CHEMICAL COMPOSITION AND IN VITRO RUMINAL FERMENTATION CHARACTERISTIC OF *SONNERATIA ALBA*

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Abstract

The aim of study was to determine chemical composition and comparison of nutritive value of *Sonneratia alba* and other forages (*Gliricidia sepium* and *Leuchaena leucochepala*) by using *in vitro* gas production technique. The result showed crude protein content in *S. alba* was lower than that *G. sepium* ($p<0.05$) and *L. leuchochepala*. The NDF content among treatments non significant difference. The ADF and lignin content *S. alba* were the highest. VFA production and dry matter degradability of *S. alba* comparable with *G. sepium* and *L. leuchocepala.*The ammonia-N production *S. alba* higher than *G. Sepium* but showed lower than *L. leuchocepala***.** In conclusion, according to the chemical composition *Sonneratia alba* was a high-quality feed resources. Utilization of *Sonneratia alba*by ruminal microorganism in vitro was available. Further in vivo studies could be required to expand the knowledge of the nutritive value *Sonneratia alba.*

Keywords: chemical composition,degradability, ruminal fermentation, *Sonneratia alba*

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INTRODUCTION

In the tropical areas, nutritive value influenced by climate. During the dry season there is scarcity of forage and when combined with a significant reduction in forage quality, grazing ruminants are often in negative energy balance until have not give good performans to ruminant yet (Ribeiro et al, 2014). With recent drought periods, farmers under pressure to maintain flock numbers and sustain the health of their flocks. Nutrition plays an important role in safeguarding flock health, and farmers are endeavouring to minimise cost associated with supplementary feeding by searching for cheaper, novel stuff (Sparkes et al, 2010) Study about alternative forage for ruminant in tropical areas has been done (Asaolu et al, 2011; Gwanzura et al, 2012; Mouafi et al, 2013).

Indonesia is a tropical area having mangrove forest. Mangrove forest in Indonesia are the species richest and most diverse in the world (Chapman 1984; Tomlinson, 1986; Alongi, 2002; Forestry Paper FAO 153, 2007) and has highest diversity with 43 true mangrove species (Forestry Paper FAO 153, 2007). Anticipation of this situation is by making use of the potential feed based on local resources, namely the utilization of mangrove plants. Mangrove plants produce

well throughout the year. There are some mangrove plants that can be used as feed by ruminant (Mouafi et al, 2013; Jactel and Brockerhoff, 2013). Farmers who live in tidal areas often use this plant as ruminant feed. *Sonneratia alba* mangrove plantsis one of the prefered ruminants. However, their nutritive value *Sonneratia alba* as forage for small ruminant is not known.

The aim of study was to determine chemical composition and comparison of nutritive value of *Sonneratia alba* and other forages (*Gliricidia sepium* and *Leuchaena leucochepala*) by using *in vitro* gas production technique.

MATERIALS AND METHODS

Experimental design: Two experiments were performed. Experiment 1, analyzed the chemical compositions of *Sonneratia alba* and other forages, including *Gliricidia sepium* and *Leuchaena leucochepala*and nutritive value was compared with each other. In experiment 2, the *in vitro*gas production technique was adopted to determine the fermentation of *Sonneratia alba,Gliricidia sepium* and *Leuchaena leucochepala* by mixed ruminal microrganism. All of the experiments were performed in the Laboratory Sciece and Feed Technology, Animal Science Faculty, Bogor Agricultural University, Bogor (June – November, 2013).

Forage Sample: *Sonneratia alba, Gliricidia sepium* and *Leuchaena leucochepala*leaves harvested on April, 2013. All the samples were hammer milled with 1 mm screen and preserved in dried bootles for later analysis.

Experiment 1: The Dry Matter (DM) content was determined by drying in a forced air oven at 60^0C for 3 h and ash was determined by incineration in a muffle furnace at 550^0C for 3 h. The N content was determined by using the Kjedhal method; those values were converted to Crude Protein (CP) by multiplying by a factor of 6.25. The Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) analyses were performed by the sequential procedure of AOAC (1999). Lignin content was taken from ADF residue dissolved with sulfuric acid (Van Soest and Robertson, 1981). Phosporus (P) was analyzed by the method of Parks an Dunn (1963). Calcium (Ca) was determined by a colorimetric method (Michaels et al, 1949).

