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ABSTRACT

An experiment was carried out to study to the role of urea lime mixture in concentrate containing cassava on the rumen fermentation of the etawah crossbred goat through *in-vivo* experiment. A randomized block design (RBD) consisted of 4 different rations and 4 replicates was used in this experiment. Atotal of 16 etawah crossbred goats with initial body weight ranging from 12.4 - 19 kg were aranged in to 16 pens experiment. Four feed treatments (A, B, C and D) were offered to four groups of four goats. The first treatment (A) was 50% elephant grass 50% concentrate (without cassava urea lime) as control diet, the second treatment (B) was 50% elephant grass 50% concentrate (without cassava, with 4% urea and 2% lime), the third treatment (C) was 50% elephant grass 50% concentrate (with 25% cassava, 4% urea and 2% lime), and fourth treatment (D) was 50% elephant grass 50% concentrate (with 50% cassava, 4% urea and 2% lime). Ration was composed based on standard requirement of 15 kg body weight goat with 75 g daily weight gain. Results of This study showed that the concentration of NH_3, VFA, propionic acid, and protozoa rumen population on treatment A, B, C, and D were significantly different (p<0,05). It can be concluded that Utilization of 4% urea and 2% lime without cassava in concentrate increased N-NH_3 level of rumen fluid, but level of N-NH_3 rumen fluid on goat fed with 4% urea and 2% lime in concentrate contain 25 and 50% cassava was not increase, compared to thoset fed controled (treatment A). Propionic acid level and rumen protozoa population could be increased through urea lime and cassava addition in concentrate.

Keyword: *urea-lime, cassava, rumen fermentation, etawah crossbred goat*

INTRODUCTION

Balance supply of N-protein and energy are derived from feed fermentation in order to support rumen microbe for maximizing protein availability which later will be degraded in rumen and increase protein efficiency of the feed. The demand of rumen microbe is approximately 80% of protein or nitrogen which is obtained through ammonia concentration (Leng and Nolan, 1984). Urea supplementation could be used as nitrogen sources, however, urea could rapidly release nitrogen and produce ammonia in the rumen . This could caused a bad impact or toxicity and even death in case of excessive dosages are given to ruminants (Stanton and Whittier, 2006). Huntington *et al.,* (2006) reported that urea rapidly hydrolyzed and release in the rumen and ammonia reached its peak production after offered to ruminant with in one hour. It is more efficient and safe to use ammonia slow released method derived from urea slow releasing N in rumen because this will prevent against ammonia toxicity (Galo *et al.,* 2003). Cherdtong *et al.,* (2011) found that supplementation of urea-CaSO4 mixture in concentrate containing 70% cassava could improved rumen ecology and increased protein rumen microbe in beef cattle.

The efisiency of urea utilization in ration needs energy or carbohydrate source which is soluble or available in the rumen since balancing of energy (VFA) and nitrogen ($N\text{-}NH_3$) are needed for optimum microbial protein synthesized. In general, molasses is used as source of carbohydrate but it is too expensive and rarely available in Bali. In that case, an alternative source of carbohydrate such as cassava should be considered in the future. Chanjula *et al*. (2004) found that synchronization of using urea and starch derived from cassava or corn in dairy cow ration resulting in no different respons to the productive performance of dairy cows. According to Rosegrant, and Gerpacio (1979) starch content in cassava (48,89%) was higher than corn (45,35%), therefore cassava could be used as an potential energy source in goat feed. It present there is no information available about the optimum balance of urea-lime to slow the release of N urea in etawah crosbred goat ration. A study the role of urea lime mixture in concentrate containing different level of cassava on rumen fermentation of etawah crosbred goat is needed to be carried out.

MATERIALS AND METHODS

Sixteen etawah crossbred goats with initial body weight range from 12.4 to 19.0 kg were used in this *in-vivo* study. The animals were randomly assigned in to 16 groups of four treatments and four replicates. Four different rations were offered as feed treatments (A, B, C and D) to the four respective groups. The first treatment (A) was 50% elephant grass 50% concentrate (wthout cassava urea lime) as control diet, the second treatment (B) was 50% elephant grass 50% concentrate (wthout cassava, with 4% urea and 2% lime). The third treatment (C) was 50% elephant grass 50% concentrate (with 25% cassava, 4% urea and 2% lime), and the treatment D was 50% elephant grass 50% concentrate (with 50% cassava, 4% urea and 2% lime). Ration was made according to standard requirement of 15 kg body weight with 75 g daily weight gain (Kearl, 1982).

