IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

Study on early fattening in sheep as a strategy to reduce nitrogen emissions

To cite this article: A Prima *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **247** 012024

View the article online for updates and enhancements.

This content was downloaded from IP address 114.99.54.65 on 09/10/2019 at 11:12

Study on early fattening in sheep as a strategy to reduce nitrogen emissions

A Prima[1,2], E Purbowati[1], E Rianto[1] and A Purnomoadi[1]

[1]Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang 50275, Indonesia
[2]Faculty of Agricultural and Animal Sciences, University of Muhammadiyah Malang, Malang, 65144, Indonesia

E-mail: agung194@yahoo.com

Abstract. Nitrogen is one of the contributors of greenhouse gases (GHG). In ruminants, more than 60% nitrogen was excreted in feces and urine during the animal life. Therefore, the faster the animal can be slaughtered the less nitrogen excreted. The aimed of this study to evaluate the decrease of nitrogen emissions by using early fattening in sheep after weaned. Thirty Thin Tailed lambs (aged 4 months; 13.70± 1.93 kg of BW) were used in this study. The feed was pelleted complete feed that contained 14% - 18% crude protein (CP) and 60% - 70% total digestible nutrients (TDN). The nitrogen emission was analyzed from urine and feces. Feed, feces, and urine were collected during 7 days using the total collection method. Nitrogen (N) was analyzed using Kjeldahl method. The data were analyzed using descriptive analysis. The results showed that lambs fattened during 3 months had 24.32 kg of slaughter weight, with an average daily gain (ADG) was 126.4 g/d, which is in traditional farmers in Indonesia required at least 12 months to achieve 24 kg of slaughter weight. It indicated that early fattening can be faster 5 months than that of the traditional farmer. In this study, the daily N emissions from feces and urine were 13.43 g/d, the emissions of N_2O was 0.27 g/d. Those results could be calculated total emissions of N and N_2O between early fattening (7 months) and traditional farmer (12 months). The total emissions of N were 2.82 kg vs 4.83 kg, N_2O; 56 g vs 96 g, respectively. Based on the result, it could be concluded that shortening rearing period in sheep can reduce the emissions of N and N2O until 41%.

1. Introduction

Nitrogen is one of the contributors to GHG. As long as ruminants live on average more than 60% of nitrogen (N) was wasted through feces and urine as a remnant of the metabolic process [1]. The utilization of nitrogen depends on the diet intake and the age of the sheep. The diet with the high quality of protein and easy to be digested will increase the N retention so that the N that was wasted on the feces and urine will decrease [2]. Young ruminants that are in the growth phase of muscle tissue require higher nitrogen compared to mature ones whose muscle tissue growth has begun to slow down. The efficiency of N utilization in young ruminants is 93% vs. 88% in mature ruminants [3].

Therefore, if young sheep are fattened with the diet high-quality protein-containing allegedly will increase average daily gain. The highest average daily gain resulting in the faster of the time to achieved the highest slaughtered weight. The faster sheep reach the slaughter weight the fewer emissions will produce. This has been proven that fattening in young sheep could reduce methane by up to 38%[4]. Allegedly by fattening young sheep can also reduce nitrogen emissions.

2. Materials and methods

Thirty Thin Tailed lambs (aged 4 months; 13.70 ± 1.93 kg of BW) were used in this study. The feed was pelleted complete feed that contained 14 - 18% crude protein (CP) and 60 - 70% total digestible nutrients (TDN). The nitrogen emission was calculated from urine and feces. Feed, feces, and urine were collected during 7 days using the total collection method. Nitrogen (N) was analyzed using Kjeldahl method [5]. The nitrous oxide (N_2O g/day) excreted in feces and urine was calculated

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

according to Menezes et al. [6], where 2% of the N excreted in livestock manure (feces and urine) was the emission factor that was adopted to find the amount of N_2O emitted. In this study, the data observed were the average daily gain (ADG), slaughter weight, nitrogen, and N_2O emissions. The data in this study were compared with the data of literature that reported the slaughter weight of sheep in Indonesia. To obtained the nitrogen and N_2O emissions during the lives of sheep, in young sheep or early fattening the emissions per day was multiplied to 210 days (7 months), in mature sheep or traditional farmer the emissions per day was multiplied to 360 days (12 months). The data were analyzed using descriptive analysis.

