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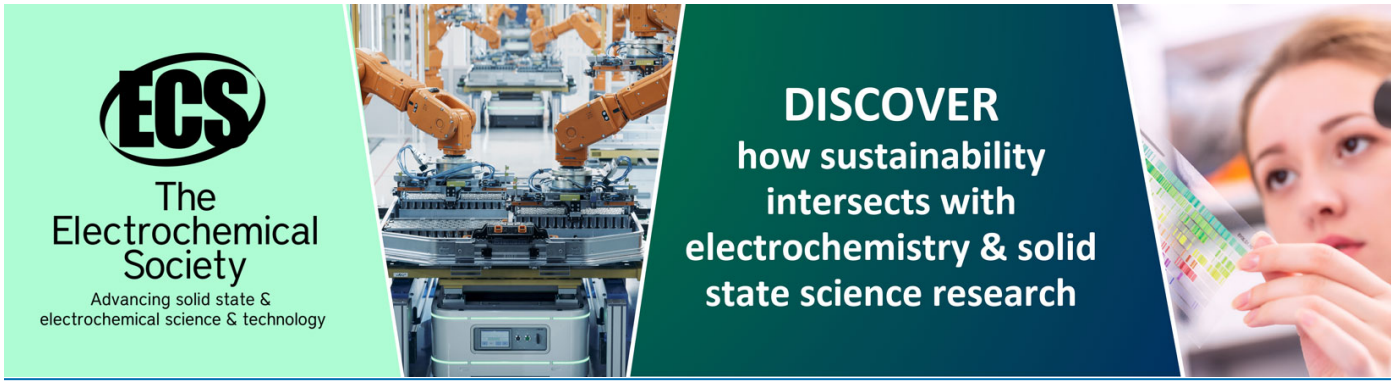

Nitrogen utility on income over feed cost in complete feed napier grass cv gama umami based with different calliandra (*Calliandra calothyrsus*) substitution levels

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Abstract. The purpose of this study was to determine the N efficiency and economics of complete feed based on Napier grass cv Gama umami with different levels of Calliandra (*Calliandra calothyrsus).* The Ewes used in this study were 15 with 11.3±1.34 kg of body weight at the age of 8 months. Complete feed treatment given to livestock objects, namely T0 = Napier grass cv GU 60% + Concentrate 40%; T1 = Napier grass cv GU 45% + Concentrate 40% + Calliandra 15%; T2 = Napier grass cv GU 30% + Concentrate 40% + Calliandra 30%. The sample collection phase consisted of treatment feed, leftover feed, and urine which were collected for seven days. The resulting data was then processed using One-way ANOVA with data that had differences in further testing using DMRT (p<0.05). The experimental results showed that the addition of Calliandra levels in complete feed did not affect nitrogen retention in sheep (p>0.05). Economic figure on feed with the addition of Calliandra to complete feed showed a higher income when compared to feed without using Calliandra (p<0.05). The most effective use of Calliandra level with the highest income is seen in giving as much as 30%.

1. Introduction

Ruminants are known to be less efficient at using nitrogen than other livestock. The process of nitrogen metabolism in ruminants eliminates nitrogen by removing unused nitrogen in ruminant digestion. This can lead to environmental pollution and loss of nutrients that can be used as production precursors. Increased protein levels in meat can be manipulated by either reducing protein breakdown using feed protection or by increasing protein levels by rumen microbes [1]. It is now known that tannins as secondary metabolites of plants, help protect ruminant feed. The ability of tannins differs from polyphenolic compounds to form complex bonds and precipitate proteins.

One of forage plant with high protein containing secondary metabolites of tannin is Calliandra (*Calliandra calothyrsus*). Calliandra has a tannin content of 8.70% and can be used as a protein protectant in ruminant diets [2]. Calliandra has the highest production among forest farmer groups spread across Yogyakarta [3]. The concentration of tannins contained in Calliandra can reduce the production of methane gas as it reduces the digestibility of dry matter and organic matter [4].

