Effects of different composition of brewer grain and rice bran in the concentrate on methane emission of Kacang goat

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Abstract. Gases that are trapped in the atmosphere are known as a greenhouse gas and caused the earth warmer. The most abundant greenhouse gas after carbon dioxide (CO$_2$) is methane (CH$_4$). Methane from livestock is mainly from enteric fermentation and manure storage. One of the strategies to mitigates methane emission is by feeding management. This experiment aimed to determine the effect of different compositions of brewer grain and rice bran in the concentrate on methane emission in Kacang goat. Fifteen male Kacang goats (1.5-2 years old and body weight 12.67 ±1.61 kg) were assigned to a completely randomized design. The treatment were T1= 48.5% king grass + 9.7% brewer grain + 38.8% rice bran; T2= 48.5% king grass + 14.5% brewer grain + 34% rice bran; and T3= 48.5% king grass + 19.4% brewer grain + 29.1% rice bran. Mineral mix was added 3% in all treatments. There were no significant differences in all parameters observed. The results of gross energy intake, digestible energy, energy digestibility, and methane energy were 1.0 MJ/kg BW$^{0.75}$/day, 0.7 MJ/kg BW$^{0.75}$/day, 67.9%, and 7.88 MJ/100 MJ GEI, respectively. The difference in composition of brewer grain and rice bran in concentrate does not have any adverse effect on methane emission.

1. Introduction
Methane is a gas produced from feed fermentation in the rumen of ruminants. Methane from livestock is known to contribute 44% of the total methane in the atmosphere. It is well known that methane is a greenhouse gas which is also known as a trigger for the increase of the earth’s global surface temperature or known as global warming. This increasing temperature is believed to drive climate change [1]. To reduce methane emissions from ruminants, many studies have been conducted, including feed management. Feed with a high fiber content will produce high methane [2].

The use of waste from the food industry as animal feed has long been known. Rice bran is one of the animal’s feeds from the grain processing industry waste which is very easy to find in Indonesia because this country produces a huge rice every year. One of the other industrial wastes is brewer grain. Brewer grain has also long been used by a farmer for animal feed. Rice bran and brewer grain still contain good nutrition for livestock and do not compete with humans as food sources. Rice bran has a similar crude fiber content to brewer grain but has less crude protein than brewer grain [3]. A study of different protein and energy balance in Kacang goat did not affect methane production [4]. However, the different composition of brewer grain and rice bran in Kacang goat has not been studied yet. Therefore, this experiment aimed to determine the effect of different compositions of brewer grain and rice bran in the concentrate on methane emission in Kacang goat.
2. Materials and methods
The research was conducted for 2 months in The Jatikuwung Research Center, Animal Husbandry Study Program, Faculty of Agriculture, Sebelas Maret University. Analysis of the nutrient content of the feed and fecal were conducted in Chemicals sub lab, UPT MIPA center, Sebelas Maret University. The research was carried out experimentally using a completely randomized design. The material used was 15 kacang goats (1.5–2 years old and initial body weight 12.67 ± 1.61 kg). Kacang goat is a native goat from Indonesia. It has a brown and smaller body than an imported goat. Feed that given consists of forage (king grass) and concentrate (brewer grain and rice bran). The nutrient content of each material is shown in Table 1. The treatments were T1= 48.5% king grass + 9.71% brewer grain + 38.84% rice bran; T2= 48.5% king grass + 14.57% brewer grain + 33.98% rice bran; and T3= 48.5% king grass + 19.42% brewer grain + 29.13% rice bran. The feeding period was 12 weeks. The total collection was 7 days in the middle of the treatment period. The variables observed were dry matter intake, energy intake, digestible energy, and energy digestibility.

Table 1. Nutrient composition of feed material.

| Materials     | Dry matter (%) | Crude protein (%) | Crude fiber (%) | Crude fat (%) | Ash (%) | Nitrogen free extract (%) | TDN (%) | Gross energy (kkal/g) |
|---------------|----------------|-------------------|-----------------|---------------|---------|--------------------------|---------|----------------------|
| King Grass    | 25.0           | 8.6               | 38.0            | 3.9           | 14.5    | 34.9                     | 60.9    | 2,067                |
| Brewer grain  | 27.1           | 25.6              | 14.2            | 6.3           | 4.3     | 49.6                     | 78.9    | 3,575                |
| Rice bran     | 87.0           | 11.9              | 13.0            | 13.6          | 8.5     | 53.0                     | 77.2    | 3,820                |

TDN: Total digestible nutrient.