3. Results and discussion

The data of average daily gain (ADG) and slaughter weight are presented in table 1 and the data of nitrogen and N_2O emissions are presented in table 2. The sheep that were used in this study were thin-tailed sheep which were included in the small type breed. The number of ADG that was obtained in this study almost similar to the results reported by [7] that Kathadin young sheep (small breed) resulted in ADG 130 g/d. The sheep start to be fattened on 3 months old, and was fattened during three months and resulted in a slaughter weight of 24 kg on 7 months old. The achievement of this weight was faster if compared to the sheep fattened in the traditional farming system that needed 12-15 months to achieve body weight of 24-31 kg [8]. This is due to the rapid growth rate in young sheep if supported by a high-quality diet. On the other hand, increasing the age will decrease the growth. Budisatria et al. [9] reported that ADG of sheep 0-3, 3-6, 6-12 older 12 months were 96, 78, 53 and 35 g/day, respectively. The results of this study indicate that fattening in young sheep can shorten raising time by 5 months compared to the traditional farming system in rural areas.

Table 1. Initial body weight, slaughter weight, average daily gain, nitrogen and nitrous oxide emissions of young sheep

Parameter	Result
Initial body weight, kg	13.70
Slaughter weight, kg	24.32
Average daily gain, g/d	126.4
Nitrogen, g/d	13.43
Nitrous oxide, g/d	0.27

Table 2. Total nitrogen and nitrous oxide emissions during the life

Parameter	Early fattening (7-month-old)	Traditional farmer (12-month-old)
Nitrogen, kg	2.82	4.83
Nitrous oxide, g	56	96

The amount of N emissions in this study was 13.43 g/d. This result was similar in young sheep which was fed 13-17% crude protein in the diet, the N emissions were 12-17 g/d [10]. The more N emissions will give the more N_2O formed [6]. The lower N emissions in early fattening sheep compare than traditional farmer was due to the shorter duration of raising.

4. Conclusion

It can be concluded that fasten the slaughter weight by an early fattening program on young sheep can be used as a method to reduce nitrogen emissions, and can be calculated to reduce N emissions up to 41%.

References

[1] Kiran D and Mutsvangwa T 2009 Nitrogen utilization in growing lambs fed oscillating dietary protein concentrations *Anim. Feed. Sci. Tech* **152** 33–41.

[2] Santos R S, Ribeiro, K G Filho, S C V, Pereira O G, Villela S D J, Rennó L N and Silva J L 2015 Effects of diets with high and low protein contents and two concentrate levels in Santa Ines Â Texel lambs *Lives. Sci.,* **177** 79–87.
[3] Lapierre H and G E Lobley 2001 Nitrogen Recycling in the Ruminant *A Review. J. Dairy Sci.* **84** E223-E236
[4] Purnomoadi A 2017 Early fattening lamb could mitigate methane production-an example of climate-smart livestock farming system in Indonesia *IOP Conf. Ser.: Earth Environ. Sci.* **119**
[5] *AOAC. Official Methods of Analysis: 18th edition* 2005 (USA: Association of Official Analytical, Chemists International)
[6] Menezes A C B, Filho S C V, Silva L F C, Pacheco M V C, Pereira J M V, Rotta P P and Rennó, L N 2016 Does a reduction in dietary crude protein content affect performance , nutrient requirements , nitrogen losses , and methane emissions in finishing Nellore bulls *Agric. Ecos. and Enviro.* **223** 239–249.
[7] Wildeus S, Turner K E and Collins J R 2007 Growth, intake, diet digestibility, and nitrogen use in three hair sheep breeds fed alfalfa hay *Small. Rumin. Res.* **69** 221–227.
[8] Budisatria I G S 2006 *Dynamics of small ruminant development in Central Java – Indonesia. PhD Thesis* (Wageningen University: Animal Production System Group)
[9] Budisatria I G S, H M J Udi, C H A M. Eilers, E Baliarti and A J van der Zijpp 2010 Preferences for sheep or goats in Indonesia *Small Rumin. Res.* **88** 16-24
[10] Ludden P A, Wechter T L, Hess B W 2002 Effects of oscillating dietary protein on nutrient digestibility, nitrogen metabolism and gastrointestinal organ mass in sheep *J. Anim. Sci.* **80** 3021–3026.