The legume supply is not sufficient to meet the other nutritional needs of ruminants. Its limited use limits legumes to further variations in the composition of the diet as a cheap and affordable source of protein. The high fibre content in rumen metabolism can be used as an energy source for ruminants including sheep. The barrier to achieving livestock nutrition with quality ingredients and when needed is availability. One grass with high nutritional content and yield is Napier grass (*Pennisetum purpureum*

cv.), Gamma-irradiated, known as GU grass has the better yield and nutrient composition than local Napier grass [5].

The nutrients in animal feed will be used as a prerequisite for animal performance and energy requirements for daily activities. Feed is the biggest expense, accounting for 60-80% of the total costs required in the sheep farming business. The choice of feed is given not only to meet the nutritional requirements but also an economic issue in sheep production. This study aimed to determine the effect of nitrogen in the diet containing Calliandra with tannins by looking at economic aspects through cost-income parameters of the diet.

2. Materials and methods

2.1. Materials

The livestock objects used in this experiment were 15 ewes of the Thin Tailed Sheep breed with an average weight of 11.3±1.34 kg, the age of the livestock object was about 8 months. The feed ingredients used were Napier grass cv Gamma umami collected in Sleman Regency which was 60 days old; Calliandra collected from Pakem Disctrict with the age of one year; and Commercial concentrate supplied from Merapi Farm with code JF94.

2.2. Methods

The livestock experimental method has been approved by the Ethical Clearance Committee, Faculty of Veterinary Medicine, Universitas Gadjah Mada by letter number 027/EC-FKH/Eks.2022. Ewes were cage for five weeks in metabolic cages, the first stage was in the form of cage and feed adaptation which was carried out for three weeks, and the second stage was an experimental phase for two weeks. Urine collection was carried out in the last week of maintenance. The research was conducted using a completely randomized design with three treatments and five replications. The data were processed using one-way ANOVA, the difference among the mean then further tested with the Duncan Multiple Range Test. The treatment given was in the form of Calliandra substitution on GU grass with the code, T0 = 60% GU grass + 40% concentrate; T1 = 45% GU grass + 40% Concentrate + 15% Calliandra; T3 = 30% GU grass + 40% Concentrate + 30% Calliandra. The treatment feed was given in the form of a total mix ratio according to the needs of DM, which was 3.9% of body weight [6]. Drinking water is provided *ad libitum*, and feeding time is twice a day, namely at 08.00-09.00 and 16.00-17.00. Samples of leftovers fed were taken before feeding then weighed and immediately placed in drying oven (temperature 55°C). Faeces sample was collected after 24 h experimental fed given and weighed, then faeces was dried for four days under the sun. Futhermore the samples were dried in drying oven at 55°C and weighed. Other samples collected were urine and feed samples, feed samples were collected 10% of the total feed given each ewes per day. Urine samples were collected after 24 h feed given. After all the samples were collected, they were analysed using the Khedjal method to determine nitrogen content [7]. Total mix ratio feedstuffs prices were collected from market at the time the study was conducted. Ewes price per kilogram information can be accessed through the Ministry of Agriculture's online market website [8].

Table 1. Nutrient composition of feedstuffs and treatment.

	Nutrient content (%)							
	DM	**OM**	**CP**	**CF**	**EE**	**EFN**	**TDN***	**N**
GU grass	21.10	89.30	14.295	35.55	4.87	34.573	52.440	2.29
Calliandra	34.36	93.89	20.961	29.98	4.22	39.731	69.366	3.35
Concentrate	90.60	91.49	18.13	10.97	6.94	53.00	49.459	

	Nutrient content (%)							
	DM	**OM**	**CP**	**CF**	**EE**	**EFN**	**TDN***	**N**
				Treatments				
T0	23.71	89.167	12.931	24.16	4.51	46.240	51.247	2.07
T1	26.07	90.194	14.259	24.71	3.71	46.516	53.786	2.28
T2	28.87	91.496	15.266	24.03	4.00	50.535	57.121	2.44

*Calculated according Hartadi et al. [9]. T0 = Napier grass cv GU 60% DM + Concentrate 40% DM, T1 = Napier grass cv GU 45% DM + Concentrate 40% DM + Calliandra 15% DM, T2 = Napier grass cv GU 30% DM + Concentrate 40% DM + Calliandra 30% DM.

