

The Effect of Various Legume Herbs Supplementation on Intake, Digestibility and Growth of Fat-tailed Lambs Given Mulato grass

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Abstract. This experiment was conducted to examine the effect of various legume herbs supplementation on feed intake, digestibility and liveweight gain of fat-tailed lambs given Mulato (*Brachiaria mulato*) grass. Twenty four male fat-tailed lambs (8 months of age and 12.73 ± 0.56 kg (SE) of initial liveweight) were randomly allotted to four treatment groups based on unfasted liveweight. Animals were housed in individual metabolism crates. The experiment was designed in a completely randomized block design, with four treatments and six replicates. The dietary treatment tested included Mulato grass *ad libitum* (M), M + *Centrosema pascuorum* (MCP), M + *Dolichos lab lab* (MDL) and M+ *Clitoria ternatea* (MCT). All supplement was offered at 1.5% body weight (W) per day. The experiment lasted for 10 weeks, with 2 and 8 weeks for adaptation and measurement period, respectively. The main parameter measured included feed intake, feed digestibility, and average daily liveweight gain (ADG). Results showed that total DM intakes (DMI) were not affected by legume herbs supplementation. Total DMI was 2.75, 2.79, 2.84 and 2.87% W/d for lamb treated with M MCP, MDL and MCT respectively. In contrast, supplementation with various legume herbs significantly increased DM digestibility (DMD) and ADG of lamb received Mulato grass, with no significant difference between legume herbs. Feed DMD was 58.17, 67.48, 64.91; 65.03% and ADG were 35.67; 58.39; 54.31 and 54.41 g/day, for lamb treated with M, MCP, MDL and MCT respectively. It was concluded that supplementation of legume herbs to fat-tailed lamb fed Mulato grass significantly increased DMD and ADG, but no significant differences across the legume herbs as feed supplements were observed.

Keywords: Legume herb, Mulato grass, fat-tailed lamb, supplementation

Abstrak. Penelitian ini dilaksanakan untuk menguji pengaruh suplementasi beberapa hijauan legum herba terhadap konsumsi pakan, pencernaan dan penambahan bobot badan domba ekor gemuk jantan muda yang mendapatkan rumput Mulato (*Brachiaria mulato*). Sebanyak 24 domba ekor gemuk jantan muda (umur 8 bulan dan bobot badan awal 12.73 ± 0.56 kg) diacak dan dibagi menjadi empat kelompok perlakuan berdasarkan bobot badan ternak. Domba selanjutnya ditempatkan pada kandang metabolis secara individu. Penelitian ini menggunakan rancangan acak kelompok yang terdiri atas empat perlakuan dan enam ulangan. Pakan perlakuan yang dicobakan meliputi : rumput Mulato *ad libitum* (M), M + *Centrosema pascuorum* (MCP), M+ *Dolichos lab lab* (MDL) dan M + *Clitoria ternatea* (MCT). Semua pakan supplement diberikan pada level 1,5% dari bobot badan (BB), dalam bentuk bahan kering per hari. Penelitian berlangsung selama 10 minggu, masing-masing 2 dan 8 minggu untuk periode adaptasi dan pengukuran. Variabel utama yang diukur meliputi konsumsi pakan, pencernaan pakan, penambahan bobot badan harian (PBBH). Hasil penelitian menunjukkan bahwa total konsumsi pakan, tidak dipengaruhi secara nyata oleh suplementasi legum herba. Total konsumsi pakan domba yang mendapat perlakuan M MCP, MDL and MCT masing-masing sebesar 2,75; 2,79; 2,84 dan 2,87% BB/hari. Namun, penambahan beberapa spesies legum herba berpengaruh nyata terhadap peningkatan, pencernaan BK dan PBBH domba ekor gemuk muda yang mendapatkan rumput Mulato. Nilai pencernaan BK pakan sebesar 58,17; 67,48; 64,91; dan 65,03%, dan PBBH 35.67; 58.39; 54.31 and 54.41 g/hari masing-masing untuk domba yang mendapatkan perlakuan M, MCP, MDL dan MCT, namun tidak terdapat perbedaan nyata antar spesies legum herba. Disimpulkan bahwa suplementasi beberapa spesies legum herba dapat meningkatkan pencernaan BK dan PBBH domba ekor gemuk muda, namun tidak terdapat perbedaan antar spesies legume herba.