Experiment 2:*In vitro* fermentation was performed according to the method Tilley and Terry (1963). The animals donor of rumen fluid were two permanently fistulated male Indonesian thin tailed sheep. The *In vitro* fermentation were in 100 ml fermentation tube containing 10 ml rumen fluid, 40 ml McDougall buffer and 500 g of forage sample and the blanks contained only McDougall buffer fluid. Incubation performed a total of 12 bottles 3 replicates x 3 treatments + 3 blanko). Bottles were placed in a water bath 39°C and maintained at slow contiuous agitation (100 rpm) for 24 h. Gas production was recorded at 2, 6, 12, and 24 h. At the and

incubation, the fermentation was stopped by swirling the bottle on ice. The culture of each bottle was strained through nylon bag (100 µm pore size). The substrate residues were collected quantitatively for determination of DM and NDF. DM degrability (DMD) of samples were calculated according to Van Soes and Robertson (1985). Total VFA concentration were analyzed by using gas chromatography (Chrompack CP9002, Netherlands, flame ionized detector, Capillary column type WCOT fused Silica 25 m x 0.32 mm, oven temperature: conditioning at 60°C and running at 115°C and nitrogen as gas carrier). Before analysis, The pH of the rumen fluid aliquts from in vitro incubation was adjusted to 3-4 with H_2SO_4. Thus, 1.5 ml of the adjusted rumen fluid aliquot was mixed solution with 30 mg sulfosalicylic acid and centrifuged at 12,000 rpm x 10 min (7°C) then 0.5 µl of the mixed solution was unjected to the GC. Ammonia ($N\text{-}NH_3$) concentrations were determined by using colorimetric metodhe (Chaney and Marbach, 1962).

Statistical analysis: The SPSS 11.0 software package was used for statistical analysis. Data Were analyzed using a one-way ANOVA by mean comparisons using the Duncan's new multiple range test.

RESULTS

Chemical composition: The CP content in *S. alba* was lower than that *G. sepium* ($p<0.05$) and *L. leuchochepala*.The NDF content among treatments non significant difference. *S. alba* was highest for The ADF content (621 g kg^{-1}) followed by *L. leuchochepala*(470 g kg^{-1} DM) and *G. Sepium*(290 g kg^{-1}). Lignin content of *S. alba* non significant difference with *G. sepium* but higher than with *L. leuchocepala*.*S. alba* calcium content was lower significantly ($p < 0.05$) compared with *L. leuchocepala*, however no different with *G. sepium*. Fosfor content of *S. alba* higher than with *G. sepium* and *L. leuchocephala*.

In vitro ruminal fermentation: VFA production and dry matter degradability of *S. alba* comparable with *G. sepium* and *L. leuchocepala.*The ammonia-N production *S. alba*(7.28 mmol L^{-1}) higher than *G. Sepium* (4.6 mmol L^{-1}) but showed lower than *L. leuchocepala*(10.5 mmol L^{-1}).

DISCUSSION

Chemical composition of the foliage species plays a crucial role in the extent to which they are utilised by goats and sheep (Osuga et al, 2008). The chemical composition of *S. alba, G. sepium* and *L. leuchochepala*in the present study is presented in table and showed significant variations (Table 1). The CP content in *S. alba* was lower than that *G. sepium* and *L. leuchochepala*. Concetrations of CP *S. alba* are comparable with *Securinega virosa* 170 (Meale et al, 2012), *Artocarpus heterophyllus* 150 (Astuti et al, 2011) dan *Robinia pseudoacacia* 169 (Chen et al, 2011) as ruminant feed. Concetrations of

