Methane emission from Male Kacang Goat fed with different concentrate composition

Y Yanti*, M S J Rabbani, S D Widyawati and W P S Suprayogi

Department of Animal Science, Faculty of Agriculture, Universitas Sebelas Maret, Jalan Ir. Sutami No. 36A Keningting Surakarta, Jawa Tengah, 57126, Indonesia
*Corresponding author: yuliyanti_fp@staff.uns.ac.id

Abstract. Methane is the second-largest greenhouse gas after carbon dioxide in contributing to global warming, which is the main driving to climate change. The emission of methane from enteric fermentation was the greatest contributor to agricultural emissions. Controls the component in the feed is one of the strategies for the reduction of methane emission from the rumen. The aim of this study was to determine the effect of different concentrate composition on methane emission and energy utilization in male Kacang goat. Twelve male goats, age 7 months and body weight (BW) 9.23 ± 1.42 kg, were assigned to a completely randomized design. The treatment was the different composition of protein (P) and energy (TDN) of their feed. The treatments included T1 (P 8.28%, TDN 56.70%), T2 (P 8.53%, TDN 61.30%), T3 (P 9.81%, TDN 57.70%) and T4 (P 10.09%, TDN 61.26%) with three replications in each treatment. There were no differences in gross energy intake, digestible energy, energy digestibility, and methane emission. The results of gross energy intake, digestible energy, energy digestibility, and methane energy were 2.67 MJ/kg BW^{0.75}/day, 1.80 MJ/kg BW^{0.75}/day, 67.09% and 7.78 MJ/100 MJ GEI, consecutively. The difference in concentrate composition does not have any adverse effect on methane emission.

1. Introduction
Kacang goat is carried out by the farmers mainly still using traditional methods so that the production is not optimum as a producer of meat. To increase the maximum production good maintenance management is needed, including feed management. Low goat productivity can be seen from low average daily gain. One of the main causes is the low quality of feed so that the needs of goats cannot be fulfilled. On the other hand, the low quality of feed increasing another problem. The feed contains high fiber content increasing methane emission [1].

Methane is the second-largest greenhouse gas after carbon dioxide in contributing to global warming which is the main driving to climate change [2]. The emission of methane from enteric fermentation was the greatest contributor to agricultural emissions [3]. Controls the component in the feed is one of the strategies for the reduction of methane emission from the rumen. Methane emissions can be decreased by supplementing the diet with certain additives and ingredients, such as adding fats [4], antibiotic [5] and adding diets with higher levels of nonstructural carbohydrate [6]. The concentrate is the feed that contains mainly grain which rich in simple carbohydrates. However, there is limited information on the effect of different composition of concentrate on methane emission in Kacang Goat. Therefore, the aim of this study was to determine the effect of compositions concentrate compositions on methane emission and energy utilization in male kacang goat.
2. Materials and methods

The experiment has been conducted in Jatikuwung Farm, Sebelas Maret University from September 2013 to January 2014.

2.1. Materials

Twelve male goats with age 7 months and initial body weight (BW) 9.23 ± 1.42 kg were assigned to a completely randomized design. The feed consists of King grass and concentrate. The concentrate was composed of rice bran, soybean meal, cassava meal and vitamins. The nutrient content of the feed was presented in Table 1.

2.2 Methods

The treatment was the different composition of protein (P) and energy (TDN) of their feed. The treatments included T1 (P 8.28%, TDN 56.70%), T2 (P 8.53%, TDN 61.30%), T3 (P 9.81%, TDN 57.70%) and T4 (P 10.09%, TDN 61.26%) with three replications in each treatment. The ration was offered at 6% BW on dry matter (DM) basis consist of King grass and concentrate (50:50). The feed was offered for 12 weeks. Fecal and urine were collected for 7 days then mixed each treatment. One hundred gram DM of fecal and urine samples in each treatment were collected for further analysis.

Table 1. Nutrient content of the feed

| Materials       | Dry Matter (%) | Crude Protein (%) | Crude fat (%) | Crude fiber (%) | Ash (%) | Nitrogen Free Extract (%) | TDN (%) |
|-----------------|----------------|-------------------|---------------|-----------------|--------|--------------------------|---------|
| King grass      | 22.76          | 19.32             | 3.61          | 56.41           | 17.27  | 4.39                     | 74.10   |
| Rice bran       | 89.13          | 5.67              | 5.82          | 31.78           | 16.28  | 40.45                    | 44.04   |
| Soybean meal    | 86.98          | 43.37             | 4.84          | 3.91            | 7.06   | 40.82                    | 85.61   |
| Cassava meal    | 20.00          | 4.90              | 1.52          | 26.42           | 8.32   | 58.83                    | 68.55   |

The analysis procedure for determining DM of feed and fecal samples according to the "Association of Official Analytic Chemist" method [7]. Proximate analysis for feed and fecal was conducted in Animal Nutrition Laboratory Sebelas Maret University. The energy of feed and fecal was analyzed using bomb calorimeter in PAU Laboratory Gadjah Mada University. The digestible energy was computed from difference gross energy intake and fecal energy. Methane production was estimated by the following equation according to Blaxter and Clapperton [8]

\[ \text{CH}_4 = 3.67 + 0.062D \]

Where D is the apparent digestibility of the energy of the feed. All observed data were analyzed by analysis of variance (ANOVA) [9].

