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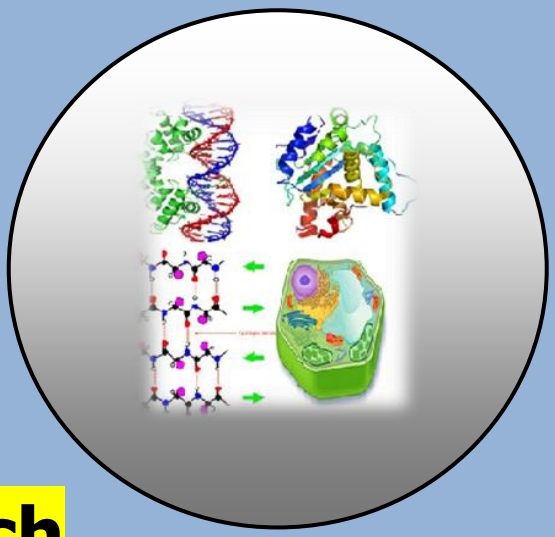

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Feed Utilization Efficiency of Ettawa Grade Goats Fed Rations Containing Different Levels of Forage and Concentrate

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ABSTRACT

This study was aimed to study feed utilization efficiency of Ettawa Grade (PE) goats by providing three types of ration. The randomized block design with 3 treatments and 3 blocks of goat based on body live weight were used in this research. The ration composition was based on dry matter (DM) are: (A) 15% elephant grass + 20% rice straw + 25% glyricidia + 10% caliandra + 30% concentrate; (B) 30% elephant grass + 30% glyricidia + 40% concentrate and (C) 20% elephant grass + 20% glyricidia + 60% concentrate. Parameters measured were feed intake, feed digestibility, weight gain and rumen fermentation products. Data were analyzed by analysis of variance. The results showed that dry matter intake (DMI), organic matter intake (OMI), crude protein intake (CPI) and crude fiber intake (CFI) was significantly (P<0.05) higher in treatment A than treatment B and C. This was because the treatment A showed dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD) and crude fiber digestibility (CFD) highest (P<0.05) in treatment A. Thus, the goat received rations A was most efficiently convert feed into body weight. Feed Convertion Ratio on treatment A was 7.20. FCR treatment B and C are 12.74 and 13.92. Daily weight gain was also highest (P<0.05) at goat recieve treatment A is 78.57 g/day compared to treatment B 32.74 g/day and treatment C 34.52 g/day. Based on these results, it can be concluded that the provision of ration with various forage composition (ration A) with addition of only a little concentrate (30%) will give better results than giving diet that consists of only two types of forage with more concentrate (40-60%).

***Keywords:** Rice Straw, Daily Weight Gain, Digestibility and Nutrient Intake.*

INTRODUCTION

Principal feed ingredients for ruminants are mainly from forage (60-70 %). While the forage production is very limited lately. Generally, rearing of goats in Indonesia is traditionally with provision of forage depend on availability at the time. This is due to fluctuating forage supplies are influenced by season. Giving concentrate on goat rearing traditionally is very limited. The common use of forage is elephant grass and glyricidia. However, during the dry season, it is not infrequently breeders use rice straw.

Utilizing rice straw as ruminant feed also expected to reduce feed costs because nearly 70% of production cost comes from feed costs. Rice straw which is one of agricultural by-products is an important ruminants feed, however, the nutritional values were low, characterized by a high content of crude fiber such as cellulose and hemicellulose, bulky and low crude protein (Lamid *et al*., 2013), its relatively slow rates of fermentation and lack of sufficient nutrients restrict its utilization by rumen microorganisms and consequently by the host animal (Yulistiani *et al.,* 2011). Therefore, the utilization of rice straw needs to be match with local forage as a source of soluble protein in the rumen.

The addition of a local green called "*gamal*" or *glyciridia sepium* to rice straw aims to provide a source of nitrogen for the rumen microorganism's life. The rumen microorganisms, predominately bacteria, protozoa and phycomycete fungi, can secrete a wide range of fibrolytic enzymes (Chen *et al*., 2008). These enzymes, such as avicelase, CMCase, xylanase and cellobiase, account for the primary reactants on dietary carbohydrates and proteins (Santra *et al*., 2007).

