

DIETARY ENERGY UTILIZATION IN RAMS BEING FED DURING THE DAY AND/OR AT NIGHT

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ABSTRAK

Suatu penelitian telah dilakukan dengan tujuan untuk mengkaji pemanfaatan energi pakan pada domba ekor gemuk jantan yang diberi pakan pada siang dan atau malam hari. Penelitian ini menggunakan 12 ekor domba lokal jantan berumur 12-18 bulan, bobot badan awal rata-rata 27,05±2,9 kg, (CV = 10,74%). Rancangan percobaan yang digunakan adalah rancangan acak lengkap (RAL) dengan 3 perlakuan dan 4 ulangan. Perlakuan tersebut adalah *day feeding* (DF): pemberian pakan pada siang hari (06.00-18.00), *night feeding* (NF): pemberian pakan pada malam hari (18.00-06.00), dan *day and night feeding* (DNF): pemberian pakan siang dan malam hari (06.00-06.00). Pemberian pakan secara ad libitum. Hasil penelitian menunjukkan bahwa waktu pemberian pakan pada siang dan/atau malam hari tidak berpengaruh nyata terhadap semua parameter yang diamati. Rata-rata konsumsi bahan kering, pertambahan bobot badan harian, konsumsi energi bruto, pencernaan energi dan deposisi energi berturut-turut adalah 1.006 g/hari, 75 g, 19,2 MJ/hari, 74,0% dari energi terkonsumsi, dan 66,2% dari energi terkonsumsi. Efisiensi pakan, efisiensi energi terkonsumsi, efisiensi energi tercerna, dan efisiensi energi terdeposisi berturut-turut adalah 7,38%, 3,86 g pbbh/MJ, 5,24 g pbbh/MJ, dan 5,84 g pbbh/MJ. Kesimpulan penelitian ini adalah bahwa pemberian pakan pada DF dan/atau NF tidak meningkatkan pemanfaatan energi pakan pada domba ekor gemuk jantan.

Kata Kunci: domba ekor gemuk jantan, pemanfaatan energi, waktu pemberian pakan

ABSTRACT

A study was carried out to assess dietary energy utilization in male fat-tailed sheep being fed during the day and/or at night. This study were used 12 rams of 12-18 months old with average of initial body weight of 27.05±2.9 kg (CV = 10.74%). The experimental design used in this study was a completely randomized design (CRD) with 3 treatments and 4 replications. The treatments were feeding during the day (06.00-18.00; DF), feeding at night (18.00-06.00; NF), and feeding all day and night (06.00-06.00; DNF). The diet was offered ad libitum. The results showed that feeding during the day and/or at night did not significantly affect ($P>0.05$) all parameters observed. The average of dry matter intake (DMI), average daily gain (ADG), gross energy intake (GEI), energy digestibility (DE) and energy metabolizability (ME) were 1006 g/d, 75 g/d, 19.2 MJ/d, 74.0% of gross energy, and 66.2% of gross energy, respectively. The feed efficiency ratio (FCR), gross energy efficiency, digestible energy efficiency, and metabolizable energy efficiency were 7.38%, 3.86 g ADG/MJ, 5.24 g ADG/MJ, and 5.84 g ADG/MJ, respectively. It is concluded that time of feeding did not affect the dietary energy utilization in local rams.

Keyword: sheep, energy utilization, feeding time

INTRODUCTION

Animals live in the tropics get heat load from the environment, especially during the day due to the high ambient temperature (Rianto, 2001; Al-Tamimi, 2007). Bhattacharya and Husein (1974) reported that at 32°C and 98% relative humidity, lambs would decrease feed intake and nutrition utilization.

Previous study showed that feeding at night increased energy utilization in lambs, because of increasing in nutrients digestibility (Hongyantarachai *et al.*, 1989; Denek *et al.*, 2006). Gaughan *et al.* (2002) reported that night feeding was able to decrease heat load and reduce lost energy for thermoregulation (Aharoni *et al.*, 2005). Isroli *et al.* (2004) reported that physiological responses of lambs would be higher in high ambient temperature to maintain their homeostatic.