Kata kunci : legume herba, rumput Mulato, domba ekor gemuk, suplementasi

Introduction

Sheep is one of the important small ruminants in Indonesia and are mostly kept by farmers to provide meat, manure and family financial asset. The population of sheep in this country is increasing from year to year. In 2018, the total population of sheep reached 17,794,344 head. About 94% of the sheep are on the island of Java, a densely populated island with intensive cropping systems (LAHS, 2019). Fat-tailed sheep are the major breed in this country which has gradually replaced the native thin-tailed sheep (Udo and Budisatria, 2011). Despite increasing the population, the contribution of sheep to national meat production in this country is still low. For example, in 2018, sheep meat contributed only 1.86% of total 4,886,170-ton national meat production (LAHS, 2019). It indicated that Indonesia needs to increase the productivity of sheep to contribute more to the national meat supply.

In Sulawesi island, Central Sulawesi has the largest sheep population, i.e. 7,922 head. The sheep are mainly owned by smallholder farmers and managed traditionally with an extensive system. During day time, the sheep are allowed to graze on natural grazing area and penned in the communal pen during night time. The main feed resources for sheep are natural pastures consisting of native grasses and a small proportion of legumes species. Although the forage can supply nutrients required by the animal during the rainy season, their productivity and nutritive value decline sharply during the dry season. At this stage, pastures are deficient in energy, protein, and minerals. This is aggravated by lack of alternative feed or supplementation during this critical period. During the long dry season where forage is scarce, the feed cannot meet the animal requirements.

One way to increase feed availability during the year is introducing new species of forages that produce high biomass and contain high

nutrient content. Mulato grass and various legume herbs such as *Centrosema pascuorum* (CPa), *Dolichos lab lab* (DL), *Clitoria ternatea* (CT), are currently introduced to Central Sulawesi to meet feed availability of ruminant animal in this region. The growth and biomass production of those forages was studied by Mustaring et al. (2014). The use of Mulato grass as a single feed or in combination with a supplement has been studied in cattle by Marsetyo et al. (2016; 2017) and to goat (Marsetyo, 2016). Legume herbs provide high feeding value supplement to increase ruminant performance (Kemp et al., 2010; Marhaeniyanto and Susanti, 2011; Phelan et al., 2015; Tedeschi et al., 2019). However, no data are available on the use of Mulato grass as a single feed and in combination with legume herb on sheep. This study was aimed to test the effect of various legume herbs supplementation on feed intake, digestibility and ADG of fat-tailed lamb received Mulato grass as a basal feed. Fat-tailed lambs are a predominant breed of sheep in Central Sulawesi.

Materials and Methods

Experimental Design, Animal and Treatments

Twenty four, eight-month-old male fat-tailed lambs with initial weight (W) 12.73 ± 0.56 kg (mean \pm s.e) were allotted to four treatments in a completely randomised block design. Each treatment was repeated six-time (six lambs per treatment). The dietary treatment 1 was control where animals were fed Mulato grass *ad libitum* (M). In treatment 2, 3 and 4, animals were fed Mulato grass *ad libitum* plus *Centrosema pascuorum* (MCP), *Dolichos lab lab* (MDL) and *Clitoria ternatea* (MCT) respectively. All supplement were offered at 1.5% W/d. Drinking water was made available at all time during the experimental period. The duration of experiment was 10 weeks, consisted of 2 and 8 weeks for diet adaptation and variable measurement (feed and water intake,

digestibility and liveweight) period, respectively. Prior to the commencement of the experiment, all animals were injected with Ivomec at the dose of 1 mL per 10 kg weight to control internal and external parasites.