Proximate analysis was conducted in the Animal Nutrition and Feed Science Laboratory, Sebelas Maret University. The energy of feed and fecal were analyzed in PAU Laboratory Gadjah Mada University using bomb calorimeter methods. The digestible energy was calculated using the computer from different gross energy intake and fecal energy.

Methane production from enteric fermentation by ruminant is difficult to measure technically. Also, since it required equipment, it has a high cost. Therefore, the equation to predict methane production is developed. One of them was Blaxter and Clapperton [5].

Methane production was estimated by the following equation \( CH_4 = 3.67 + 0.062D \) [5]. Where \( CH_4 \) is methane, and \( D \) is the apparent digestibility of the energy of the feed. All observed data in the present study were analyzed by the R program (R version 3.6.2) [6].

3. Results and discussion
Nutrient intake, nutrient digestibility, and energy balance in Kacang goat fed different composition in rice bran and brewer grain are shown in Table 2. There were no significant differences in dry matter intake (\( P>0.05 \)). The dry matter intake did not differ in all treatments indicating that the three diets had the same palatability. Palatability usually was described as those characteristics of a feed that involve a sensory response in the animal [7]. Moreover, palatability is defined as all the physical and chemical (odor, taste, etc) characteristics of the feed that affects appetite. It suggested that all treatment in the present study has similar taste and odor.

The difference in the composition of brewer grain and rice bran in this study also did not affect the crude protein and crude fiber intake, nor did it affect the digestibility of crude protein and crude fiber (\( P>0.05 \)). With no difference in crude fiber intake, this can answer why methane emissions in this study were no different (\( P>0.05 \)). This is agreed with Kurihara et al. [2], and Yanti and Yayota [8] that methane production is influenced by the consumption of crude fiber.

The average methane production in this study was 0.08 of gross energy intake. This result was in line with Adesogan et al. [9] and Yanti et al. [4] which are often quoted for feeds at maintenance. Methane is a product from the fermentation of feed within the ruminant’s digestive system. It has been known
that the higher feed intake, the higher methane emission [10]. However, methane production may also be affected by dietary nutrient composition, carbohydrates or fiber, fat content, and digestible energy intake [11]. There was no effect of nutrient composition found in the present study. This is consistent with studies [4][12] that different nutrient compositions did not influence methane production. The feed materials in the present study did not have adverse effects on the methane emission of the goat because it is often quoted for feeds at maintenance.

| Table 2. Nutrient intake, nutrient digestibility, and energy balance in Kacang goat. |
|---------------------------------|--------|--------|--------|
| Items                          | T1     | T2     | T3     |
| Dry matter intake (g/day)      | 640.8  | 545.1  | 565.3  |
| DM digestibility (%)           | 70.4   | 70.0   | 70.8   |
| Organic Matter intake (g/day)  | 586.6  | 497.4  | 519.9  |
| Organic matter digestibility (%)| 70.8   | 70.2   | 71.2   |
| Crude Protein intake (g/day)   | 76.8   | 68.3   | 75.1   |
| Crude protein digestibility (%)| 67.7   | 72.3   | 73.7   |
| Crude fiber intake (g/day)     | 161    | 136.8  | 143.3  |
| Crude fiber digestibility (%)  | 72.7   | 68.2   | 68.8   |
| Gross Energy intake (Mj/day)   | 7.6    | 6.5    | 6.7    |
| Digested energy (Mj/day)       | 5.1    | 4.4    | 4.6    |
| Energy digestibility (%)       | 67.1   | 68.3   | 68.2   |
| Methane emission MJ/100 MJ GEI | 7.8    | 7.9    | 7.9    |

4. Conclusion
The different composition of brewer grain and rice bran in concentrate did not affect the energy utilization of male Kacang goat. The methane emission was not too high. Future research is needed to find the best feed management as a strategy to reduce methane emissions in the ruminant. This reduction hopefully would slow global warming in the near future.

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