Quality and Rumen Fermentation Profile of Indigenous Forage on Karst Mountain

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ABSTRACT
The purpose of this study was to evaluate the quality and rumen fermentation kinetics of indigenous forages that were common to fed the goats by farmers. The method used was a survey by identifying the forages for the goat fed by the farmers surrounding South Gombong, Central Java, karst hills. The soil chemical compound consists of C-organic: 2.6-4.3%; Ca-total 0.108–0.924%; N-total 0.267–0.427%; P_2O_5-total 0.095–0.184%; and K_2O total 0.122– 0.237%. The identified forages were then analyzed for the nutrients content by proximate method and followed with in vitro method for analyzed the rumen fermentation profile. The results of this study showed that there were 20 species of forage that were fed to goat, which were dominated by 5 species of grasses with the nutrients content were crude fiber (CF): 32.69-39.50%, crude protein (CP): 5.73-10.96%, total digestible nutrient (TDN): 50.66-54.71%, and the rumen fermentation profiles were dry matter digestibility (DMD): 34.36-40.35%, organic matter digestibility (OMD): 48.32–52.37%, volatile fatty acids (VFA): 40-73 mM, ammonia (NH_3): 3.6-8.0%. There were 3 species of legumes with nutrients content and fermentation profile were CF: 21.20-39.98%, CP: 13.80-22.64%, TDN: 50.14-69.16%, DMD: 41.26-47.94%, OMD: 53.16-57.66%, VFA: 52-125 mM, NH_3: 7.30-15.6 mM. Ten species of schrubs and two trees were also identified. The nutrients content and fermentation profile of the scrubs were CF: 22.74-36.72%, CP: 12.15-16.94%, TDN: 52.30-64.79%, DMD: 33.66-51.54%, OMD: 47.36-63.28%, VFA: 20-130 mM, NH_3: 2.70-10.80 mM, and for the trees were CF: 23.72-33.88%, CP :12.50-13.34%, TDN: 56.06-62.99%, DMD: 37.98-38.62%, OMD: 49.62-49.64%, VFA: 17-42 mM, NH_3: 1.90-4.80mM. This study concludes that *Cynodon dactilon*, *Calliandra calothyrsus*, *Commelina difusa* and *Artocarpus heterophylus* are the potential forage to develop in karst mountain.

Keywords: *Forage, Karst mountain, nutrients content, rumen fermentation profile. ,*

1. INTRODUCTION

Karst Mountain in Indonesia lies from the far west Sumatera Island to the Far East Papua Island, covering 15.4 million ha or 8.2% of land in Indonesia. Karst mountain has a strategic function because it contains carbonate rocks such as limestone and dolomit widely used for construction and cement raw material. Besides, karst mountain is landscape with important value for the environment such as water resource, biodiversity and tourism. Karst mountain in Gombong Central Java province, Indonesia is among the many karst landscapes with unique geological component and serve as natural water management while bearing scientific value. The establishment of 10.102 ha Gombong karst as Karst conservation area is based on Decree of Ministry of Energy and Mineral Resources of the Republic of Indonesia No.: 3043 K/40/MEM/2014 dated 4th July 2014.

Karst mining in Gombong has been starting since 1963. The most detrimental effect is the desolated unused open space that will extend from time to time and affect the ecosystem change in Gombong karst mountain. Furthermore, it will decrease the quality and production of forage and the performance of goat and cattle farming in the area.

The study by [1] in the ex-mining area of Gombong karst mountain showed only nine indigenous forages species (5 species of grass, 1 legume, and 3 shrubs) with only 5.90 ton/ha/year production. In contrastanother study [2] reported 20 species were identified (7 grass, 4 legumes, 7 shrubs and 2 ferns) with 19,75 ton/ha/year production in a closed area of Gombong karst mountain. The disparity indicated that karst mining affect the indigenous forage ecosystem and might decrease It's diversity, productivity, and quality

Plants cannot grow well in the soil of the karst region in Slovenia, except for shrubs and trees. Besides, pasture in Slovenia is dominated by weeds, shrubs, and trees that are preferable for goats than sheep[3]. Soil in Gombong karst generally has low-medium fertility with 2.9 – 4.52% organic matter, 0.239 – 0.427% total nitrogen, 0.095 – 0.184% total P_2O_5, 0.069 – 0.237% total K_2O and 2.758% total calcium (Ca). Ecosystem and soil conditions in Gombong karst mountain potencially affect the quality of the indigenous forages and it's profile of rumen fermentation.

2. MATERIALS AND METHOD

The study was conducted in three selected villages with the highest goat farming potential in Gombong karst mountain Central Java Province. These included Kalisari in Rowokele sub-district, Jatijajar in Ayah sub-district and Banyumudal in Buayan subdistrict (Figure 1).

The forage feed for goat given by the farmers every day were identified by the survey. The research sample consisted of 15 goat farmers randomly selected from each village, results in 45 goat farmers on the whole. Data based on identification were tabulated into four forage groups including grass, legume, shrubs and trees.