Measurements

During the measurement period, daily feed intake and refusal were recorded, and samples of feed offer and refusals for each lamb was taken. The samples were oven-dried at 60 °C for 72 h and ground to pass a 1 mm screen before chemical analysis. Water intake was measured during the digestibility run by measuring water offered and water refusal each day per lamb. In vivo nutrient digestibility was measured per animal from in vivo nutrient intake and the total amount of faeces excreted that was measured on weeks 8 of the measurement period. Total faecal output of each lamb was recorded daily, mixed and taken 10% for sample and stored separately in a freezer (-4 °C). Similarly, the 24 hour urine output from each lamb was collected, recorded, mixed and taken 10% for sample and stored separately in a refrigerator. The samples collected during seven days for each lamb were bulked at the end of the experiment. Sub-samples of the faeces were then taken, oven-dried at 60 °C to constant weight and ground (1 mm mesh) for later chemical analysis.

Rumen fluid was collected from each lamb on the last day of the experiment, by rumen tube, at 3 and 24 h after the morning feeding. The pH of the rumen liquid was recorded immediately after the collection of liquid. The estimation of ME requirement of lamb (ME_m, MJ/day) was based on the equation from SCIRO

(2007). The estimation of total ME intake (MJ/day) of lamb was calculated by multiplying total DMI (kg/d) with energy content (M/D; MJ/kg DM) of the feed.

Chemical Analyses

Feed offered, feed refusal and faeces collected during digestibility were sampled and the representatives were ground and analysed for dry matter (DM), organic matter (OM) and ether extract content (EE) (AOAC, 1990). Samples were oven-dried at 60°C to obtain a constant weight. Feed offered were also sampled and analysed for neutral detergent fibre (NDF) using the procedures described by Goering and Van Soest (1970). Nitrogen (N) content of the feeds, faeces and urine was determined using the standard micro Kjeldahl method (AOAC, 1990).

Statistical Analysis

Data collected (feed intake, digestibility and ADG of lambs) were analysed as a block randomized design using ANOVA in Genstat Release 11.1 statistical package (GenStat, 2008). Different means across treatment were compared using the Least Significant Differences test (Steel and Torrie, 1980).

Results and Discussions

Feed Composition

The chemical composition of Mulato grass and legume herbs used in this study are presented in Table 1. Neutral detergent fiber content was higher than CP, but EE was lower in Mulato grass than in legume herbs. The rest of the constituents were not significantly different between Mulato grass and legume herbs.

Table 1. The chemical composition of Mulato grass and legume herbs used in the experiment

Feedstuffs	DM ¹ (%)	OM ¹ (% DM)	CP ¹ (% DM)	NDF ¹ (% DM)	EE ¹ (% DM)
Mulato grass	89.89	84.24	9.01	63.66	1.88
<i>Centrosema pascuorum</i>	88.93	83.81	17.54	54.99	3.36
<i>Dolichos lab lab</i>	89.80	86.00	15.41	51.01	3.70
<i>Clitoria ternatea</i>	88.94	80.83	16.89	45.88	3.97

DM = dry matter, OM = organic matter, CP = crude protein, NDF = neutral detergent fibre, EE = ether extract