The utilization of glyricidia as supplementation for female goat has done by Munier *et al*. (2006), and the result showed, supplemental feeding glyricidia 700 g/day could increase the daily weight gain of female goats 60.43 g/goat. Providing 90% forage (20% grass + 60% glyricidia + 10% hibiscus) and 10% concentrate molamix significantly (P<0,05) improve DMD, OMD, CPD and CFD respectively 11,58%, 16,49%, 35,70% and 39,77% compared with ration consist of 70% grass + 30% concentrate (Cakra *et al*., 2014). The use of feed from forage alone (100%) can still improve livestock productivity, as long as the proportion is set such that the balance of nutrients for livestock physiological needs are met. Forage used should at least consist of forage as a source of energy and protein sources that contain minerals and vitamins needed by livestock.

The objective of this study was to determine the efficiency of Goat rations containing different levels of forage and concentrate.

MATERIAL AND METHODS

Material

A total of nine (9) male goats PE with initial weight range 10-15 kg used in this study and were placed in individual cages .Ration given was a complete ration in mash form consisted of of 3 types. The ration composition is based on dry matter (DM) are: (A) 15% elephant grass + 20% rice straw + 25% glyricidia + 10% caliandra + 30% concentrate; (B) 30% elephant grass + 30% glyricidia + 40% concentrate and (C) 20% elephant grass + 20% glyricidia + 60% concentrate. Rations and drinking water were provided as *ad libitum*.

The research is using Randomized Block Design (RBD) with three types of rations as treatment and 3 body weight groups as replicates. Composition of the diets used in the experiment presented in Table 1.

Method

1. Weight gain

Goats weighing had done every two weeks. Goat's weight gain was obtained by subtracting the initial body weight to the final body weight. Daily live weight gain is a weight gain during the study divided by the length of the study.

2. DMI, OMI, CPI and CFI

DMI obtained by reducing the DM gave with the rest of it.

OMI = total ration intake x % Dry Matter x % OM

CPI = total ration intake x % Dry Matter x % CP

CFI = total ration intake x % Dry Matter x % CF

3. DM Digestibility, OM Digestibility, CP Digestibility and CF Digestibility

a. Dry Matter Digestibility (DMD) :

$$\frac{\text{DMI – Feces Dry Matter}}{\text{DMI}} \text{ X } 100\%$$

b. Organic Matter Digestibility (OMD):

$$\frac{\text{OMI – Organic Matter Feces}}{\text{OMI}} \text{ X } 100\%$$

c. Crude Fiber Digestibility (CFD) :

$$\frac{\text{Crude Fiber Intake – Crude Fiber feces}}{\text{Crude Fiber Intake}} \text{ X } 100\%$$

d. Crude Protein Digestibility (CPD) :

$$\frac{\text{Crude Protein Intake – Crude Protein Feces}}{\text{Crude Protein Intake}} \text{ X } 100\%$$

Data analysis

The data obtained in this study analyzed by analysis of variance. If the results are significantly different ($P<0.05$) between treatments, the analysis followed by orthogonal contrast test at 5% level according to Steel and Torrie (1991).

RESULTS AND DISCUSSION

DMI, OMI, and Nutrient Intake

The highest DMI formed by goats that got treatment A which is 416.69 g/day (Table 2). Goat with treatment B and C, although the rations did not contain rice straw and even containing higher concentrate than Treatment A is not able to make higher DMI. It is similar with OMI. High of OMI made CPI and energy higher.

Ration A contains waste such as rice straw, which has low digestibility, is difficult to digest. However, with the glyricidia leaves on ration A is able to increase the activity of rumen microbes to digest especially rice straw ration so that nutrients contained in it can be utilized. As a result, the DMI and OMI be the highest in goats that received rations A compared with goats that received rations B and C. Ration B and C contain more concentrate than the rations A. However, it is not able to increase DMI, OMI and other nutrients in the ration.