Procedures and Variables Observation. Rumen fermentation such as: pH, NH_3 were measured using Spectrofotometer according to Solorzano (1969), total VFA with steam distilling (GLP, 1996), partial VFA with chromatography gas technique, and methane gas following the methode explained by Ørskov and Ryle (1990). Rumen microbiology such as: protozoa population was counted fallowing the model of Ogimoto and Imai (1981).

Table 1. Composition and nutrient content of concentrate (*in-vivo* experiment)

Feed components (%)	Concentrates A	Concentrates B	Concentrates C	Concentrates D	Elephan Grass
Cassava	0,00	0,00	25,00	50,00	-
Pollard	29,80	24,80	12,80	12,80	-
Soybean hull	25,00	25,00	25,00	25,00	-
Ricebran	41,00	40,00	27,00	2,00	-
Molasses	2,00	2,00	2,00	2,00	-
Urea	0,00	4,00	4,00	4,00	-
Lime	0,00	2,00	2,00	2,00	-
Salt	2,00	2,00	2,00	2,00	-
Vitamin Mineral	0,20	0,20	0,20	0,20	-
TOTAL	100,00	100,00	100,00	100,00	-
Nutrient contents (%)					
Dry Matter	90,2789	92,4208	91,9213	88,5462	98,2871
Crude Protein	14,3664	25,9614	23,5431	22,4767	8,9664
Ether Extract	4,3506	4,1887	3,8053	1,7033	1,7308
Crude Fiber	19,8096	15,4534	9,2115	6,8772	30,6123
Gros Energy /GE (kcal/g)	3,9835	3,6301	4,1741	4,2943	3,7585

Note:
A= Concentrate (without cassava, urea and lime) as control diet.
B= Concentrate (without cassava, with 4% urea and 2% lime).
C= Concentrate (with 25% cassava, 4% urea and 2% lime).
D= Concentrate (with 50% cassava, 4% urea and 2% lime).

All data collected then were analyzed using analyis of variances (steel and and Torrie, 1986), and whenever significant different between means was found analysis was continued using Duncan’s Multiple Range Test.

RESULTS AND DISCUSSION

Results of the experiment are presented in Table 2. Rumen pH, non glukogenic ratio (NGR), acetic acid, butyric acid and methan gas production, were not affected by treatment. However, rumen NH_3-N concentration was the highest in treatment B, total VFA concentration in treatment C and D was significantly ($p<0.05$) higher than A (control), but not significantly different when compared to the goat on B treatment. Concentartion of propionic acid in treatment D were the highest compared to other treatments. Protozoa population in treatment C and D were higher than treatment A and B. In addition, the results of this research showed that NH_3 level in treatment A, B, C, and D were 11.66; 19.42; 17.11, and 11.75 mM respectively. The analysis of variances showed that NH_3 level on treatment D was significantly lower ($P<0.05$) compared to those in treatment B, but not significant ($P>0.05$) compared to the goat on treatment A. It was indicated that the present of cassava in treatment D could provide carbohydrate and energy sources to form rumen microbe and excessive NH_3 had no bad effect on goat. In contrast, NH_3 concentration in treatment B was significantly higher compared to treatment A and D but not significantly different compared to treatment C. It was observed that supplementation of urea-lime without supplementation of cassava caused an excessive of NH_3 in the rumen.

Table 2 Effect of offering urea-lime and cassava on rumen fermentation product of etawah crosbred goats

Variables	Treatments				
	A[1)]	B	C	D	SEM[3)]
Ruminal pH	6,50 [a2)]	6,70 [a]	6,60 [a]	6,57[a]	0,07
Non Glucogenic Ratio	4,60[a]	4,25[a]	4,01[a]	3,71[a]	0,30
NH_3-N (mM)	11,66[b]	19,42[a]	17,11[ab]	11,75[b]	1,76
Total VFA (mM)	99,66 [b]	120,09 [ab]	138,92 [a]	152,39 [a]	10,97
Acetic acid/C2 (mM)	66,01[a]	77,02 [a]	88,15 [a]	92,76 [a]	6,81
Propionic acid/C3 (mM)	19,94[c]	25,79 [bc]	30,76 [ab]	36,59 [a]	3,06
Butyric acid/C4 (mM)	12,53[a]	14,48[a]	17,71[a]	20,69 [a]	2,42
C2:C3	3,32 [a]	3,09 [a]	2,86 [ab]	2,56 [b]	0,15
Methan gas production (mM)	34,63[a]	39,40[a]	45,24[a]	47,59 [a]	3,65
Protozoa (x 10^5 /ml)	5,93[c]	6,13[b]	6,34[a]	6,41[a]	0,03