The measured forage quality comprised dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) subjected to proximate analysis according to [4], nitrogen free extract (NFE), total digestible nutrient (TDN) according to [5] and neutral detergent fiber (NDF) according to [6]. . Response of ruminal fermentation profile were measured based on the dry matter digestibility (DMD), organic matter digestibility (OMD) in vitro according to [7], total volatile fatty acids (VFA) [8] and ammonia ($N\text{-}NH_3$) [9]. .

2.1. Rumen Fermentation Profile

The samples of each experimental feed were incubated *in vitro* with a buffered rumen fluid mixture by following the procedure from [7]. Rumen fluid was collected before morning feeding from a rumen fistulated Ettawah Crossbred goat fed on a diet of forage and concentrate mixture following the ration for *in vitro* substrate. The experiment was conducted at The Faculty of Animal Sciences, Jenderal Soedirman University, Purwokerto, Central Java, Indonesia. Before being used, rumen fluid was filtered using cheesecloth and placed in insulated flasks under anaerobic conditions. About 500 mg feed was inserted into the fermentation tube, added with 40 ml McDougall buffer solution, 10 ml rumen fluid, and flushed with CO_2 gas for 30 seconds. The tube was closed with a rubber cap and placed in a waterbath at 39°C for 48 hours of fermentation. At the end of 48 hours of incubation, the fermented substrate was filtered The filtrate was spin down by centrifugation at 3,000 rpm for 15 minutes to determine the ammonia content using spectrophotometer. The supernatant was used measure VFA concentration using Gas Chromatography.]. Nutrient digestibility was determined after 48 hours of incubation; 3 mL of 20% HCl and 1 mL of 5% pepsin were added and incubated for 48 hours. The fermented substrate was filtered and the residue was analyzed for dry matter and organic matter digestibility.

2.3. Statistical Analyses.

Data from the calculation of nutrients digestibility were analyzed by one-way analysis of variance. Comparisons between means were analyzed using the t-test of Duncan Multiple Range Test.

3. RESULT AND DISCUSSION

This result showed that some forages grow in the karst mountain area, including grasses, legumes, Scrubs, and tree plants. (Table 1). Grass from those area has 32.69-39.50% crude fiber, 32.30-50.61% NDF, 5.73-10.96% crude protein and 51.16-54.71 % TDN. Legume has 21.20-39.98% crude fiber, 37.49-50.76% NDF, 13.57-22.64% crude protein, and 50.14-69.16% TDN. Scrub has 22.74-36.72% crude fiber, 27.59-48.34% NDF, 12.23-16.94% crude protein and 52.30-64.79% TDN. Tree plant has crude fiber 23.72-33.88%, 34.74-36.80% NDF, 12.50-13.34% crude protein and 56.05-62.99 % TDN. Shrub species dominate 50% of the forage diversity, followed by 25% grass, 15% legume, and 10% tree. Tree species generally contain high total phenol and total tannin. Furthermore, plants in temperate climates have more phenol than those in the Mediterranean [10].

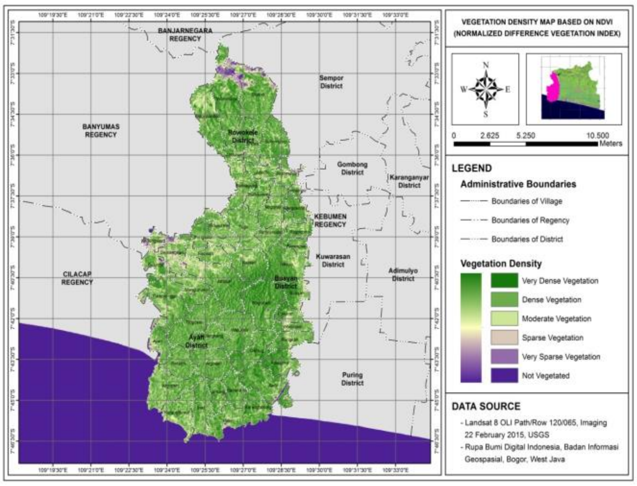

Figure 1 Vegetation density map.

