Nutrients composition, relative feed value and *in vitro* digestibility of some tropical legume species in Indonesia

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Abstract. The aim of the current work is to evaluate nutrient profile, relative feed value (RFV) and *in vitro* true digestibility (IVTD) of 5 tropical legume in Indonesia. Daisy^{II} Incubator (Ankom Technology Corp, Fairport, NY) was used for IVTD measurement. *Arachis hypogea*, *Indigofera zollingeriana*, *Leucaena leucocephala*, *Gliricidia sepium* and *Vigna radiata* were evaluated in this experiment. Variables measured were nutrient composition, relative feed value and *in vitro* true digestibility. Experimental design of this study was completely randomized design with six treatments and four replications. The results show that *L. leucocephala* contains the highest crude protein content (31.36%). The lowest neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents were produced by *L. leucocephala* by 33.16 and 21.43% respectively ($P<0.05$). *L. leucocephala* and *I. zollingeriana* produced the highest RFV and included in "prime" forage quality value. The highest IVTD was produced by *I. zollingeriana* and *L. leucocephala* by 74.99 and 73.47%, respectively ($P<0.05$). Based on fiber profile, RVF and IVTD value, *L. leucocephala* was the best quality of tropical legume as forage.

1. Introduction

Legumes have often used for ruminant feeding in cut and carry system in Indonesia. Various types of tropical legumes are reported to be potentially in supply of forage due to good nutrient quality [1]. Legumes can increase animal performance with environmental benefits by symbiotic nitrogen fixation [2]. Some recent studies have evaluated the nutrient value and digestibility of some legumes as roughage. Tona et al. [3] reported that the legume species in south-western Nigeria contained higher crude protein (CP), ash and predicted organic matter digestibility than grass species. Hadi et al. [4] stated that degradation rate of some legume species (*S. glandiflora, G. sepium* and *C. calothyrsus*) was higher than non-legume species (*A. heterophyllus, M. zapota* and *T. cacao* L.). Evitayani et al. [5] stated that some tropical legume forages had showed good nutritive value with less phenolics compound. Furthermore, it is reported that *P. phaseloides* and *L. leucocephala* have a good potential nutritive value for feed supplement.

A. hypogea, *G. sepium*, *I. zollingeriana*, *L. leucocephala* and *V. radiata* were some tropical legumes that grow in Indonesia. There is not much information evaluating the comparison of nutrient

profile and digestibility values between some tropical legumes in Indonesia. Relative feed value (RFV) is parameter that necessary to be observed to determine forage quality. Relative feed value represents the biological value of the feedstuffs [6]. Therefore, this study aimed to evaluate nutrient profile, relative feed value and *in vitro* true digestibility (IVTD) of 5 tropical legume in Indonesia.

2. Material and Methods

2.1. Sample Preparations

The 5 tropical legume species were harvested at the field of agriculture division, Center for Isotopes and Radiation Application, National Nuclear Energy Agency of Indonesia. *A. hypogea*, *G. sepium*, *I. zollingeriana*, *L. leucocephala* and *V. radiata* were evaluated in this study. The straw component is the part evaluated in *A. hypogea* and *V. radiata* species. Leaves and petiole are the part evaluated in *G. sepium*, *I. zollingeriana* and *L. leucocephala*. The three legume tree species were obtained from 1.5 – 2 years of tree's age. All legumes were chopped, dried at 60°C for 48 h, and grinded to 1-2 mm to determine the dry matter (DM) content, nutrient content and *in vitro* experiment.

2.2. Nutrient Profile Analyses

Organic matter (OM), CP and EE content were determined as described in AOAC [7]. Neutral detergent fiber (NDF) and ADF were analyzed as described in Van Soest et al. [8] using Ankom A^{200} fiber analyzer (Ankom Technology Corp, USA). Hemicellulose content was calculated as NDF – ADF.

2.3. Determination of Relative Feed Value

Relative feed values of six legumes were calculated as following : DMD (%) = 88.9 – (% ADF x 0.779), DMI (% live weight) = 120 / %NDF, RFV = (DMD x DMI) / 1.29 [6,9]. The RFV were assessed based on: prime (>151), 1-premium (151 - 125), 2-good (124 – 103), 3-fair (102 – 87), 4-poor (86 – 75), 5-reject (< 75) [6,9].

2.4. In Vitro Digestibility Measurements

In vitro true digestibility was undertaken according to Ankom [10]. Rumen liquor was obtained from 2 cannulated Peranakan Ongole (PO) bulls fed on concentrate mixture and rice straw. The rumen liquor was taken under CO_2 infusion and filtered through two layers of cheesecloth. Buffer solution was prepared according Ankom [10]. Approximately 500 mg DM of samples were placed into filter bag Ankom (Ankom Technology F57). The filter bags (24 samples) were placed inside cylinder with mixed buffer solution (1600 ml) and rumen liquor (400 ml). The cylinder was aerated for 30 seconds with CO_2 immediately and then incubated for 48 h. after incubation, filter bags were cleaned and analyzed for NDF digestibility with Ankom fiber analyzer. *In vitro* true digestibility (IVTD) of samples was estimated by: IVTD (%) = 100 – ((W3 – (W1 x C1))*100)/W2. Where: W1 (weight of filter bag), W2 (weight of sample), W3 (final weight after NDF analyses), C1 (correction factor from empty filter bag).