CP *S. alba* higher than CP concentrations below the threshold of 70 g CP kg^{-1} DM, restrict microbial activity due to a lack of nitrogen (Hariadi and Santoso, 2010)during the most part of grazing period and can provide sufficient ammonia for the growth of microorganism in the rumen (Kamalak et al, 2005a). The NDF content among treatments non significant difference. The NDF content of *S. alba* is comparable to previously reported values of *Cratylia argantea* 532 (Meale et al, 2012), lower than *andropogon gayanus* grass harvested at 84 days 716 (Ribeiro et al, 2014). The ADF content *S. alba* was highest for *L. Leuchochepala*(470 g kg^{-1} DM) followed by *G. Sepium*. The ADF content in *S. alba* higher than mustard early flowering 564 (Kamalak et al, 2005a) but lower than with *andropogon gayanus*grass harvested at 84 days 389 (Ribeiro et al, 2014). *S. alba*including forage alternative low NDF and ADF compared with NDF and ADF of *Sinapsis arvensis* (665 dan 564) in the flowering period will be used an alternative forage in winter (Kamalak et al, 2005b). Dietary CP and NDF concentrations influence the amount of substrate organic matter fermented and the short chain fatty acids that are produced (Njidda and Nasiru, 2010). Lignin content of *S. alba* comparable with *G. sepium* but higher than with *L. leuchocepala*. Lignin, a very complex biopolymer in the plant cell wall, is usually treated as contaminant agriculture and in the pulp (Huang et al, 2008). *S. alba* calcium content was lower significantly ($p < 0.05$) compared with *L. leuchocepala*, however no different with *G. sepium*. Fosfor content of *S. alba* higher than with *G. sepium* and *L. leuchocephala.* In addition to nutrient content, the digestibility is an important factor affecting the nutritive value of feed (Chen et al, 2011). *In vitro* gas production technique has been used as a method for determining the nutritive value of feedstuffs (Herrero et al, 1996). The *in vitro* gas production system is a reliable tool to evaluate feedstuffs for ruminants since gas production is reported to be highly correlated with microbial protein synthesis and *in vitro* digestibility (Getachew et al, 1998a). The effect of forage species on in vitro gas production and DMD is given in Table 2.

.VFA production and dry matter degrability of *S. alba* comparable with *G. sepium* and *L. leuchocepala. In vitro* dry matter degrability and VFA production of are high. VFA value *S. Alba* are comparable with VFA production of *Moringa oleifera* 102.4 (Meale et al, 2012) dan *Artocarpus heterophyllus* 105.03 (Astuti et al, 2011). The gas Production is basically the result of the fermentation of carbohydrates into VFA (Getachew et al, 1998b). The high VFA value of *S. alba* indicated the carbohydrate fraction indikasi was readily availability to the microbial population in the rumen. These correlation with DMD of *S. alba* that was high. There is a positive correlation between *in vitro*

Table 1. Chemical Composition of *S. alba, G. sepium* and *L. leuchochepala* g kg^{-1} DM.

Chemical Composition	*Sonneratia alba*	*Gliricidia sepium*	*Leucaena leucocepala*
CP	180[a]	204[b]	185[a]
NDF	520[a]	520[a]	521[a]
ADF	621[c]	290[a]	470[b]
Lignin	230[a]	225[a]	195[b]
Ca	6.0[a]	6.7[a]	14.0[b]
P	3[ab]	1.9[a]	2.1[a]

Different superscript on the same row represent a significant difference ($p<0.05$).
DM = Dry Matter, CP = Crude Protein, NDF = Neutral Detergent Fiber, ADF = Acid Detergent Fiber, Ca = Calsium, P = Phospor.

Table 2. Cumulative gas, ammonia accumulation and in vitro dry matter digestibility (IVDMD) of 24 h .

Item	*Sonneratia alba*	*Gliricidia sepium*	*Leuchaena leuchochepala*
VFA (mM)	100.93[a]	101.27[a]	101.56[a]
Amonia-N (mmol L^{-1})	7.28[ab]	4.6[a]	10.5[b]
DMD (g Kg^{-1})	527[a]	714[a]	555[a]

Different superscript on the same row represent a significant difference ($p<0.05$).
VFA = Volatile Fatty Acid, DMD = Dry Matter Digestibility

DMD total VFA production. The ammonia-N production *S. alba* higher than *G. sepium* but showed lower than *L. leuchocepala*. If compare with forage non legum, N-NH_3 *S. alba* showed lower than *Annona senegalensis* 14.3 but higher than *Moringa oleifera* 0.4 (Meale et al, 2012). There is positive correlation with CP was low and can not induce the bloat so that more safe for ruminant.

CONCLUSION

It can be concluded that *Sonneratia alba* used in this study was a high quality feed resources and utilization of *Sonneratia alba*by ruminal microorganism *in vitro* was available. Further *in vivo* studies could be required to expand the knowledge of the nutritive value *Sonneratia alba.*

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