Higher TDN level increase N excretion in Kacang Goats

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Abstract. The aim of this study was to evaluate the correlation between nitrogen intake and nitrogen excretion in different total digestible nutrients (TDN) level. Thirty five heads of male Kacang goats were used and fed by two different levels of TDN (60% and 65%). Feces and urine from all goats were collected separately, then analyzed to get the percentage of crude protein. The parameters measured were N intake, N feces, N urine, and N total and calculated in weight (g/day). The data was analyzed by linear regression to determine the correlation and equation between N intake and N excretion, then evaluated by t-test. The result showed that N intake was significant different and had a negative strong correlation with N feces and N total (-0.73 and -0.68, respectively) in TDN 60%, while positive strong correlation with N feces and N total (0.75 and 0.67, respectively) in TDN 65%. The higher nitrogen intake increased N urine either in TDN 60% or 65% (r = 0.27 and r = 0.45, respectively). TDN 60% in feed reduced N excretion with the increase of N intake. Based on the results of this study, it can be concluded that TDN 60% gave the lower N excretion in high N intake than TDN 70%.

1. Introduction

Goats contribute to global warming through the emission of ammonia (NH_3) and nitrous oxide (N_2O) to the environment. N_2O is an important greenhouse gases with 310 times more potent the global warming than CO_2 [1]. The main source of N_2O is connected to the nitrogen (N) release from animals [2]. The N release from goats is defined as the amount of N excreted from urine and feces. The amount of N excreted as manure by animal is varied depending on the amount of N intake [3].

One of limiting factors that affect N intake is Total Digestible Nutrients (TDN) content in the diet. The availability of TDN is used for rumen microorganism growth in order to utilize protein. However, if the N requirement of rumen microorganism has met, the excess of nitrogen wasted through N excretion because of energy spilling reactions [4]. These excessive supply of feeds results in increase feces and urine N excretion [5]. Therefore, the amount of TDN contributes to optimize the efficiency of microbial utilization of N need to be calculated. This study was aimed to evaluate the correlation between N intake and N excretion in different level of TDN.

2. Materials and methods

2.1. Animals

Thirty five heads of male Kacang goats (3 to 6 months) with initial body weight (BW) 10 – 15 kg were used in this study. They were fed by two different levels of total digestible nutrients (TDN; 60% and

65%) with average level of crude protein (CP) 12 – 16%. Diets were offered at 3.5% of BW to reach the requirements. All goats were kept in individual cage and given free access of water.

2.2. Sampling method

The experimental period lasted for 3 months with 1 week for total collection sampling period. During sampling phase, the feces and urine per day from each goat was collected separately. The feces were collected using a plastic zip, while the urine using a filter funnel connected to a plastic tube. Both of feces and urine were sprayed with 20% of H_2SO_4. Each feces and urine was weighed and sampled for analyzing crude protein (CP). The N of feces and urine were calculated on weight (g/day) by dividing each CP of feces and urine (g/day) with 6.25. Dry matter intake (DMI) was also measured daily during total collection period, then calculate the N intake (g/day). The parameters measured were N intake, N feces, N urine, and N total (comprises of N feces and N urine).

2.3. Statistical analysis

The data was analyzed by linear regression to determine the correlation and equation between N intake and N excretion. The strength of correlation coefficient was evaluated by the value of Residual standard deviation or standard error of prediction [6], while the accuracy of the equation of regression was evaluated by t-test.

3. Results and discussion

The correlation between N intake and N feces is presented in figure 1. N intake in TDN 60% was negatively correlated with N feces, while in TDN 65%, N intake was positively correlated with N feces. Both of N feces in TDN 60% and 65% had a significantly ($p<0.05$) strong correlation with N intake, being -0.73 and 0.75, respectively (table 1). The increase of N intake in TDN 60% decreased the N feces. This result caused by microbial degradation in the rumen can utilize the available of nitrogen intake well at TDN 60%. It was confirmed that the balance of TDN and protein in the diet increased rumen microbial growth that will support the fermentation and feed utilization [7]. The increase of N feces in TDN 65% was caused by the excess of TDN level for utilizing the protein. If the N requirement of rumen microorganism has met, the excess of nitrogen waste through N excretion because of energy spilling reactions [4].

Table 1. The equation regression of N intake and N excretion in Kacang Goat.

Variable	Equation	r	R^2	SE	P-value
N Feces 60%	y = -0.5947x + 20.927	-0.73	0.53	2.137	0.011
N Feces 65%	y = 0.3195x - 0.1464	0.75	0.57	0.509	0.000
N Urine 60%	y = 0.0826x + 1.6755	0.27	0.07	0.418	0.426
N Urine 65%	y = 0.2093x + 0.5858	0.45	0.20	0.452	0.027
N Total 60%	y = -0.5121x + 22.603	-0.68	0.46	1.977	0.022
N Total 65%	y = 0.5288x + 0.4394	0.67	0.45	0.951	0.000

The correlation between N intake and N urine is presented in figure 2 that showed the positive correlation in both levels of TDN. Based on the data showed in table 2, N intake in TDN 60% and 65% had medium correlation with N urine (0.27 and 0.45 respectively), but the significant value only found in TDN 65% ($p<0.05$). Although the increase of N intake slightly increased N in urine, the correlation of N intake and N urine at TDN 60% was not significantly different ($p>0.05$).