Based on above argumentation, it was considered to be important to study the effect of feeding at night compared to feeding during the day and/or at night on the energy utilization to support the production of local rams. The aim of this study was to assess the efficiency of energy utilization in male fat tail sheep fed during the day and/or at night. The results of this study were expected to improve production of sheep through feeding management.

MATERIALS AND METHODS

Animals, Diets and Treatments

Twelve rams, aged 12-18 months, weighed 27.05 ± 2.9 kg (CV = 10.74%) were used in this study. The rams were kept in individual pens equipped with feed buckets and drinking water piles. They were fed complete feed (pellets) consisting of wheat straw, molasses, cassava, rice bran and soybean meal. Feed composition and nutrient content of feed that used in this study are presented in Table 1. The treatments applied were time of feeding, i.e. day feeding (06.00 -18.00, DF), night feeding (18.00-06.00, NF), day and night feeding (06.00-6.00, DNF).

Experimental Procedures

The rams were firstly adapted to the environment and time of feeding for 2 weeks. The rams were weighed prior the data collection period. Feed was offered to the rams according the treatment applied. For rams of DF, the feed was offered in 12 hours a day, i.e. from 06.00 to

18.00, then it was pulled. For rams of NF, the feed was offered, i.e. from 18.00 to 06.00, then it was pulled. For rams of DNF, the feed was offered in 24 hours a day. During the feeding time, the feed was *ad libitum*. The feed refusals of DF was weighed everyday at 18.00; while those of NF and DNF were weighed everyday at 06.00. Feed samples were daily collected at amount of 100 grams for dry matter content analysis.

In the 5th week of data collection period, faeces and urine were collected for 7 days. The faeces and urine collected were homogenized and sampled for energy content analysis.

In the 6th week, methane of rumen exhaled via mouth was measured using CH₄ Analyzer (Horiba Ltd., Japan) and Airflow Meter, which was connected to a computer. Measurements were performed for 10 minutes at intervals of 3 hours for 2 x 24 hours (Kawashima *et al.*, 2001).

During the data collection period, the rams were weighed every week to determine their body weight to adjust the feed given in fither week. The live weight gains of the rams were obtained from the difference between the live weight in week 10 and the week 0.

Parameter Measured

The parameters measured in this study were average daily gain, dry matter intake, gross energy, fecal energy, urinary energy, methane energy, digestible energy, metabolizable energy, feed efficiency, efficiency of gross energy, efficiency of digestible energy, and efficiency of metabolizable energy.

Statistical analysis

The data obtained were analyzed statistically using ANOVA procedure appropriate for completely random design. After a significant F test ($P < 0.05$), Duncan's multiple range test was used to inspect differences among group means.

RESULTS AND DISCUSSIONS

Performance of Rams

Dry matter intake (DMI) and average daily gain (ADG) of rams are presented in Table 2. Time of feeding did not have significant effect on the DMI, because there was no big difference in ambient temperature between day at night time, i.e. 27.7°C and 25.2°C so that the heat load that animal received were relatively same.

This finding was in agreement with the study of Rianto (1997) that DMI of lambs was not

Tabel 1. Feed Composition and Nutrient Content

Feed Ingredient	Composition/ Content
A. Feed Composition	
Wheat straw (%)	21
Molases (%)	1
Cassava (%)	10
Rice bran (%)	42
Soy bean meal (%)	26
B. Nutrient content (100% DM) :	
Dry Matter (%)	84.14
Organic Matter (%)	90.29
Crude Protein (%)	16.64
Crude Fiber (%)	22.51
Extract Ether (%)	3.08
Gross Energy (MJ/kg)	19.09
Total Digestible Nutrients (%)	66.41

significantly reduced when day/night temperature was elevated from 20°C/20°C to 47°C/39°C. Rianto *et al.* (2005) reported that DMI of merino lambs weighed 33 kg lived both at 20°C and 40°C/32°C were able to consume up to 1105 g/day. This result suggested that ambient temperature did not cause any decrease in DMI until quite high levels of temperature were reached. The increase or decrease in feed intake is related to animal's efforts in increase or decrease body heat production when the ambient temperature is low or high. The DMI in study was 1006 g/day or 3.75% of body weight. This was lower than Purbowati *et al.* (2008), who reported that rams fed complete feeds composed of agroindustry and agricultural by product required 5.31% DMI of body weight.