2.5. Statistical Analyses

Experimental study was completely randomized design with six treatments and four replications. Data of nutrient profile, digestibility estimation and *in vitro* true digestibility were analysed using one way analysis of variance (ANOVA) and tested by Duncan Multiple Range Test (DMRT) [11], performed using SPSS 19.0 software package.

3. Results and Discussion

Nutrient contents of each legume species are shown in Table 1. *V. radiata* contains high OM content. High CP was observed in *L. leucocephala* and *G. sepium*. High EE content was observed in *L. leucocephala* ($P<0.05$). Low NDF, ADF and hemicellulose content was found in *L. leucocephala* ($P<0.05$).

Table 1. Nutrient profile of some tropical legumes species in Indonesia

Tropical legumes	OM	CP*	EE	NDF	ADF	Hemicellulose
			% DM			
A. hypogea	85.49^{ab}	15.94	2.55^{a}	46.43^{c}	30.10^{c}	16.33^{b}
G. sepium	82.32^{a}	30.73	6.63^{b}	45.92^{c}	28.57^{c}	17.35^{b}
L. leucocephala	86.10^{ab}	31.36	9.69^{c}	33.16^{a}	21.43^{ab}	11.73^{a}
I. zollingeriana	87.04^{ab}	28.98	6.63^{b}	41.84^{b}	21.94^{b}	19.89^{b}
V. radiata	89.10^{b}	27.47	5.10^{ab}	48.98^{c}	30.61^{c}	18.37^{b}
SEM	0.845	2.911	0.645	1.401	1.133	0.819

OM (organic matter), CP (crude protein), EE (ether extract), NDF (neutral detergent fiber), ADF (acid detergent fiber), DM (dry matter), SEM (standard error mean), means with different superscripts within row are different (P<0.05).* CP values are without replication

The nutrient profile from some tropical legumes in this experiment is fairly variable. This variablility could due to many factors such as plant part (straw vs leaves) and plant maturity. High CP content found in *L. leucocephala* was similarly with previous study [3,11]. Jayanegara et al. [12] reported that *L. leucocephala* contains high CP by 30.36% and this plant may be used as feed supplement for poor roughages. *A. hypogea* and *V. radiata* contains high NDF and ADF due to the part observed is mostly in stem. The low NDF and ADF content in *L. leucocephala* could associated with lignin content. Lignin is main barrier of fiber digestion in roughages. The lower lignin content on ruminant rations may increase fibrolytic bacteria activity and digestibility [2].

The DMD, DMI estimated, RFV and IVTD value are presented in Table 2. The lowest and the highest predicted of DMD and DMI value were observed in *V. radiata* (P<0.05). *L. leucocephala* has also produced the highest RFV and IVTD values (P<0.05). A number of legumes included in prime forage class, i.e. *L.leucocephala* and *I. zollingeriana*.

Table 2. Relative feed value and *in vitro* digestibility of some tropical legumes species in Indonesia

Tropical legume	DMD (%)	DMI (% live weight)	RFV	Forage class	IVTD (%/500 mg DM)
A. hypogea	65.45^{a}	2.59^{ab}	131.67^{a}	1-premium	68.37^{ab}
G. sepium	66.64^{a}	2.62^{ab}	135.29^{a}	1-premium	64.79^{a}
L. leucocephala	72.22^{b}	3.64^{c}	204.32^{c}	Prime	73.47^{cd}
I. zollingeriana	71.81^{b}	2.89^{b}	161.03^{b}	Prime	74.99^{d}
V. radiata	65.05^{a}	2.45^{a}	123.71^{a}	2-good	69.89^{bc}
SEM	0.816	0.108	7.435		0.976

DMD (dry matter digestibility), DMI (dry matter intake), RFV (relative feed value), IVTD (*in vitro* true digestibility), SEM (standard error mean), means with different superscripts within row are different (P<0.05).

The quality of forages digestibility depends on nutrient composition in Table 1. The low NDF and ADF content affects the RFV and IVTD value. This result may be explained that the high non fiber carbohydrate content in legumes species due to lower NDF and ADF, could increase energy utilization from forages. Kondo et al [13] reported that fiber carbohydrates (in form of NDF and ADF) are slowly degradable, thus non fiber carbohydrate would be more beneficial to increase supply energy for microbial protein synthesis. The higher IVTD value could also be affected by high CP content. It could be seen in *L.leucocephala* and *I. zollingeriana* species. The higher CP content clearly could increase the NH_3 concentration in the rumen thus could increase microbial protein synthesis [2].

4. Conclusion

L. leucocephala and *G. sepium* contains high CP content. The lowest NDF and ADF contents were produced by *L. leucocephala*. *I. zollingeriana* and *L. leucocephala* produced the highest RFV and

included in "prime" forage quality value. The highest IVTD was produced by *I. zollingeriana*. *L. leucocephala* was the best quality of tropical legume species as forage based on RFV and IVTD value.

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