The average DM and CP intakes of treated lambs are presented in Table 2. None of the supplement allowances was completely consumed by the animals. Supplement DM intake of lamb received MCP, MDL and MCT were 95, 94 and 96% of their total allocation (1.5% W/d), respectively. Supplementation with different legume herbs had a significant ($P<0.05$) CP intakes, but did not significantly affect ($P>0.05$) total DM intake of lamb given Mulato grass (Table 2). The present finding agreed with Marsetyo et al. (2017) on the supplementation of Mulato grass with *Leucaena leucocephala*, *Gliricidia sepium* and *Desmanthus pernambucanus* intake. Lack response of legume herbs supplementation to increase total DM intake may be associated with the substitution of supplement to the basal diet. In the current study, supplementation with CPa, DL and CT resulted in intake depression of Mulato grass at the level of 0.50, 0.52 and 0.52, respectively. This rate of substitution was high compared to previous studies. Marsetyo et al. (2017) for example, reported that supplementation of *Desmanthus pernambucanus*, *Gliricidia sepium* and *Leucaena leucocephala* to basal feed, resulted in the substitution rate of 20, 27 and 26%, respectively for Kacang goat given Mulato grass. Higher substitution rate of the current study

could be associated with higher supplement intake (approximately 1.5% W/d) than in the study of Marsetyo et al. (2017) which was only 1% W/d. Substitution effect is in contrast to the theory that nitrogen-fortified supplement could enhance basal diet intake due to the elevation of microbial activities in the rumen (Poppi et al., 1994; Bayoli et al., 2014; Boval et al., 2014; Hadgu, 2016). However, the physical properties of the supplements often stimulate the depression of basal diet intake (Marsetyo et al., 2012, Allen, 2014; Tedeschi et al., 2019). The bulky nature of the legume herbs used in the current experiment may limit the capacity of the reticulorumen to accommodate more biomass from the basal diet. Marsetyo et al. (2016) reported that the level of substitution of bulky supplement such *Gliricidia sepium* was about double compared to the less bulky supplement such as rice bran.

Legume herbs supplementation had no effect ($P>0.05$) on the amount of water consumed by fat-tailed lamb given Mulato grass (Table 2). Under the experimental condition, the range of water intake of the lambs was 1.432 to 1.594 g/d. The water intake of lambs in the current study is lower than water consumption reported sheep recommended by Primefcat (2014) that ranged from 2 to 4 liter/d.

Table 2. The effect of various legume herb on feed intake, nutrient digestibility, water intake of fat-tailed lamb given Mulato grass

Parameters	Dietary treatments			
	M	MCP	MDL	MCT
DM supplement intake (%W/d)	0.00	1.42	1.41	1.44
DM Mulato grass intake (%W/d)	2.75	1.37	1.43	1.42
Total DM feed intake (% W/d)	2.75	2.79	2.84	2.87
Total CP intake (% W/d)	0.25 ^a	0.37 ^b	0.35 ^b	0.37 ^b
DM digestibility (%)	58.17 ^a	67.48 ^b	64.91 ^b	65.03 ^b
CP digestibility (%)	68.11 ^a	74.58 ^b	72.45 ^b	73.89 ^b
Digestible DM intake (% W/d)	1.60 ^a	1.88 ^b	1.84 ^b	1.86 ^b
Digestible CP intake (% W/d)	0.17 ^a	0.28 ^b	0.25 ^b	0.27 ^b
Drinking water intake (g//d)	1432	1472	1416	1594
Drinking water intake (% W/d)	10.40	10.63	11.37	10.72

M: Mulato grass ad libitum; MCP: M + *Centrosema pascuorum*; MDL: M + *Dolichos lab lab*; and MCT = M + *Clitoria ternatea*, DM: dry matter, OM: organic matter, CP: crude protein, W: weight, d : day
 Means with different superscripts in same row are significantly different ($P<0.05$).