3. Results and Discussion

Energy utilization in Kacang goat is shown in Table 2. The results of the statistical analysis showed the treatment from the different composition of the concentrate in the ration had no significant effect (P≥0.05) on the DM intake. The average DM intake that is relatively the same in each treatment shows that the palatability is the same in goat. It is supposed that the feed ingredients and the feed properties in each treatment have in common. In accordance with the opinion of Mubarok [10] that uniformity of the physical properties of feed can cause the same palatability of feed. According to Parakkasi [11] factors that influence the amount of intake are species, age of livestock, environment, physical properties and composition of food ingredients.
**Table 2.** Energy utilization in Kacang goat fed different composition of concentrate

| Items                              | Treatment |
|------------------------------------|-----------|
| Dry matter (DM) intake (g/day)     | T1        |
|                                    | 563.87    |
|                                    | T2        |
|                                    | 413.42    |
|                                    | T3        |
|                                    | 673.87    |
|                                    | T4        |
|                                    | 658.23    |
| Gross Energy intake (MJ/kg BW₀.₇５/day) | T1        |
|                                    | 2.39      |
|                                    | T2        |
|                                    | 2.16      |
|                                    | T3        |
|                                    | 2.63      |
|                                    | T4        |
|                                    | 3.5       |
| Digested energy (MJ/kg BW₀.₇₅/day) | T1        |
|                                    | 1.47      |
|                                    | T2        |
|                                    | 1.42      |
|                                    | T3        |
|                                    | 1.82      |
|                                    | T4        |
|                                    | 2.5       |
| Energy digestibility (%)           | T1        |
|                                    | 64.22     |
|                                    | T2        |
|                                    | 64.74     |
|                                    | T3        |
|                                    | 68.22     |
|                                    | T4        |
|                                    | 71.19     |
| Methane emission MJ/100 MJ GEI     | T1        |
|                                    | 7.47      |
|                                    | T2        |
|                                    | 7.68      |
|                                    | T3        |
|                                    | 7.9       |
|                                    | T4        |
|                                    | 8.08      |

T1 (P 8.28%, TDN 56.70%), T2 (P 8.53%, TDN 61.30%), T3 (P 9.81%, TDN 57.70%) and T4 (P 10.09%, TDN 61.26%). P: Protein. TDN: Total Digestible Nutrient.

Sufficient energy is needed for normal growth. Lack of energy in livestock, especially livestock during growth will inhibit the growth of these animals. The results of statistical analysis showed that each treatment difference in the composition of the concentrate in the ration had no significant effect (P≥0.05) on energy consumption. This is possible because DM intake in all treatments has no significant effect (P> 0.05). High and low DM intake does not determine the energy consumption of Kacang goat. Wilkinson and Stark [12] state that the factors that influence energy intake are the type and quality of rations, feeding frequency, body weight, and the level of livestock production.

The results of the statistical analysis showed that each treatment difference in the composition of the concentrate in the ration was not significantly different (P≥0.05) of the digested energy. This was alleged because the energy consumption in this study was not significantly different. As stated by [13] digested energy can be affected by the physical and chemical properties of food ingredients, consumption levels and livestock species.

The average digested energy (MJ/kg BW₀.₇₅/day) in male Kacang goats is T1 (1.47), P2 (1.42), P3 (1.82), and P4 (2.5). The results obtained in this study are higher than the results of research conducted by Nugroho et al. [14]. The average digestible energy for sheep with bodyweight ± 18 kg is 0.23 MJ/kg BW₀.₇₅/day. It is suggested that goats in the present study use more energy than sheep [14].

The average energy digestibility in this study was 67.09%. The average energy digestibility in this study is higher than that of Nugroho et al. [14], which is 50.97%. This difference is supposed to be the ability to digest feed in this study better than research conducted by Nugroho et al. [14]. In addition, it is suspected that the feed given in the study of [14] contains more crude fiber compared to this study. In accordance with the opinion of Yanti et al. [15] that the more consumption of crude fiber will reduce digestibility. Crude fiber 40-42% has not disrupted the digestive process, it is possible the crude fiber content consists of cellulose, hemicellulose and lignin content which is still low because the king’s grass is cut at the age of 40 days so that the lignin content is not high.

Predicted energy losses as methane in this study were 0.08 of GE intake, and this value agreed with the value of predicted methane in Adesogan et al. [16] results which often quoted for feeds at maintenance. It implied that feed in this study does not have any adverse effect on methane emission. Therefore, with this feed, small ruminants will not contribute to increasing the methane concentration in the atmosphere that caused climate change.

**4. Conclusion**

It can be concluded that the difference in concentrate composition does not affect the energy utilization in male Kacang goat and also does not has any adverse effects on methane emission. Further work is required to find the ingredient of concentrate that can reduce the contribution to greenhouse gas emission before it can be recommended for the commercial farm.
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