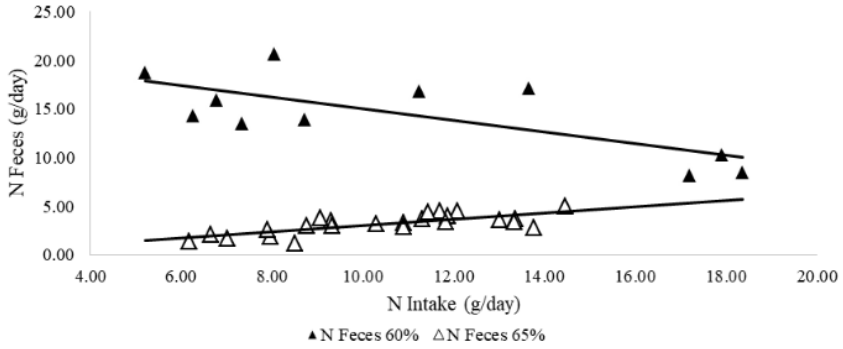

Figure 1. The correlation between N intake (g/day) and N feces (g/day) in Kacang Goat.

This result can be caused by the nitrogen was well utilized by rumen microorganisms in TDN 60%. The synchronous diet increased the efficiency of microbial protein synthesis by capturing N for their growth, and reduced N excretion [8]. In 65% level of TDN may occur the imbalance of energy and protein that resulted in an inefficient use of nitrogen. When dietary is in excess of the amount required by rumen microorganisms, the excessive is degraded to ammonia N, absorbed, metabolized to urea in the liver and lost in the urine [5].

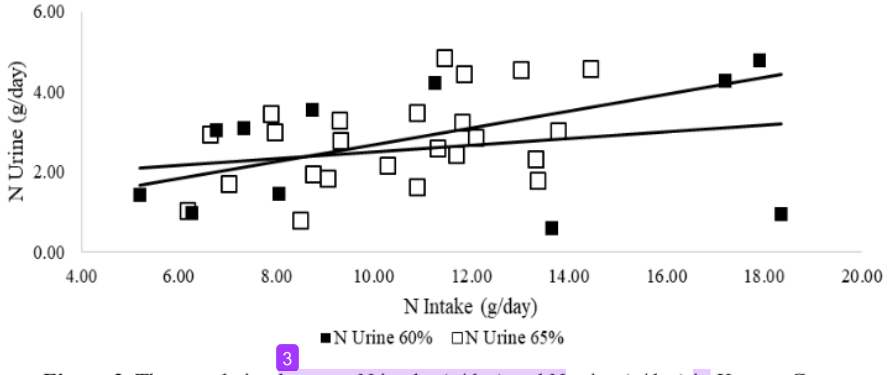

Figure 2. The correlation between N intake (g/day) and N urine (g/day) in Kacang Goat.

Figure 3 showed the strong negative correlation between N intake and N excretion total at TDN 60%, while at TDN 65%, the result showed positively correlated. The correlation value in TDN 60% and TDN 65% were -0.68 and 0.67, respectively (table 2). The significant value ($p<0.05$) in both level of TDN presented that the increase of N intake at TDN level 60% reduced N total excreted, while at 65% level of TDN, the increase of N intake increased N excretion. Considering that the average of protein used in this study was 14%, TDN 65% may not support the rumen microorganisms to utilize the nitrogen. The total amount of microbial protein flowing to the small intestine depends on energy and protein availability and efficiency of use of these nutrients by ruminal bacteria [9]. The excess of nitrogen was excreted through urine and feces.

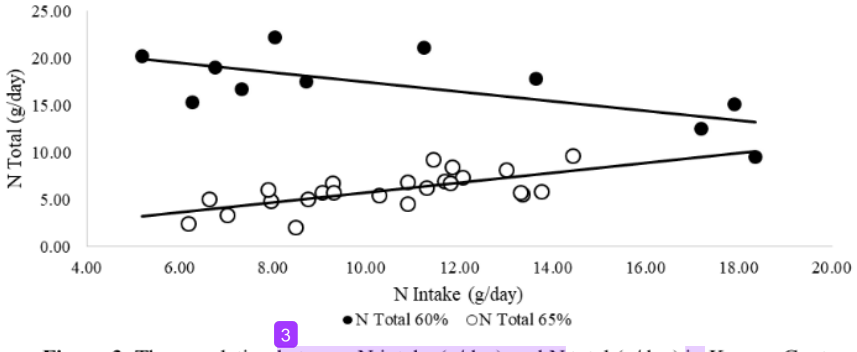

Figure 3. The correlation between N intake (g/day) and N total (g/day) in Kacang Goat.

Conclusion

Based on the results of this study, it can be concluded that the increase of N intake in TDN 60% reduce N excretion in feces and urine. It showed that the balance of energy and nitrogen must be appropriate to enhance microbial protein synthesis in the rumen to utilize nitrogen.

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