Note:
1) A= 50% elephant grass + 50% concentrate (without cassava urea lime) as control diet.
B= 50% elephant grass + 50% concentrate (without cassava, with 4% urea and 2% lime).
C= 50% elephant grass + 50% concentrate (with 25% cassava, 4% urea and 2% lime).

D= 50% elephant grass + 50% concentrate (with 50% cassava, 4% urea and 2% lime).
2) Average values in the same rows was the same letter are not significantl (P>0,05)
3) SEM = “Standard Erorr of the Treatment Means”.

Fluctuation of VFA and NH_3 levels in rumen was mainly used as an indicator which caused rumen activity alteration. The main components of VFA were acetic (C2), propionate (C3), and butyric acids (C4). VFA production was a product resulted from microbe of rumen activity (Van Soest, 1994).

VFA production is essential to understand the process of carbohydrate fermentation and related to the animal productivity since most of VFA in rumen derived from carbohydrate feed fermentation (Hungate, 1966). The total average of VFA rumen fluid in treatment A, B, C, and D were 99.66; 120.09; 138.92; and 152.39 mM respectively as shown in Table 2. Analysis of variance showed that VFA in treatment C and D were significantly higher ($p<0.05$) compared to treatment A but not significantly different compared to treatment B. High VFA level of rumen fluid in treatment C and D showed that increased of feed degradability by rumen microbe. This was caused by the balance of NH_3 and VFA rumen in used by microbe. In addition, high level of VFA also indicated that the increased of organic matter digestibility. Substrate of organic matter (starch, cellulose, and hemicellulose) was fermented by rumen microbe to produce fermentation products such as organic acids (C2, C3, C4, CH4) and CO_2.

Acetic acid and propionic acid ratio (C2/C3) is usually to determine the efficiency of energy utilization in ruminant. Acetic acid is a non glucogenic compound and most body tissues could oxidate them because after being absorbed they were directly burn or not accumulated. Oxidation of asetic acid caused high heat increament then low efficiency in animals. To the contrary, propionate (C3) is a sugar precursor compound or main prospective glucogenic (Susanti *et al.*, 2001). McDonald *et al.*, (1988) stated that if C2/C3 ratio is high so there will be an increase of milk fat level, however, if C2/C3 ratio decreased so milk fat level will also decreased. Low ratio of C2/C3 will stimulate fat formation to the animal. Table 2 secorred that C2/C3 ratio of the treatments A, B, C and D were 3.32; 3.09; 2.86; and 2.56 respectively. The analysis of variances showed that average of C2/C3 ratio on treatment D was significantly lower compared to A and B treatments, but not significantly different than C treatment. It showed that proportion of propionate level on D treatment was higher compared to other treatments. High propionate concentration gave a significant benefit to growth of etawah crosbred goats

Besides VFA product, feed efficiency of ruminant could also be observed from methane gas (CH_4) as the final product of fermentation activity in rumen and derived from H_2 and CO_2 through a proses methanogenic by rumen bacteria. McDonald et al. (1988) stated that the higher methane produced, could cause feed inefficciency. The whole treatments of average methane production in all treatments were not significantly different (Table 2). It was showed that supplementation of urea-lime and cassava in treatment did not gave any significant effect to methane gas production.

CONCLUSION

The mixture of 4% urea and 2% lime in concentrate was optimum level to inhibit NH_3 released from urea hydrolysis in vitro. Utilization of 4% urea and 2% lime without cassava in concentrate could increase level of N-NH_3 rumen fluid, but level of N-NH_3 rumen fluid on goat fed with 4% urea and 2% lime in concentrate contain 25-50% cassava did not increase. Rumen Propionic acid level and rumen protozoa population could be increased through urea lime and cassava addition in concentrate.

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