Effect of dietary Nitrogen and non fiber carbohydrate ratio in diet supplemented with urea limestone mixture on productive performances of growing goats

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Effects of Dietary Nitrogen and Non-Fiber Carbohydrate Ratio in Diet Supplemented with Urea-Limestone Mixture on Productive Performances of Growing Goats

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ABSTRACT

The previous study indicated that the urea-limestone mixture could be an alternative source of nitrogen for ruminant diet. However, the use of the mixture in diet needs a proper level of fermentable carbohydrate (non-fiber carbohydrate/NFC). This study was aimed to examine the effect of dietary N:NFC ratio on productive performances of growing goats. Twelve native male Jawarandhu crossbreds with 20.83 kg of body weight average and aged at 4-6 months were divided into three groups and fed on C12 diet (1:12 of N to NFC ratio, without supplementation of urea-limestone mixture), LU12 diet (1:12 of N:NFC ratio, with urea-limestone mixture supplementation), and LU18 diet (1:18 of N:NFC ratio, with limestone-urea mixture supplementation), respectively. The dietary treatments did not affect the nutrient intakes and nutrient digestibility. The UL 18 diet gave the highest ($P<0.05$) average daily gain, N retention, and feed efficiency. The supplementation of urea-limestone mixture may give the best productive performance of goat when the dietary ratio of N:NFC was 1:18.

Key Words: Urea-Limestone Mixture, Dietary N:NFC Ratio, Performance, Growing Goat

INTRODUCTION

Dietary nitrogen is one of the main factors that influence animal growth. Animals at the stage of growing need sufficient dietary energy and protein supplies. Urea is commonly used as a nitrogen source in ruminant diet. Rapidly release of urea to NH_3 in the rumen may increase nitrogen loss via urine and feces. Delaying the rapid solubility of urea in rumen is necessary to synchronize with the formation of carbon skeleton and energy from dietary carbohydrate in the process of microbial protein synthesis (Cherdthong *et al.* 2014). In addition, a combination of urea with soluble carbohydrate has also been recognized as an important factor to improve ammonia utilization by ruminal microbes. Harahap *et al.* (2017) reported that limestone-urea mixture has a slower ruminal release of nitrogen than urea alone. However, inclusion of limestone-urea mixture as nitrogen source in the ruminant diet needs soluble carbohydrate in a combined form.

Non-fiber carbohydrate (NFC) is used as a measure of dietary soluble carbohydrate. Da-Cheng *et al.* (2013) reported that a diet containing 56% NFC may show clinical signs of subacute ruminal acidosis in ruminant. The NFC level may widely vary in ruminant diets, ranging from 18 to 55% (Zhang *et al.* 2012; Da-Cheng *et al.* 2013; Li *et al.* 2014). A synchronization between utilization of soluble carbohydrate and NH_3 in rumen may improve feed digestibility and animal performances (Soto *et al.* 2014). The aim of this study was to examine the effect of N:NFC ratio in a diet supplemented with limestone-urea mixture on productive performances in growing goats.

MATERIAL AND METHODS

Animal and experimental diet

Twelve native male Jawarandhu crossbred goats having an average body weight of 20.83 kg and aged at 4-6 months old were used in this study. Animals were housed in individual metabolic cages, and drinking water was available continuously. Experimental goats were randomly divided into three groups and fed on C12 diet (1:12 of N:NFC ratio, without supplementation of limestone-urea mixture), LU12 diet (1:12 of N:NFC ratio, with limestone-urea mixture supplementation), and LU18 diet (1:18 of N:NFC ratio, with limestone-urea mixture supplementation), respectively. Both LU12 and LU18 diets were supplemented with limestone-urea mixture at 5% of total feed (Table 1). The limestone-urea mixture was prepared according to previously reported (Harahap *et al.* 2017). Nitrogen and Ca content of limestone-urea mixture product were 10.66 and 35.92%, respectively. The level of NFC in diets was calculated according to Rotger *et al.* (2006).

Table 1. Feed composition

Feedstuff	Dietary treatments		
	C12	LU12	LU18
Feed composition (% DM)			
P. purpureum	45.00	43.00	25.00
Cassava waste	3.00	6.00	33.00
Rice bran	33.80	26.80	18.80
Molasses	1.00	2.00	1.00
Soybean meal	17.00	17.00	17.00
Ur-Lim	0.00	5.00	5.00
Mineral mix	0.20	0.20	0.2.0
Nutrient content (% DM)			
NDF	38.19	35.28	22.56
EE	4.25	3.68	2.97
NFC[1]	26.21	26.68	45.93
CP[2]	12.71	12.06	11.46
N[3]	2.04	2.46	2.36
TDN	62.61	60.19	67.08
N:NFC ratio	1 : 12	1 : 12	1 : 18

