Effect of Energy and Protein Contents of Dietary Having the Same Synchrony Index on Local Beef Cattle Performance

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Abstract

Macronutrients such as energy and protein affect rumen microbial growth and efficiency of microbial protein synthesis which can be increased by synchronizing energy and N-protein released in the rumen. The experiments were conducted to study the optimum energy and protein content of diet that were synchronized in releasing energy and N-protein in the rumen of native beef cattle. Randomized block design with a factorial of 3 x 2 was used in this experiment. The first factor was three diferent crude protein (CP) levels i.e. 10, 12, and 14 %; the second factor was two deferent levels of TDN (total digestible nutrients) (65 and 70 %). Eighteen local cattles were arranged into three groups on the basis of average body weight of the animals. Each group was fed six types of diet that was different in levels of CP or TDN. The diets had the same synchrony index, namely 0.560. The results showed that, with the exception of crude fat digestion, there was no effects of interaction between protein and energy on variables measured. Compared to diet with 70% TDN, diet with 65% TDN produced higher rumen microbial N, consumption and digestion of nutrients, and N retention (P<0.05). Diet with protein level of 12% tend to have better allantoin concentration in the urine, consumption and digestion of nutrients, N retention and blood urea nitrogen (BUN) than that of 10% or 14%. It can be concluded that the diet having 65% TDN and 12% protein with synchrony index of 0.560 generate more efficient N synthesis of rumen microbes and average daily gain of local cattle.

Keywords: synchrony index, degradation, N retention, intake of nutrients, digestion

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Introduction

The intentions of synchronizing the release of N and energy from diets in the rumen are to maximize microbial protein synthesis from the capture rumen degradable protein (RDP), to reduce the requirement for expensive undegradable protein (UDP), to minimize losses of ammonia from the rumen, and to minimize energy cost for converting the excess ammonia into urea and for excreting urea in urine, and to improve animal performance (Sinclair *et al*, 1993; Gustafsson *et al*, 2006).

The available energy in the rumen (ruminally degradable organic matter) is the most limiting factor for ruminal N utilization (Shabi *et al*, 1998). But these may need to take second place when looking at more recent finding (Block, 2006). Maeng *et al*. (1999) demonstrated that supply of crude protein (CP) or nitrogen improved microbial efficiency to greater extent than did either fiber or starch.

The experiments were conducted to study the optimum energy and protein content of diet that were synchronized in releasing energy and N-protein in the rumen of native beef cattle (sapi pesisir)

Materials and Methods

The feedstuffs used to formulate the treatment diet were presented in Table 1. The rumen-fistulated cattle was used to determine ruminal degradability coefficient of organic matter (OM) and protein of the feedstuff, namely by mean of the equation: $p= a + b\ (1- e^{-ct})$ (Orskov and McDonald, 1979); where p= the amount degraded at *t* time; *a*= the rapidly soluble fraction; *b*= potentially degradable fraction; *c*= the rate of degradation of fraction *b*; and *t*= time (h). From hourly quantity of OM and protein degraded, a synchrony index of nitrogen to organic matter was then calculated by the following equation:

Synchrony Index=

$$\frac{25 - \sum_{1-24} \frac{\sqrt{(25 - hourlyN/OM)^2}}{24}}{25}$$

(Sinclair *et al.* 1993), where 25= 25 g N/kg organic matter trully digested in the rumen.

Table 1. Chemical composition and sinchrony index of feedstuff (%)

	Field grass	Rice brand	Corn meal	Coconut peal	Fish meal
Dry matter (DM)	35.6	87.8	85.8	89.2	87.2
Organic matter (OM)	94.3	90.8	99.1	79.7	59.8
Crude protein (CP)	10.2	13.0	7.7	17.6	22.7
Crude fiber (CF), %	27.8	11.6	0.9	9.7	11.2
Ether extract (EE), %	2.0	8.6	3.5	9.7	3.4
Total digestible nutrients (TDN), %	63.7	66.8	81.9	65.3	12.3
Sinchrony index[1)]	0.538	0.277	0.660	0.827	-0.167

[1)] synchrony index is calculated according to Sinclair *et al.* (1993) modified by Hermon *et al*. (2008) concerning efficiency of microbial protein synthesis in the rumen to be 20g N/kg OM fermented.

Table 2. Composition and sinchrony index of treatment diets (% of DM)

	10P65E	10P70E	12P65E	12P70E	14P65E	14P70E
Field grass	86.3	43.4	32.9	22.2	13.2	9.0
Rice brand	-	6.3	6.1	23.1	21.7	32.6
Corn meal	6.7	38.0	28.3	29.1	20.0	19.0
Coconut peal	6.5	8.1	23.7	23.0	37.6	36.8
Fish meal	0.01	3.7	8.5	2.1	7.0	2.2
Mineral	0.5	0.5	0.5	0.5	0.5	0.5
OM	93.1	93.0	88.6	90.3	86.1	87.5
CP	10.4	10.4	12.4	12.0	13.9	13.6
CF	24.7	14.3	13.4	11.6	10.8	10.3
EE	2.6	3.6	4.7	5.7	6.7	7.3
TDN	64.7	68.5	64.7	68.6	64.7	67.3
Sinchrony index[1)]	0.562	0.562	0.562	0.562	0.562	0.564

10P65E= diet of 10%CP, 65% TDN; 10P70E= diet of 10%CP, 70%TDN; 12P65E= diet of 12%CP, 65%TDN; 12P70E= diet of 12%CP, 70%TDN; 14P65E= diet of 14%CP, 65%TDN; 14P70E= diet of 14%CP, 70%TDN.