3. Results and discussion

3.1. Nitrogen utilization

The experimental results show that Calliandra substitution can increase Nitrogen intake in the ration (p<0.05) with no differences between levels of Calliandra, then the data is presented in Table 2 below.

Table 2. Nitrogen utilization of treatment.

	Treatments			*p*- Value
	T0	**T1**	**T2**	
N Intake (g/day)	7.21±1.32^{a}	9.77±0.64^{b}	10.29±0.60^{b}	0.002
N Feces (g/day)	1.97±0.63^{a}	3.49±0.54^{b}	3.54±0.89^{b}	0.018
N Urine (g/day)	0.36±0.09^{a}	0.53±0.12^{b}	0.59±0.10^{b}	0.030
N Retention (g/day)	4.89±0.67	5.75±0.26	6.17±0.92	0.066
Net Nitrogen Utilization (%)	68.11±2.60	58.95±2.46	59.94±7.45	0.083

T0 = Napier grass cv GU 60% DM + Concentrate 40% DM, T1 = Napier grass cv GU 45% DM + Concentrate 40% DM + Calliandra 15% DM, T2 = Napier grass cv GU 30% DM + Concentrate 40% DM + Calliandra 30% DM

Substituting Calliandra for GU grass at different levels did not affect nitrogen retention (p> 0.05). The addition of Calliandra to the complete feed showed a significant difference in urinary and faecal N excretion (p<0.05). Based on the experimental results, the substitution of Calliandra in the complete feed with different concentrations did not affect the utilization of N in ruminants. The N requirement has been met for microbial and animal protein which is then excreted in the faeces and urine, or reused through the animal's saliva [10]. The higher Calliandra ratio, the lower the nitrogen utilization since crude protein intake exceeds the requirement of 10 kg 60 per day thin-tailed sheep breed [11]. The addition of Calliandra is proportional to the N excreted in the faeces. The tannins content of Calliandra bound to proteins in tannins complexes reduces protein degradation in the rumen so that higher N digestion occurs post-rumen and will be excreted in the faeces [12].

3.2. Income over feed cost

The figure results from an economic point of view show that the substitution of Calliandra in GU grass-based complete feed can increase income, with the highest yield being at the level of Calliandra 30%. The calculation results are presented in Table 3.

Table 3. Income over feed cost.

	Treatments			*p*- Value
	T0	**T1**	**T2**	
ADG (g/day)	48.14[b]	105.00[a]	107.86[a]	0.004
Income (Rp/g/day)*	2,648	5,775	5,932	0.004
Feed cost (Rp/g/day)**	2,398	2,479	2,410	0.910
IOFC (Rp/day)	249.60[b]	3295.60[a]	3522.00[a]	0.002

*Based on Rp 55,000/kg [8], **Based price on market (GU Rp1,100/kg; Calliandra Rp2,000/kg; Concentrate Rp3,400/kg). T0 = Napier grass cv GU 60% DM + Concentrate 40% DM, T1 = Napier grass cv GU 45% DM + Concentrate 40% DM + Calliandra 15% DM, T2 = Napier grass cv GU 30% DM + Concentrate 40% DM + Calliandra 30% DM

The experimental results show that there is a significant difference in income with substitution of Calliandra ($p<0.05$) without difference of Calliandra levels. The increased income was due to the higher daily body weight of experimental animals using Calliandra. The higher protein content in feeds using Calliandra is used by cattle as a precursor for meat growth [1]. The use of high tannins feed as a protein protector for ruminants is strongly encouraged as a source of protein to increase animal production, as sometimes the protein source comes from microorganisms. Animals cannot meet protein requirements as a way to increase production. Food materials with appropriate tannin content can be used as sustainable food in production [13]. Another study showed that using Calliandra as a feedstuffs increased milk production from 0.6 to 0.75 kg, thus increasing milk production compared with not using Calliandra [14].

4. Conclusions

The use of Calliandra as a substitute for complete feed based on Napier grass cv GU did not affect nitrogen retention in sheep due to high N supply, although high N excretion in faeces. Calliandra substitution can increase income as indicated by better daily body weight growth results, as well as providing cheap feed for sheep.

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