Table 3. Estimated metabolizable energy (ME) intake and ME retention, nitrogen intake and retention, rumen pH and average daily gain of fat-tailed lambs given Mulato grass as single feed and supplemented with various legume herbs

Parameters	Dietary treatments			
	M	MCP	MDL	MCT
Estimated ME intake (MJ ME/d)	3.13	3.84	3.38	3.89
Estimated ME intake (MJ ME/kg W ^{0.75} /d)	0.44 ^a	0.53 ^b	0.51 ^b	0.53 ^b
ME requirement (MJ ME/kg W ^{0.75} /d)	0.43	0.45	0.46	0.46
ME retention (MJ ME/kg W ^{0.75} /d)	0.01 ^a	0.08 ^b	0.05 ^b	0.07 ^b
N intake (g/d)	5.44	8.29	6.97	8.53
N faeces (g/d)	1.23	1.34	0.90	1.02
N urine (g/d)	1.34	1.29	1.05	1.04
N retention (g/d)	2.87 ^a	5.66 ^b	5.02 ^b	6.47 ^b
Ruminal pH 3 h after feeding	6.62	6.63	6.67	6.68
Ruminal pH 24 h after feeding	6.49	6.46	6.52	6.32
Liveweight gain (g/d)	35.67 ^a	58.39 ^b	54.31 ^b	54.41 ^b

M: Mulato grass *ad libitum*; MCP: M + *Centrosema pascuorum*; MDL: M + *Dolichos lablab*; and MCT = M + *Clitoria ternatea*. ME: metabolisable energy, MJ: mega joule, N: nitrogen
 Means with different superscripts in same row are significantly different (P<0.05)

Data of estimated ME intake and ME retention, N intake and retention, rumen pH and ADG of fat-tailed lamb received Mulato grass *ad libitum* and/or supplemented with various legume herbs are presented in Table 3. It appeared in Table 3 that supplementation of legume herbs to Mulato grass as a basal diet significantly increased (P<0.05) estimated ME intake and ME retention, N intake and retention and ADG of fat-tailed lamb. The significant difference in ADG between the control and supplemented lambs may be attributed to increased digestible DM, CP and estimated ME intakes. Data of digestible DM and CP intakes (Table 2) and estimated ME and N retention (Table 3) were significantly higher for supplemented than non-supplemented lambs. This result suggests that supplementation of legume herbs lead to more nutrients (CP and ME; Table 2) available for ADG of the lambs. The three legume herbs as supplement enhanced a similar response in increasing of the ADG of the animals. Supplementation of CPa, DL and CT resulted in a remarkable increase in ME retention and in corresponding with ADG with the value of increase 63.69, 52.26 and 52.54%, respectively from the control treatment. This result is in agreement with previous studies (Golding et al. 2011; Boloyi et

al., 2014; Brown et al., 2015; Obeidat et al., 2019; Phelan et al., 2015; Marsetyo et al. 2016 and 2017, Mekuriaw, and Asmare, 2018) that increasing ME and N retention in the diet from forage legumes was corresponding to the increased ADG of the animal.

The rumen fluid pH in the rumen at two different sampling times (3 and 24 h post-feeding) are presented in Table 3. There was no significant effect (P>0.05) of legume herbs supplementation of lambs fed Mulato grass either at 3 or 24 h post-feeding. The value of rumen fluid pH ranged from 6.62 to 6.68 (3 h post-feeding) and 6.32-6.49 (24 h post-feeding) which is still optimum for microbial protein synthesis (Baloyi et al., 2014).

Conclusions

The growth of fat-tailed lambs given Mulato grass alone was lower than those lambs supplemented with legume herbs such as *Centrosema pascuorum*, *Dolichos lablab* and *Clitoria ternatea*. The increased growth performance of legume herbs supplemented lambs is associated with increased intakes of DM, CP, ME, nutrient digestibilities, ME and N retention which is in association with a high N content of legumes. There were no significant differences among legume herbs species in

total DMI, DMD and ADG of fat-tailed lamb. This study indicated that legume herbs were recommended to enhance low or medium quality basal diets for lambs to increase their growth performance.

Acknowledgements

The authors acknowledge the contribution of the technical assistance of Laboratory of Animal Nutrition at the Department of Animal Sciences of Brawijaya University, and technical assistant at Department of Animal Sciences, Tadulako University. Finally, the authors are grateful to the Indonesian Directorate General of Higher Education for providing fund to this experiment.

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