Methane Respiration Emission, Feces Production and Feces Quality of Sheep

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Methane Respiration Emission, Feces Production and Feces Quality of Sheep Fed with Different Level of Energy and Protein Content

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Abstract

Study investigating methane respiration emission, feces production and feces quality of sheep that fed with combination different level of energy and protein content was done. Combination of two level total digestible nutrient (TDN) (±60 and 70%) and three level protein (±14, 16 and 18%) were investigated. The result showed that feed with higher TDN content gave effect on methane production in term of L/h/d but no significant effect in term of L/dry matter intake. Feces nutrients from treatment with higher TDN content were higher than that from lower TDN content. In term of sustainable agriculture feed with lower TDN and protein content that investigated in this study is more recommended than that with higher TDN and protein content.

1. Introduction

Livestock production particularly ruminant animal has the highest contribution to the greenhouse gas (GHG) emission from agricultural sector and small ruminants share about 12.25% of the total GHG emission from livestock's enteric fermentation and manure CH_4 and manure N_2O [1].

A strategy to reduce GHG emission from animal is by increase animal productivity, therefore it can decrease GHG emission per kg animal product. In the case of sheep production, that part of small ruminant, this animal usually started to fattened in age of 6 – 8 months. Early sheep fattening (3 months) probably can be alternative to reduce GHG emission from this animal, since this strategy can produce earlier readily slaughtered sheep. In addition, by early sheep fattening probably can produce lamb with low fat content.

Methane, an important GHG, is produced during feed fermentation in animal digestive tract. Changes in the efficiency of feed energy utilization can influence CH_4 emissions of animals and the feed energy utilization depends on the type of animal, the type or quality and quantity of feed, environmental condition, etc. [2]. Therefore, the aim of this paper is to determine the effect of different level of energy and protein feed content on methane respiration emission, feces production and feces quality.

2. Materials and Methods

2.1. Animals and diets

Twenty four thin tailed bucks (14.19 ± 1.17 kg) were randomly divided into six combination treatment. Two level total digestible nutrient (A) and 3 level protein (B). Diet composition and the nutrient content for each treatment can be seen in Table 1. The sheep were individually kept in metabolic cages. The animals were fed with pellet ration two times a day at 8 a.m. and 4 p.m. Both

feed and water were accessible at all times. Sheep were adapted for four weeks followed by 14 weeks of data collection. Feces and urine were collected in the week 9th for 7 days and feces were kept in the freezer until for its chemical composition analysis.

Table 1. The Ration Composition and Nutrient Content (Nutrient Composition are Expressed as Percentage of Dry Matter (DM).

Feedstuffs / Nutrients (%)	Treatments					
	A1B1	A1B2	A1B3	A2B1	A2B2	A2B3
Molasses	6.00	6.00	6.00	8.00	8.00	8.00
Cassava	11.50	9.50	7.00	38.50	36.40	34.30
Sugar cane leave	30.20	29.00	28.50	10.35	8.90	7.00
Rice bran	18.00	16.00	14.00	19.65	18.00	17.30
Cassava peel	15.00	15.00	15.00	3.00	3.00	3.00
Soybean meal	13.50	17.50	21.50	14.50	18.50	22.20
Fish meal	3.80	5.00	6.00	4.00	5.20	6.20
Mineral mix	2.00	2.00	2.00	2.00	2.00	2.00
Nutrients content in the rations:						
Crude protein	13.37	15.58	17.69	13.45	15.67	17.72
Total Digestible Nutrients (TDN)	60.39	61.15	61.67	68.93	69.63	70.17

2.2. Respiratory Methane Emission

Evaluation of respiratory methane emissions of sheep were evaluated using facemask method according to [3]. The methane concentration was analyzed using methane analyser (VIA-510, HoribLtd., Japan), while air volume was measured by air flow meter (STEC SEF-6470, Horiba Ltd., Japan). The data were recorded continuously using IBM PC/AT compatible computer by Test Point TM program (Test Point TM Technique & Reference, 1999). Data were collected for 10 minutes at 3-hour intervals over two days [4].

2.3. Analytical procedure

Crude protein, fiber, fat, total solid and ash content were analysed using proximate analysis. Data were analysed using ANOVA with 95% confidence level. Duncan multiple range tests (DMRT) were used in post ANOVA analysis when differences were found to be significant [5].