Six treatment diets prepared following the randomized block design of a 2 x 3 factorial (Table 2). The first factor is the level of TDN in diets, namely 65 and 70%. The second factor is the level of protein in diets, namely 10, 12, and 14%. All these diets had the same relative synchrony index.Each diet was given to three cattle (1 to 1.5 years of age and weighing 90-135 kg), which were randomly placed in individual cages. The diet given 2 times daily with the same dose at 8.00 and 16.30. The study was conducted for 35 days, 14 days for a period of adaptation to diet treatment, 14-day fattening period and 7 days before the end of the study for the collection period. In the collection period, measurements were daily consumption and collection of feces and urine. Blood samples to determine blood urea nitrogen (BUN) were taken from coccygeal vessels at the last sampling day. Urine was used to determine the retention of N and purine derivate which was then used to calculate the efficiency of rumen microbial protein synthesis/ rumen microbial production (Chen and Gomes, 1992). Rumen fluid was taken from rumen-fistulated cattle fed diet treatment, namely before feeding in the morning and 3, 6, 9 h after feeding. Data were analyzed for variance of randomized block design using the GLM procedure SAS (2004).

Result and Discusion

Table 3 shows that the production of rumen microbial protein was influenced by diet energy and was not affected by diet protein, corresponding to the statement

Karsli and Russell (2002). Rumen microbial production of the diet with 65% TDN was higher than that of the diet with 70% TDN ($P < 0.05$), while the diet with 10% protein tend to yield higher microbial production than the diet with the other proteins. This might occur because of the diet contained more forage (Table 2), so that the dilution rate in the rumen was high (Stern and Hoover, 1979), and because of lower fat content (Table 2) (Van Soest, 1982).

The greater rumen microbes may increase activity of nutrients fermentation including CF. There is a close correlation between CF and DM digestibility in the rumen (Varga and Hoover, 1983) and it is estimated that most of the diet will be fermented in the rumen, it will increase the digestibility of DM, including nutrient contained in it (Table 2). There was also a close relationship between the consumption and digestibility (Poppi *et al*., 2000), therefore the diet with 65% TDN or the diet with 10% protein would be more consumed than the diet with 70% TDN and the diets with protein 12 or 14% ($P < 0.05$).

Table 3 shows that the diet with 65% TDN produced a higher N retention compared to the diet with 70% TDN ($P<0.05$), while the diet with 12% protein tend to produce higher N retention compared to the diet with protein of 10 or 14%. Although N retention was high, the diet with 12% protein had a lower ADG (204 g / day) compared with the diet with 14% protein (207.7 g/day). This may be happen

Table 3. Effect of treatment diets on variables

	CP (%)			TDN (%)		Interaction: CP vs TDN
	10	12	14	65	70	
Consumption:						
DM; kg	2.0	2.1	1.8	2.3[a]	1.6[b]	ns
CF; kg	0.4	0.3	0.2	0.4[a]	0.2[b]	ns
Digestion : DM; %	69.3[a]	62.5[a]	58.8[b]	67.9[a]	59.2[b]	ns
CP; %	68.7[a]	63.3[b]	60.4[b]	63.3[a]	61.0[b]	ns
CF; %	64.3[a]	36.7[b]	33.5[b]	56.9[a]	32.9[b]	ns
RMP[1)]; g N/day	14.3	12.4	10.2	16.3[a]	8.3[b]	ns
N retention; g	3.6	5.7	4.3	6.2[a]	3.0[b]	ns
ADG; g/day	169.7	204.0	207.7	219.7	167.9	ns
BUN; mg/dl	37.1	39.6	34.7	36.2	38.1	ns
VFA; mM	112.9	93.5	99.6	98.9	105.1	s
NH_3; mg/100ml	17.0	15.4	18.6	16.6	17.5	ns
PER; %	72.5	79.8	79.0	84.5	76.3	ns

[a,b] deferent subscript in the same row and nutrient was significant ($P<0.05$); s= significant; ns= not significant; [1)]RMP= rumen microbial production.

because some of N retened within diet with 12% protein was converted to BUN to meet energy needs, this was corresponded to the statement of Bani *et al*. (1991). High BUN concentration was likely not derived from the excessive rumen NH_3, because its concentration was low compared to the diets of 10 and 14% protein. The Diet with 12% protein had a higher PER than diets with 10 or 14% protein.

Conclusion

It can be concluded that the rumen microbial production was influenced by the availability of energy for its body protein synthesis, although the diet was formulated synchronously to release N-protein and energy in the rumen. Local cattle diet containing 65% TDN and 12% protein with 0.560 synchronization index had the optimal rumen microbial production, protein efficiency ratio and average daily gain

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