DMI in this study was lower compared with the results of the study of Sutama *et al*. (2006) where the provision of a complete diet containing 35% rice straw fermentation resulted weight gain at 59.2 g/day with a DMI at 438.5 g /day, CPI in goats received treatment A statistically does not showed significant differences (P>0.05) with C. Whereas treatment A containing 20% rice straw and less concentrate (30%) compared to treatment C which does not contain rice straw but contains more concentrate (60%) . This fact informs that the diet containing rice straw can match or even exceeding the quality of the ration without rice straw and contains more concentrate (60%) as long as there is a presence of the protein as a source of RDP in the ration to stimulate the growth and the activity of rumen microbes.

Weight Gain and Feed Conversion Ratio of Goats

Goat showed a better response when given treatment A compared to B and C. Table 3 shows the difference in weight gain produced by the goats who received treatment A (P< 0.05) higher , respectively 139,98% and 127.61% compared to the goats who got treatment B and C.

One of the factors greatly affecting the weight gain was feed intake. The intake of DM, OM, and nutrient (mainly CP and energy) on treatment A is significantly (P <0.05) higher compared with treatment B and C. The weight gain of goats with treatment A in this study is even higher than the results of research conducted by Putra *et al*. (2009) which does not use rice straw but 85% forage in the form of natural grass consist of hibiscus and glyricidia with 15% molamix concentrate on PE goats resulting weight gain 62 g/day with an intake of 451 g/day DM. The growth chart of PE goat presented in Figure 1. Goats that treated with treatment A efficiently convert feed into body weight. This fact supported by a number of FCR. The smaller FCR number, the more efficient livestock change the feed into their body weight. The efficiencies goat with treatment A that change the feed into weight gain is probably due to the palatability of ration A is better than ration B and C. The more diet's component their palatability and quality will be better, because some of the materials can complement each other's shortcomings. That is what happened on ration A. Although forage contains low energy, they are the greatest source of fiber. Dietary fibre is an essential nutrient in feeds and useful for the maintenance of normal rumen function, which has been associated with adequate salivation, optimal pH for cellulolytic microorganisms and energy supply (Wanga *et al*., 2010).

Fiber hold fundamental role in ruminants to maximize Dry Matter Intake (DMI), stimulates chewing activity and fermentation processes in the rumen. DMI will decrease linearly with the decrement of NDF forage content of the feed (Nadeem and Sufyan, 2005).

Digestibility of DM, OM, CP, CF and Ether Extract

The diversity of forage composition in the ration A caused DM digestibility, OM digestibility, CP digestibility and Ether Extract digestibility significantly (P<0.05) higher than treatment B and C where the rations are only consists of elephant grass and gamal even their concentrate is higher than treatment A (Table 4) . In line with the results of Cakra *et al*. (2014), where the provision of diverse forage although concentrate added only 10% were able to increase the digestibility of DM, OM and CP than the provision of only grass field forage although added 30% of concentrate, respectively 60.53% vs 54.25%; 80.46% vs 69.07% and 74.65% vs 55.01%. Similar result was also generated from Ramos *et al*. (2009), that sheep fed diet with forage-concentrate ratio 70:30 has higher DMD and OMD respectively : 50,6% and 58,9% compared with DMD and OMD of sheep fed diet with forage-concentrate ratio 30:70, respectively: 41,7% and 49,5%.

While that, the digestibility of crude fiber did not differ among all treatments. However, CF digestibility at goats with treatment A tends to be the highest (P>0,05) followed by treatment C and B. Although diet A contains lowest concentrate at least (30%) than the other two treatments, diets A also contains waste of rice straw which is containing high crude fiber. Increasing fiber content in diet effectively increases chewing activity resulting in increased saliva flow.

Table 1. Composition of the diets used in the experiment.

Items	Treatments		
	A	B	C
	----------%----------		
Feed Ingredients (DM)			
Elephant grass	15.00	30.00	20.00
Rice straw	20.00	-	-
Glyricidia	25.00	30.00	20.00
Caliandra	10.00	-	-
Consentrate	30.00	40.00	60.00
Total	100.00	100.00	100.00
Nutrient Content			
Energy (kcal/kg)	4099	4002	4164
Crude Protein (%)	13.23	12.23	14.14
Ether Extract (%)	2.09	2.99	2.51
Crude Fiber (%)	20.91	18.34	14.74
TDN (%)	61.99	65.97	67.20

A= 15% elephant grass + 20% rice straw + 25% glyricidia + 10% caliandra + 30% concentrate; B= 30% elephant grass + 30% glyricidia + 40% concentrate and C= 20% elephant grass + 20% glyricidia + 60% concentrate.