3. Results and Discussion

3.1. Methane respiration emission

There was no interaction effect of combination treatment on methane respiration emission ($p>0.05$). The significant effect ($p<0.05$) was only found in the treatment level of TDN on methane respiration emission in term of L/h/d (Table 2). Methane respiration emission in this study is in accordance with [6]Shibata et al. (1992) who reported that methane emission in sheep and goat is 34.3 and 25.2 L/d respectively while in term of L/kg DMI is 25.9 and 27.1 respectively.

The higher methane production in treatment A1 than that in treatment A2 in term L/h/d can be attributed by the fact that ration in treatment A2 has higher TDN content than TDN content in treatment A1. As reported by [7]Shibata and Terada (2010) that ruminant methane production is affected by feed quality, forage species, forage processing, the proportion of forage in the diet and the source of grain in the ration. Feed with high quality will promote the microbial growth and propionate production which lead to reduced CH_4 production.

Table 2. Respiration Methane Emissions

Respiration Methane Emissions	Treatments combination				Average
		B1	B2	B3	
L/h/d	A1	45.08	38.62	34.07	39.26[a]
	A2	30.68	29.80	25.42	28.63[b]
	Average	37.88[a]	25.40[a]	29.75[a]	
L/DMI	A1	28.71	30.57	30.06	29.78[a]
	A2	35.39	38.21	26.67	33.42[a]
	Average	32.05[a]	34.39[a]	28.36[a]	

[a,b]: Values in each raw and column in the same parameter followed by the same letters are not significantly different (p>0.05)

3.2. Feces production and its quality

Feces production and its quality of sheep fed with different protein and energy content are presented in Table 3. There was no interaction of combination treatment between level TDN and protein content of sheep ration on feces production and its quality. There was no significant effect (p>0.05) of protein content on sheep feces production. However, there was significant effect (p<0.05) of level TDN on feces production. Feces production from treatment A1 was 613.36 g DM/h/d while it's from treatment A2 was 251.33 g DM/h/d. The higher feces production in treatment A1 than that from treatment A2 probably was attributed by higher feed consumption (p<0.05) (data not shown) in treatment A1 than feed consumption in treatment A2. In addition, higher TDN content in ration A2 probably can be limiting factor of feed consumption therefore feed consumption in this treatment was significantly lower (p<0.05) than that in treatment A1.

On average, feces nutrients of sheep fed with higher TDN content (treatment A2) were significantly higher (p<0.05) than that from treatment A1. Feed with higher TDN content means that this ration contain more part of nutrient that can be digest by animal, however since the absorption of nutrient capacity of sheep digestible tract is limited therefore part of this nutrient will undergo to the feces or urine. In this study there was significant effect of combination treatment on sheep productivity (data not shown) and since higher nutrient content in sheep feces treatment with higher TDN content probably can produce higher CH_4 and N_2O therefore in respect of agriculture sustainability a lower protein and TDN content in this study is more recommended than the higher one.

Table 3. Feces Production and Its Quality

Parameters (%)	Treatments combination				Average
		B1	B2	B3	
Crude protein	A1	8.77	9.12	9.22	9.04[a]
	A2	12.32	12.36	13.59	12.76[b]
	Average	10.55[a]	10.74[a]	11.41[a]	
Crude fat	A1	1.89	1.17	1.97	1.68[a]
	A2	2.54	2.92	3.25	2.90[b]
	Average	3.16[a]	2.05[a]	2.61[a]	
Fiber content	A1	26.44	26.86	25.82	26.37[a]
	A2	26.32	23.93	22.82	24.36[b]
	Average	26.38[a]	25.40[b]	24.32[c]	
Feces Production (g DM/h/d)	A1	613.15	659.11	567.83	613.36[a]
	A2	257.86	239.34	256.78	251.33[b]
	Average	435.86[a]	449.23[a]	412.31[a]	

[a,b]: Values in each raw and column in the same parameter followed by the same letters are not significantly different ($p>0.05$)

4. Conclusion

Feed with higher quality produced lower methane production in term L/h/d but no effect in term L/DMI. This feed also produced higher nutrient content on the feces that probably can produce more manure CH_4 and N_2O emissions. Since no effect on the sheep productivity therefore in term of livestock environmentally friendly, ration with lower TDN and protein content in this study is more recommended than that with higher TDN and protein content.

Acknowledgments

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