[1]NFC non-fiber carbohydrates calculated as: 100 – (NDF + EE+ CP + Ash) (Rotger *et al.* 2006); [2]CP: Analyzed on the base of N feed merely; [3]N: Combined of N feed + N urea-limestone mixture; C12 diet: 1:12 of N to NFC ratio, without supplementation of limestone-urea mixture; LU12 diet: 1:12 of N:NFC ratio, with limestone-urea mixture supplementation; LU18 diet: 1:18 of N:NFC ratio, with limestone-urea mixture supplementation

Sample collection and analysis

The study was conducted for nine weeks of observation period. After eight weeks of adaptations to experimental diet and environment, each goat was subjected to seven days of the sampling collection period. The daily amount of feed intake and excretions of feces and urine were recorded to estimate feed digestibility and nitrogen retention in experimental goats. Body weight of each goat was measured every two weeks throughout nine weeks of observation. The performance productions of experimental goats were observed on the basis of intake and digestibility of experimental diet, feed efficiency, nitrogen retention, and body weight gain.

The proximate component content of experimental diet, feces, and urine was determined according to the methods of AOAC (1990). Data were tested using one way analyze of variance and continued by Duncan's multiple range test.

RESULTS AND DISCUSSION

Nutrient intake and digestibility

The dietary treatments did not effect on intake of dry matter (DM), crude protein (CP), nitrogen (N), and total digestible nutrient (TDN). In this experiment, the highest level of dietary NFC was 46% (LU18 diet), and this diet did not effect on nutrient intake (Table 2). Da-Cheng *et al.* (2013) reported that animals start to lose appetite when the level of dietary NFC is 56% because it tends to produce sub-acute ruminal acidosis (SARA). The SARA is commonly occurred by decreasing rumen pH in undesirable value. The excessive non-structural carbohydrates intake and inadequate fiber intake of animals are the main factors to tend a SARA condition (Li *et al.* 2014).

Table 2. Results of experiment

Variables	Dietary treatments			P value
	C12	LU12	LU18	
Daily intake (g/BW$^{0.75}$)				
Dry matter	64.11±6.85	58.42±13.91	61.66±12.83	0.67
Crude protein	8.15±0.87	7.05±2.28	7.07±1.47	0.31
Nitrogen	1.30±0.13	1.44±0.46	1.46±0.30	0.59
Total digestible nutrient	40.14±4.29	35.17±11.38	41.37±8.61	0.31
Digestability (%)				
Dry matter	61.59±7.43	70.06±11.85	69.37±12.60	0.63
Organic matter	63.19±7.48	72.86±10.76	71.55±11.86	0.52
Crude protein	55.92±8.64	67.29±13.55	67.30±13.30	0.47
Daily N retention (g)	2.95±1.16^{b}	4.07±1.17^{ab}	4.51±1.43^{a}	0.05
Feed efficiency (%)	12.44±3.08^{b}	18.91±3.85^{ab}	23.50±4.94^{a}	0.04
Average daily gain (g)	73.58±20.58^{b}	103.33±15.27^{b}	142.86±20.84^{a}	0.01

^{a,b}P<0.05; C12 diet: 1:12 of N to NFC ratio, without supplementation of limestone-urea mixture; LU12 diet: 1:12 of N:NFC ratio, with limestone-urea mixture supplementation; LU18 diet: 1:18 of N:NFC ratio, with limestone-urea mixture supplementation

The digestibilities of feed dry matter, organic matter, and crude protein were unaffected by treatment of dietary N:NFC ratio. As the result, nutrient digestibility of the C12 diet (control) was similar to the diet that of LU12 and LU18 diets (supplemented with limestone-urea mixture). Harahap *et al.* (2017) reported inclusion of limestone-urea mixture as nitrogen source in the diet requires soluble carbohydrate in combined form. The treatment of dietary N:NFC ratio increased ($P<0.05$) nitrogen retention, though there was no different result in dietary protein digestibility. In other words, increasing nitrogen retention linearly as increasing N:NFC ratio up to 1:18. This means that the rumen microbes utilize more available NH_3 and carbon skeleton from better synchronization of dietary N and carbohydrate degradation in the rumen. Holder *et al.* (2015) reported urinary N excretion is mainly driven by N intake, fermentability of dietary nitrogen and the ability of microbes to use more NH_3 in the rumen. Improving synchrony of carbohydrate and N degradation in the rumen would result more efficient utilization dietary protein (Spanghero *et al.* 2017).

The treatment of dietary N:NFC ratio increased ($P<0.05$) feed efficiency (Table 2). The dietary treatment improved N retention which in turn increasing daily gain of goats, and this reflected better dietary N utilization at N:NFC ratio at 1:18.

CONCLUSION

The supplementation of limestone-urea mixture in diet with N:NFC ratio at 1:18 would give better productive performances of goats than the control diet. Further study is needed to clarify protein metabolism in goat fed on a diet supplemented with limestone-urea mixture.

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