Table 2. Dry Matter, Organic Matter and Nutrient Intake.

Intake (g/day)	Ransum Perlakuan			SEM
	A	B	C	
DM	416.69[a]	322.82[b]	378.81[c]	7.7923
OM	363.56[a]	288.44[b]	346.99[a]	14.4794
Energi	1636.24[a]	1330.24[b]	1556.88[a]	36.1251
Crude Protein	55.13[a]	39.48[b]	53.56[a]	3.2191
Crude Fiber	76.13[a]	77.32[a]	59.63[a]	2.009
Crude Fat/Ether Extract	8.72[a]	9.65[a]	9.51[a]	1.9005

Superscripts with different small letters in the same row indicate significant difference (P<0.05)
SEM = "Standard Error of the Treatment Means"

Table 3. Weight Gain and Feed Convertion Ratio.

Parameters	Treatment			SEM
	A	B	C	
Initial weight (kg)	10.67[a]	12.00[a]	12.00[a]	0.5092
Final weight Gain (kg)	15.07[a]	13.83[b]	13.93[b]	0.2117
Weight gain (kg)	4.40[a]	1.83[b]	1.93[b]	0.3203
Daily weight gain (g)	78.57[a]	32.74[b]	34.52[b]	5.0203
Feed Convertion Ratio (FCR)	7.20[b]	12.74[a]	13.92[a]	0.3878

Superscripts with different small letters in the same row indicate significant difference (P<0.05)
SEM = "Standard Error of the Treatment Means

Increasing chewing activity and salivary buffer production are believed to be indicators of improving the dietary effect on rumen health and function (Gencoglu and Turkmen, 2006). Increasing the level of rice straw in the diet leads to an increased dietary neutral detergent fiber (NDF) content. Higher dietary NDF content tends to increase salivation through eating and ruminating, and might benefit the growth of cellulolytic microbes (Lu *et al*., 2005), so increase DMD, OMD, CPD and CFD (Table 4).

Table 4. Nutrient Digestibility.

Parameters	Treatment			SEM
	A	B	C	
	----------%		----------	
Dry matter digestibility (DMD)	76.69[a]	63.59[b]	68.18[b]	1.4215
Organic matter digestibility (OMD)	78.27[a]	67.04[b]	71.25[b]	1.4184
Crude protein digestibility (CPD)	72.84[a]	61.73[b]	72.96[a]	2.0049
Crude fiber digestibility (CFD)	67.13[a]	64.71[a]	65.09[a]	4.9262
Ether extract digestibility (EED)	50.71[a]	44.74[b]	41.49[b]	1.3746

Superscripts with different small letters in the same row indicate significant difference (P<0.05)
SEM = "Standard Error of the Treatment Means"

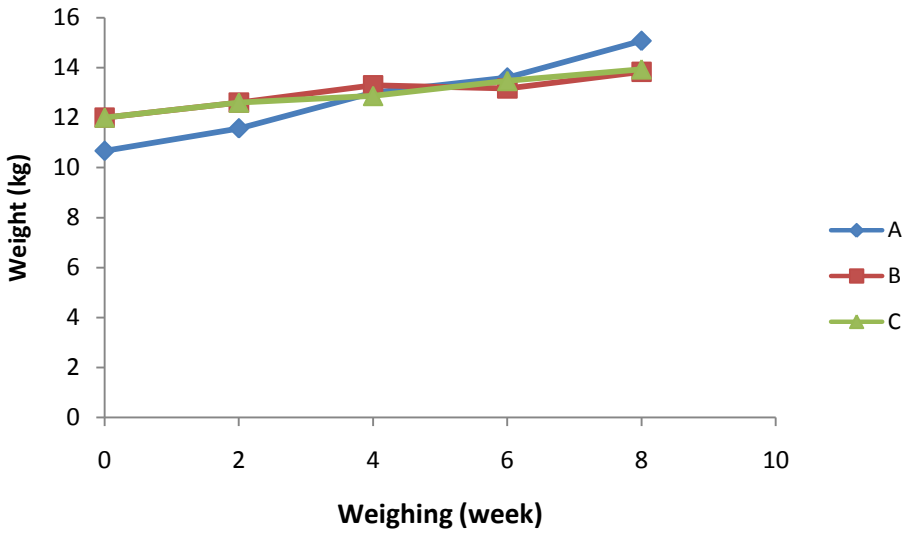

Figure 1. Goat's weight chart every 2 weeks. (A) 15% elephant grass + 20% rice straw + 25% glyricidia + 10% caliandra + 30% concentrate; (B) 30% elephant grass + 30% glyricidia + 40% concentrate and (C) 20% elephant grass + 20% glyricidia + 60% concentrate.