Table 1. Nutrients content of forages in Karst Mountain

Feedstuffs	Water	Ash	EE	CF	CP	BETN	TDN	NDF
	%	···············(%DM)············..				%	%	%
Grass Spesies								
Cynodon dactylon	78.80	21.48	1.81	33.37	8.03	35.31	52.64	32.30
Eragrostis amabillis	81.80	10.30	4.21	35.35	10.96	39.18	54.71	40.40
Eulalia amaura	69.40	13.79	2.32	32.69	7.50	43.70	54.38	50.61
Imperata cylindrica	68.10	5.86	3.90	39.50	6.30	44.45	50.56	47.76
Themeda arguens	66.00	7.19	1.06	35.52	5.73	50.49	51.16	44.68
Legume Spesies								
Calliandra calothyrsus	79.20	10.24	4.69	21.20	22.57	41.31	69.16	50.76
Centrosema pubescens	73.50	5.93	2.59	39.98	13.80	37.70	50.14	37.49
Sesbania grandiflora	82.60	12.41	3.11	24.01	22.64	37.83	65.10	48.65
Shurbs Spesies								
Ageratum conyzoides	82.90	9.43	3.34	27.56	16.94	42.73	61.65	37.77
Clerodendron serratum	82.30	6.05	2.98	23.78	16.21	50.99	64.79	33.03
Commelina difusa	90.50	20.83	3.33	22.74	14.61	38.49	64.28	48.34
Hyptis capitate	81.90	8.87	3.37	24.88	15.78	47.10	63.85	29.19
Lantana camara	67.40	6.48	2.66	29.48	12.15	49.22	58.91	31.24
Mikania micrantha	87.50	9.33	2.75	24.51	15.18	48.23	63.46	46.31
Neptunea lutea	69.60	5.70	2.21	31.83	12.50	47.76	56.61	37.00
Stachytarpheta jamaicencis	81.50	5.98	2.48	31.55	12.31	47.68	57.04	27.59
Urena lobata	73.10	9.36	1.73	36.44	15.29	37.18	52.30	30.08
Vitex trifolia	70.50	5,56	3.02	36.72	12.23	42.48	53.12	29.73
Trees Spesies								
Artocarpus heterophylus	66.40	18.97	2.87	23.72	13.34	41.09	62.99	36.80
Swietenia macrophylla	64.80	5.95	3.55	33.88	12.50	44.13	56.05	34.74

Table 2. Fermentability of forage from Karst Mountain Gombong

Feedstuff	DMD (%)	OMD (%)	VFA, mM	N-NH3, mM
Grasses Spesies				
Cynodon dactylon	38.033	52.370	188	11.20
Eragrostis amabillis	34.361	48.321	181	22.80
Eulalia amaura	38.940	50.781	169	9.70
Imperata cylindrica	40.360	49.748	150	10.00
Themeda arguens	37.370	51.114	193	8.40
Legume Spesies				
Callyandra calothyrsus	47.940	57.658	235	19.80
Centrosema pubescens	41.267	53.160	162	20.40
Sesbania grandiflora	46.612	57.067	203	13.10
Scrubs Spesies				
Ageratum conyzoides	45.940	58.536	233	11.00
Clerodendron serratum	38.021	52.412	124	9.30
Commelina difusa	51.542	63.282	185	15.60

Hyptis capitata	34.020	50.635	171	8.40
Lantana camara	36.710	47.788	190	7.50
Mikania micrantha	43.021	57.252	203	13.60
Neptunea lutea	34.521	47.362	137	9.40
Stachytarpheta jamaicencis	33.662	48.413	130	10.20
Urena lobata	39.491	51.933	158	10.40
Vitex trifolia	39.410	50.890	180	9.70
Trees Spesies				
Artocarpus heterophylus	38.623	49.643	152	6.70
Swietenia macrophylla	37.980	49.619	127	9.60

In vitro data showed that the legume group had >50% organic matter digestibility, followed by 50% in the grass group and <50% in tree plants (Table 2). Dry matter and organic matter digestibility of *Commeliadifusa* was 51.54% and 63.28%, respectively. Dry matter digestibility of plants species was low, under 40%. Total VFA and $N\text{-}NH_3$ concentration of legume was higher than that of grass, scrubs and tree plant. The result is similar to that by [1, 11].

Cynodon dactylon from grass species, *Callyandra calothyrsus* from legume species, *Commelina difusa* from shrub species and *Artocarpus heterophyllus* from tree species are plants that have the best nutrient content and rumen fermentation profile consisting of DMD, OMD, VFA and NH_3 from plants that grow in the Gombong karst mountains. This is comparable to [12], that *Cynodon dactylon*, *Calliandra calothyrsus*, *Commelina difusa* are forages that grow and develop in karst mountain. The nutrient content of *Cynodon dactylon* is comparable to [13], but lower than [14] *Calliandra calothyrsus* comparable to [15], *Commelina difusa* crude protein content 3% lower than [16] *Artocarpus heterophyllus* comparable to [17] According to [18] differences in forage nutrient content are influenced by cutting age, proportion of forage parts, digestibility test methods [19] add to the environmental conditions of karst areas affecting growth and reproduction which can lead to the level of diversity of plant species. The types of plants that grow are species capable of adapt and tolerate karst environmental conditions. According to [20], the higher the velocity The dry matter digestibility of a feed ingredient is proportional to the quality of the feed ingredient. Organic matter digestibility is higher than the value of dry matter digestibility of a feed ingredient. Organic matter digestibility was proportional to crude protein and negatively correlated with crude fiber as an organic component. According to [21], organic matter in an easily digestible feed comes from soluble organic matter such as crude protein, soluble carbohydrates and fat. Crude fiber causes a decrease in the value of degradation because SK has cellulose and hemicellulose components that often bind to lignin so that it is difficult to break down by digestive enzymes.

4. CONCLUSION

Cynodon dactilon, *Calliandra calothyrsus*, *Commelina difusa* and *Artocarpus heterophylus* are the potential forage to develop in karst mountain.

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