R3	R4
pH	7.17± 0.206	7.12±0.288	7.07±0.251	7.00±0.216
VFA (mM)	40.48±5.465	43.64±11.57	48.70±12.45	49.96±2.422
NH <sub>3</sub> (mM)	4.635±1.329	3.34±0.515	4.51±1.699	4.12±1.830

Note: R1= 80% Elephant grass+20% Rice bran; R2= 80% Mini elephant grass+20% Rice bran; R3= 80% *Panicum maximum* grass+20% Rice bran; R4= 80% *Brachiaria decumbens* grass+20% Rice bran.

Table 2 showed that the pH level in the rumen of goat was R1=7.17, R2=7.05, R3=7.15, and R4=7.00. There was no significant difference ( $P>0.05$ ) in the pH level in the rumen of goat fed four diet treatment. The pH level in the rumen of all goat was in the range of optimum level for rumen microbe growth and rumen fermentation activities [16]. The pH level in the rumen will be affected by the level of volatile fatty acids (VFA) in the rumen. The higher the VFA production in the rumen the lower the level pH in the rumen fluid of the goat [17].

The result measurement of VFA production in the rumen of goat indicated that R1=40.48mM, R2=43.64mM, R3=48.70mM, and R4=49.96mM. There was no significant differences ( $P>0.05$ ) between the treatment diets. The concentration of the VFA in the rumen fluid of goat varied from 40.48mM to 49.96 mM. This indicated that the VFA concentrations in the rumen fluid of goat tended to be lower than normal VFA concentrations 80mM to 160mM [18], [19], [20], [21]. It is well known that the normal VFA concentration in the rumen was supported by the optimum growth of rumen microbes. In this experiment, the VFA concentration in the rumen of goat fed R4 (*Brachiaria decumbens* grass + rice bran) tended to be higher than that of R1, R2, and R3. This might be due to the higher organic matter and NFE content in the diet R4. NFE is a carbohydrate consisting of monosaccharide, disaccharide, and polysaccharide which is easily degraded and digested by rumen microbes in the rumen [22], [23], [24], [25]. VFA is the end result of feed degradation and fermentation by rumen microbes in the rumen. The higher NFE content in the diet will result in higher propionic acid production in the rumen. Whereas the higher crude fiber content in the diet tended to result in higher acetic acid production in the rumen [18], [26], [27].

Table 2 also showed that the NH<sub>3</sub> concentrations (mM) in the rumen of goats fed four different diets were R1=4.63, R2=3.34, R3=4.51, and R4=4.12. The result of the analysis of variance indicated that there is no significant difference ( $P>0.05$ ) in the levels of NH<sub>3</sub> (ammonia) concentrations in the rumen of goats fed 4 different diets. The NH<sub>3</sub> concentrations (mM) in the

rumen of goats fed four different diets varied from 3.34 to 4.63. This suggested that the concentration of ammonia in the rumen of all goats tended to be lower than that of optimum level of ammonia (6.0–17.65 mM) [28], [29], [30]. The optimum level of ammonia in the rumen is very important for optimum rumen microbe activity. The lower level of ammonia in the rumen will result in the lower activities of rumen microbes for feed degradation and fermentation, hence the lower VFA production in the rumen. The concentration of ammonia in the rumen will depend on the protein content in the diet consumed, the length of feed degraded in the rumen, the rate of feed degradability, also pH level of rumen fluid in the rumen [31], [32]. In this experiment the concentration of ammonia fed diet R2 tended to be lower than that of other diets. Figure of feed dry matter intake indicated that goat consume more diet R2 (542 g/head/day) compared to that diet R1 (464g/head/day), diet R3 (336g/head/day), and diet R4 (457g/head/day). Diet R2 contains lower dry matter and lower crude protein content (Table 1), this explains why goat consume more diet R2 and takes longer time to consume diet R2 to meet their dry matter intake requirement. The longer time to consume diet R2 might be due to the lower palatability of diet R2. The palatability of feed is affected by physical appearance, taste, also the smell of the feed offered to goat [33], [34], [35].

## CONCLUSIONS

Four diet treatments studied were readily fermentable and digestible in the rumen of goats. The pH concentration in the rumen of goats fed those four diets was in the range of optimum microbial growth in the rumen. However, the ammonia concentration in the rumen of goat tended to be lower than that of the suggested optimum ammonia concentration for the optimum growth of the rumen microbes. This might be due to the low dry matter, crude protein content, and also palatability of the diets. Although the goat consumed adequate dry matter of the diet, volatile fatty acids production in the rumen also tended to be lower than that of the suggested optimum concentration of the volatile fatty acids in the rumen of goat fed general purpose diet.

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