

Cell wall nitrogen content, degradability and gas production kinetics of Calliandra and Leucaena leaves as influenced by different drying temperatures

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Abstract – High crude protein in the feed material is important to provide the amino acids for further digestion and absorption in the small intestine. It is not entirely true because crude protein is divided into several fractions based on solubility and degradation rate in the rumen of ruminant. Calliandra (*Calliandra calothyrsus*) and Lamtoro (*Leucaena leucocephala*) contain proteins in the cell wall. Protein fractions in the cell walls may be affected by different drying temperatures. This study aimed to examine the effect of different drying temperatures on cell wall nitrogen content, digestibility and gas production kinetics of *C. calothyrsus* and *L. leucocephala* leaves. *C. calothyrsus* and *L. leucocephala* leaves were chopped, weighed and then put in the oven with different drying temperatures. A completely randomized design with 5 treatments and 3 replications was assigned in this experiment. The treatments were P1 (drying at 40° C), P2 (drying at 50° C), P3 (drying at 60° C), P4 (drying at 70° C), P5 (drying at 80° C). The parameters observed crude protein, ADF (*Acid Detergent Fibre*), NDF (*Neutral Detergent Fiber*), NDICP (*Neutral Detergent Insoluble Crude Protein*) and ADICP (*Acid Detergent Insoluble Crude Protein*) contents. Result of this study showed that higher drying temperature for *C. calothyrsus* increased the crude protein, NDF, ADF, NDICP and ADICP content ($P < 0.05$). In general, the resulting gas production is increased when the drying temperature increased.

1. INTRODUCTION

Kaliandra (*Calliandra calothyrsus*) and Lamtoro (*Leucaena leucocephala*) are leguminous trees and have high production. This legume potential as a forage because it contains nutrients needed by ruminant. However, high crude protein in *C. calothyrsus* and *L. leucocephala* overall cannot be digested by ruminants. Protein fraction in the cell wall may be affected by different drying temperatures. Level the drying temperature used is 40, 50, 60, 70, and 80° C. To determine the effect of different drying temperatures for digestibility, using invitro incubation with Theodorou method. The advantages of this method are: fermentation of feed occurs in the rumen can be measured faster, lower cost, and the number of samples can be evaluated with good and controlled condition (Church & Pond 1998).

2. METHODS

2.1 Chemicals

ADS (*Acid Detergent Solution*), NDS (*Neutral Detergent Solution*), McDougall, H₂SO₄ 0.005 HCl 0.5 N, H₂SO₄ 15%, aseton, HCl 0.1 N 10 mL, NaOH 1 N 0.5 ML, 0.2 N buffer fosfat.

2.2 Procedures

Material feed used in this study are the leaves *C. calothyrsus* and *L. leucocephala* obtained from Cage B Agrostologi Laboratory, Faculty of Animal Husbandry, Bogor Agricultural University. 1 kg of fresh samples at each repetition, weighed and then put in the oven with a temperature of 40, 50, 60, 70 and 80° C for 24 hours in accordance with the treatment. After that, the sample is then weighed, screened with 1 mm scale and analyzed in accordance with the observed variables. **Crude Protein (AOAC 2005)** 0.3 gram sample is weighed, added with 1.5 g of selenium catalyst mixture. Then put in a Kjeldahl flask and added 20 mL of H₂SO₄. Destruction is done until the color of the solution became green yellowish clear, cooled about 15 minutes, then added 300 mL of distilled water and cooled again. Then added with 100 mL 40 % NaOH, and distillation. Distillation result added with 10 mL of 0.1 N H₂SO₄. *In vitro* fermentation technique is based on the theory of Theodorou *et al.* (1994). 0.75 gram substrate inserted into the bottle incubation. Total gas production was measured at hours 2, 4,

8, 12, 24, 36, 48, and 72. Measurement of gas production is done by piercing the cover of the bottle using a syringe. The total volume of gas (ml) can be known by reading the manual on a scale of syringe. **Organic Matter Digestibility.** After 24 hours of incubation *in vitro*, residual feed tube inserted into the cup and then put in the oven 135° C for 2 hours. Value of organic matter digestibility (KBO) obtained through the difference in organic matter content (BO) early before incubation and after incubation. **Van Soest analisis.** Neutral detergent fiber (NDF) Analisis (Van Soest 1991) using the solvent used as NDS solution. 1 gram sample is inserted into the glass beaker and added about 100 mL and boiled for 40 minutes. After boiling, the samples then immersed in acetone for 10 minutes and then put into the oven. The difference with the initial sample weight and after being put in the oven is measured as the value of the NDF. Unlike the NDF analysis, the analysis of Acid Detergent Fibre (ADF) only use ADS solvent. NDF and ADF sample residue after being put in the oven then analyzed to determine the NDICP and ADICP values.

