METHANE CONVERSION RATE AND METHANE EMISSION FACTOR OF BUFFALO FED DIFFERENT LEVEL OF LOCAL YEAST CULTURE CONTAINING *Saccharomyces cerevisiae*

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ABSTRAK

Penelitian pengaruh penambahan ragi dengan konsentrasi 0, 0.5, 1.0 dan 1.5% dalam pakan ternak terhadap laju konversi metan (MCR) dan faktor emisi metan (MEF) empat ekor sapi dengan bobot hidup 200 kg dilakukan dengan menggunakan rancangan bujur sangkar latin. Hasil penelitian menunjukkan bahwa penempatan ragi tidak berpengaruh nyata terhadap MCR dan MEF. Namun demikian besarnya MCR dan MEF secara konsisten menurun dengan meningkatnya konsentrasi ragi dalam pakan. Dibandingkan dengan nilai yang digunakan IPCC (Intergovermental Panel on Climate Change), MCR dan studi ini lebih tinggi, sedangkan MEF lebih rendah. Besarnya MEF studi ini sekitar 37 kg/kepala/tahun, sementara IPCC sekitar 55-57 kg/kepala/tahun untuk sapi jantan dewasa dan antara 45-67 kg/kepala/tahun untuk sapi dewasa betina. Penelitian lebih lanjut pengaruh penambahan ragi pada pakan ternak ruminan lainnya dengan mempertimbangkan tingkat konsumsi pakan disarankan.

ABSTRACT

The effect of adding local yeast culture (YC) in the diet buffalo on methane conversion rate (MCR) and methane emission factor (MEF) was investigated. It was found that the inclusion of YC in the diet, statistically did not affect the MCR and MEF. However, these value consistently decreased with YC. In comparison with IPCC value, MCR of this study was higher while the MEF was lower. The average of MCR of this study was 8.5%, and IPCC was 7.5%. Furthermore, the MEF of this study was 37 kg/head/year, while the IPCC was 55-57 kg/head/year for adult males and 45-67 kg/head/year adult females. Further research on the effect of adding YC in the diet on MCR and MEF of other ruminants considering the feeding rate is suggested.

Key word : Methane conversion rate, methane emission factor, buffalo, *Saccharomyces cerevisiae*.

INTRODUCTION

Methane is one of the most important trace gases responsible for global warming and ozone. Methane concentration in the atmosphere is currently increasing by about 1% a year. Livestock, one of potential methane source, contributes about 20-35% of total emission emitted to atmosphere (Crutzen, 1986). One of factors affecting methane emission per unit feed consumed (methane conversion rate, MCR) is feed quality. The lower feed quality is, the higher MCR is.

In comparison with other developed countries, Indonesian feed quality is lower. In addition the type of feed also varies considerably from one site to another site. MCR of Indonesian livestock may therefore be higher and vary depending on quality of feed and feeding management. However, study on MCR and also factors affecting MCR reduction of Indonesian livestock is very limited.

Kumar *et al.* (1994) reported that the use of *Saccharomyces cerevisiae* in buffalo fed by high concentrate diets, significantly increased total count of viable bacteria, amylolytic and cellulolytic

bacteria and protozoa. Mustvangwa *et al.* (1992) found that *S. cerevisiae* also increased the concentration of acetate and total VFA, and reduce methane production significantly. Another experiment showed that methane production was reduced slightly by the presence of S. cerevisiae in the gastro-intestinal tract of cattle (William, 1988).

The objectives of this study were (1) to examine the effect of the use of local yeast culture (YC) containing mainly *S. cerevisiaae, Thyzopus oryzae,* and *Mucor* sp. on ruminal fermentation, nutrient digestibility, and nutrient utilization of buffalo fed with low quality roughage (rice straw as main fiber source), (2) to estimate MCR and methane emission factor (MEF) of buffalo, based on fermentation characteristic in the rumen and energy utilization, (3) to evaluate the potential of local YC in reducing methane emission. The YC is commonly produced and used in Indonesia as an inoculant in producing fermented cassava.

MATERIALS AND METHODS

Four ruminally fistulated buffaloes of 200 kg live weight were used in 4 x 4 Latin square design with 4 periods of observations to examine the effect of 4 different level of YC (0, 0.5, 1, and 1.5% in the concentrate diets) on ruminal fermentation, microbial population, nutrient digestibility, and utilization of energy. Each period of observation consisted of 21 days of adaptation and 7 days of collection. The buffaloes were housed individually and fed with the ration containing 9.7% crude protein (CP) and 53% TDN with gross energy 3561 kcal/kg, and consisted of 50% rice straw and 50% concentrate in DM basis. The animals were fed twice daily at 80% of maintenance level (4.4 kg/daily). The YC contains viable yeast 2.8 x 10^8 CFU/g and directly mixes with the concentrate according to the treatment. During the collection period, rumen flued (RF) samples were withdrawn at before and 4 hours after morning feeding via the fistulae. Determination of nutrient digestibility coefficient was carried out using total collection method. This research was conducted in 1995 at Faculty of Animal Husbandy, Bogor Agricultural University.