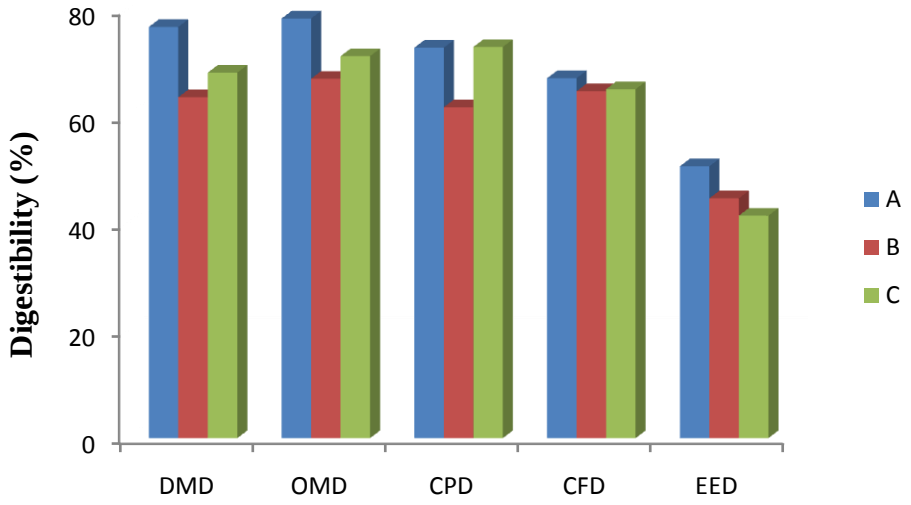

Figure 2. Nutrient Digestibility. (A) 15% elephant grass + 20% rice straw + 25% glyricidia + 10% caliandra + 30% concentrate; (B) 30% elephant grass + 30% glyricidia + 40% concentrate and (C) 20% elephant grass + 20% glyricidia + 60% concentrate. DMD=dry matter digestibility; OMD= organic matter digestibility; CPD=crude protein digestibility; CFD= crude fiber digestibility; EED= ether extract digestibility.

However, with the 20% *glyricidia* as RDP can improve the activity of fiber digesting microbial rumen resulting to the highest CF digestibility.

Treatment B and C contain higher concentrate than A respectively 40% and 60% and contains *glyricidia* at 20% to 30% each. The composition of ration B and C are not able to balance the need of nutrient for rumen microbes so it's resulting lower digestibility than treatment A. Nitrogen generated from *glyricidia* in rations B and C were not utilize to the maximum by rumen microbes. Feed protein degradation will affects fermentation in the rumen and in the end will affect the efficiency of nutrients absorption (Gabler and Heinrichs, 2003). Optimizing protein degradation in the rumen and microbial protein synthesis can suppress the excretion of N that was lost (Reynal and Broderick, 2003). The ultimate objective of the nutrients availability in the rumen is to maximize the utilization of RDP so that microbial growth will also maximum. Maximizing the utilization of RDP will not only increase the supply of amino acids to the small intestine but also improve the utilization of N. N losses can be reduced through the balance of RDP with RUP ratio and improve the utilization of N by microbes (Bach *et al*., 2005).

CONCLUSION

Rations containing rice straw with diverse forage composition (ration A) although the addition of the concentrate is low (30%) will give better results compared with rations which are consist of two types of forage only, even with more concentrate (40-60%). Breeders can utilize rice straw as the component of ruminant feed without processing first. When using rice straw to the level of 20% based on DM of ration, preferably combined with 15% elephant grass as an energy source and 25% *glyricidia*. To get better results, use a variety of forage because the materials can cover each other inadequacies.

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