3. RESULTS AND DISCUSSION

Table 1. Chemical composition of *Calliandra calothyrsus* leaves as affected by different drying temperatures

Variable	Treatments				
	P1	P2	P3	P4	P5
Crude Protein (%)	20,91 ^a	22,72 ^b	23,30 ^c	23,47 ^c	24,64 ^d
ADF (%)	55,36 ^{ab}	54,44 ^a	58,24 ^{bc}	59,37 ^c	61,21 ^c
NDF (%)	62,22 ^{ab}	59,33 ^c	60,60 ^{ab}	62,69 ^b	66,22 ^c
ADICP (%)	13,42 ^a	12,04 ^a	14,65 ^b	14,83 ^b	15,21 ^b
NDICP (%)	16,33 ^{bc}	15,00 ^a	16,00 ^a	17,33 ^c	19,00 ^d

Table 2. Chemical composition of *Calliandra calothyrsus* leaves as affected by different drying temperatures

Variable	Treatments				
	P1	P2	P3	P4	P5
Crude Protein (%)	19,22 ^b	20,05 ^c	18,45 ^a	20,15 ^c	21,25 ^d
ADF (%)	46,15 ^c	35,20 ^a	46,93 ^c	41,48 ^b	40,89 ^b
NDF (%)	53,69 ^c	45,06 ^a	49,61 ^b	48,87 ^b	48,22 ^b
ADICP (%)	9,86 ^b	5,78 ^a	12,73 ^c	9,62 ^b	7,10 ^a
NDICP (%)	12,27 ^c	9,54 ^a	10,96 ^b	11,64 ^{bc}	9,58 ^a

Result of this study showed that higher drying temperature can increase the crude protein, NDF, ADF, NDICP and ADICP content ($P < 0.05$). High quantities of NDICP in feedstuffs causing protein in the feed material more slowly degraded in the rumen and negatively correlated with protein metabolism and the rate of protein degradation (Dewi, 2015) . It is suggested that the high temperature drying is not necessary because it can damage the nutritional quality of the feed material. It is concluded that the higher temperature for kaliandra increased cell wall protein.

Table 3. Gas production kinetics of *Calliandra calothyrsus* leaves as affected by different drying temperatures

Gas production kinetics	Treatments				
	P1	P2	P3	P4	P5
6	3.75 ^a	8.75 ^c	3.25 ^a	5.875 ^b	7.00 ^b
8	6.75 ^a	14.00 ^c	7.25 ^a	10.62 ^b	12.00 ^b
10	9.75 ^a	20.00 ^d	12.25 ^b	15.87 ^c	17.50 ^c
12	13.50 ^a	25.50 ^d	16.25 ^b	20.88 ^c	22.50 ^c
24	24.50 ^a	37.50 ^d	27.25 ^b	32.13 ^c	34.00 ^c
48	34.50 ^a	49.00 ^d	37.25 ^b	42.63 ^c	44.75 ^c
72	41.50 ^a	58.00 ^d	45.25 ^b	50.63 ^c	53.25 ^c

Table 4. Gas production kinetics of *Calliandra calothyrsus* leaves as affected by different drying temperatures

Gas production kinetics	Treatments				
	P1	P2	P3	P4	P5
6	0.63 ^{ab}	4.25 ^{ab}	4.50 ^b	0 ^a	10.50 ^c
8	4.38 ^{ab}	8.50 ^c	8.00 ^b	3.00 ^a	16.50 ^d
10	9.38 ^{ab}	13.50 ^c	13.00 ^{bc}	7.00 ^a	23.50 ^d
12	15.38 ^b	18.50 ^b	17.00 ^b	10.25 ^a	29.50 ^c
24	27.88 ^b	33.50 ^d	30.50 ^c	22.00 ^a	46.00 ^d
48	41.13 ^b	47.50 ^c	45.75 ^c	32.00 ^a	62.50 ^d
72	52.38 ^b	58.00 ^c	56.75 ^c	40.00 ^a	74.50 ^d

Table 4 and 5 showed that longer fermentation process followed by increasing of the gas production. This process because the nutrients found in *C. calothyrsus* and *L. eucocephala* can be ingested with high quantity over time.

Table 5. Organic matter degradability of *Calliandra calothyrsus* and *Leucaena leucocephala* leaves as affected by different drying temperatures

Plant species	Treatments				
	P1	P2	P3	P4	P5
<i>C. calothyrsus</i>	20.94	20.92	18.42	24.24	16.22
<i>L. leucocephala</i>	22.02 ^b	32.00 ^c	22.50 ^a	30.76 ^c	30.89 ^c

Table 5 showed that generally, digestibility is increasing when the drying temperature increased. Organic matter degradability in *C. calothyrsus* not significant with drying temperature, but *L. eucocephala* with different drying temperature have significant increasing organic matter digestibility ($P < 0.05$). This because the difference of cell structure in both types so the forage degradation process in the rumen to be different.

4. CONCLUSION

Result of this study showed that higher drying temperature for *C.calothyrsus* increased the crude protein, NDF, ADF, NDICP and ADICP content ($P < 0.05$). In general, the resulting gas production is increased when the drying temperature increased.

5. REFERENCES

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