MCR, expressed as a percentage of energy intake, were estimated based on following orders :

1. Digestion trials were used to estimate coefficient of digestible energy (DE), as a percentage of gross energy intake (GEI),
2. Energy of methane (EM) was calculated using formula of Czerkawski (1986); EM, as a percentage of energy hexosa fermented = [28 - 0.47 (b + d)]/(100 + c + d), where b, c and d are % molar of propionate, butyrate, and valerate respectively,
3. Methane conversion rate (MCR), as a % of energy intake = EM x DE,
4. Methane emission factor (MEF), g/head/day = (MCR x GEI x 16)/210.8, where 16 = molecule weight of methane, and 210.8 = calorific value of methane,
5. Gross Energy Intake (GEI) = gros energy of feed x level of consumption.

These assumptions were used considering ± 90% of potential feed energy consisted of polysaccharide. It was also assumed that methane production was highly related to the fermentation of carbohydrate in the rumen.

The results were compared with the estimates produced by Blaxter and Clapperton (1965) method, i.e.

1. MCR, as a percentage of gross energy intake = 0.0367 + 0.062 DE,
2. MEF, g/head/day = (MCR x GEI x 16)/210.8.

RESULTS AND DISCUSSIONS

The results fo this experiment are summarized in Table 1. There were no statistically significant effects of YC addition to fermentation end products. The YC addition tended to increase energy digestibility. However, the addition of YC did not affect the VFA, and methane production in the rumen.

The results showed that MCR and MEF were not different significantly, although both values tended to decrease as the YC increased. Methane production per N retention also decreased with the YC (Table 1). Eventhough methane production per feed consumed relatively the same, the addition of YC increased efficiency of nitrogen utilization. In other word, YC tended to decrease methane production, if it is expressed in methane production per unit production or per unit nitrogen retention.

Table 1. Effect of local yeast culture (YC) on fermentation end products, nutrient digestibility, nitrogen utilization and methane production in buffalo

Parameters	YC in the concentrate, %				Significant of different
	0	0.5	1	1.5	
A. Fermentation and products					
1. Total VFAs, mM	87.46	86.21	92.72	88.58	n.s
2. Individual VFAs, % molar					
2.1. Acetate	59.69	57.72	57.61	59.96	n.s
2.2. Propionate	22.50	21.33	22.57	22.95	n.s
2.3. Butyrate	13.20	14.84	14.26	14.23	n.s
2.4. Valerate	4.61	6.10	5.56	5.85	n.s
B. Digestibility of energy, %	66.78	66.90	66.92	67.08	n.s
C. Nitrogen retention, g/head/day	34.8	37.0	39.4	39.1	n.s
D. Methane production [a]					
1. Energy of methane (EM) (% of energy intake)	12.96	12.48	12.36	12.07	n.s
2. Methane conversion rate (MCR) (% of energy intake)	8.76	8.32	8.17	8.05	n.s
3. Methane emission factor (MEF), g/head/day	104.16	98.32	97.20	95.77	n.s
4. Methane emission factor (MEF), kg/head/year	38.02	35.89	35.48	34.96	n.s
5. Ratio of methane production/N retention	2.99	2.66	2.47	2.45	n.s
E. Methane production [b]					
1. Methane conversion rate (MCR), (% of gross energy intake)	7.81	7.82	7.82	7.83	
2. Methane emission factor (MEF), g/head/day	92.88	92.97	92.99	93.10	
3. Methane emission factor (MEF, kg/head/year	33.90	33.93	33.94	33.98	

Note : a) Based on rumen fermentation pattern and energy utilization
b) Based on Blaxter and Clappertion formula (1965).

The non significant effect of the treatments maybe because the buffaloes was fed at 0.8 maintenance level. Moss *et al.* (1994) stated that the changing of forage-concentration ratios did not affect methane production significantly at maintenance level. But at 1.4 maintenance level, methane production differed significantly.

MCR of Indonesian buffalo, expressed as a percentage of energy consumed, was 8.5%. This value was higher than the IPCC (1995) value about 1%. This is probably due to low quality of feed even concentrate had been added. As the level of consumption is limited, methane emission (MEF) emitted by Indonesian buffalo is also lower (37 kg/head/year) than that of IPCC. In the IPCC, MEF was 55.57 kg/head/year for adult males and 45-67 kg/head/year for adult females. The value of MEF calculated using Blaxter-Clapperton formula was lower than that calculated based on rumen fermentation pattern (Table 1).

The result showed that the MEF values calculated based on rumen fermentation pattern tended to decrease with increasing level of YC added to diets, while those calculated that the estimation of methane emission by considering the fermentation pattern was sensitive to the change of feed composition. Therefore, this approach may be useful to explain the effect of varying feed on MCR and MEF of other ruminants.

CONCULSION

Inclusion of YC in the diet of buffalo did not affect nutrient digestibility, MCR and MEF significantly. However, there is a tendency that MCR and MEF decreased as the YC increased. MCR's average value from this research was 8.5%, and emission factor value was 101.12 g/head/day or 37 kg/head/year. This result was different from IPCC values, i.e. 7.5% for MCR, and 55-57 kg/head/year for MEF of adult males or 45-67 kg/head/year for MEF of adult females.

As the feeding rate also affect othe MCR and MEF, further study on the effect of addition of YC on MCR and MEF considering the feeding rate need to be carried out.

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