Average daily gain among the treatments showed no significant difference, averaged 75 g. This was because the lambs had no difference in DMI. This finding was lower than previous research; Rianto *et al.* (2004) reported that average daily gain of animals fed tofu cake (CP:13.67, CF:18.17, and TDN:63.52) was 120 g. This finding indicated that different nutrients contain of diet would affect live weight gain in

animals.

Energy Utilization

The results showed that the average of energy utilization were not significantly different. The results of this study indicate that time of feeding had no effect ($P>0.05$) on utilization of energy. Dietary energy utilization in rams are presented in Table 3.

The total energy intake of each treatment (DF, NF, and DNF), showed no significant difference. The average of energy intake was 19.19 MJ/day. This was because DMI was not significantly different (Table 3). Metabolizable energy intake in this research was not significantly different, with the average of 12.89 MJ/day. This condition was also due to the no difference in ambient temperature during the day and at night. The non-difference in ambient temperature during the day and at night led to similar animal's physiological condition, which in turn caused the lambs to have similar body heat production.

Fecal energy of DF, NF, and DNF was not significantly different. The average of fecal energy in this research was 25.97% of gross energy intake. Feces was the largest energy that was lost from the feed. The fecal energy in this study was lower than that stated by Purnomoadi *et al.* (2005), being 30.80-37.10% of the energy intake. This was confirmed by the lowest nutrient digestibility in previous study, i.e. 67.23% (Purnomoadi *et al.*, 2005), whereas in this study was 68.58%, thereby reducing energy through feces.

Urinary energy excretion was not significantly different ($P>0.05$) among the treatments. The average of urinary energy was 0.28 MJ/day or 1.16% of gross energy intake. The content of nitrogen in feed closely related to the urinary energy, as the energy released from the metabolism of amino acids, where the relation to the excess of nitrogen in the form of urea feed is wasted as urine. Urinary energy in this study (1.16% of gross energy intake), was lower than the study reported by von Keyserlingk and Mathison (1993), that the urinar energy or animal during heat stress was 1.55% of the energy consumed, whereas in normal condition was 1.23%. Urinary energy was affected by animal metabolic and the reducing levels of metabolism, causing a decrease in the urine volume (Edey, 1983).

Methane energy in this research were not

Table 2. Dry Matter Intake and Average Daily Gain of Rams

Parameter	Treatment				P Value
	DF	NF	DNF	Average	
DMI (g/day)	1078	865	1074	1006	0.900
ADG (g)	66	60	100	75	0.291

No significant differences at 5%. DMI: Dry matter intake; ADG: Average daily gain.

Table 3. The Effect of Time of Feeding on Energy Utilization in Rams

Parameter	Treatment				P Value
	DF	NF	DNF	Average	
Gross Energy (MJ/day)	20.59	16.50	20.50	19.19	0.900
Energy Utilization (MJ/day)					
Feces	4.97	4.38	5.26	4.87	0.806
Urine	0.45	0.25	0.12	0.28	0.273
Methane	1.58	1.15	1.13	1.29	0.135
Energy Loss Through (%)					
Feces	25.46	26.77	25.68	25.97	0.923
Urine	1.29	1.56	0.63	1.16	0.173
Methane	7.92	6.04	5.90	6.62	0.342
Digestible Energy (MJ/day)	15.59	12.10	15.24	14.32	0.923
Digestible Energy (%)	74.53	73.2	74.32	74.03	0.835
Metabolizable Energy (MJ/day)	13.94	10.80	13.86	12.89	0.901
Metabolizable Energy (%)	65.31	65.62	67.79	66.24	0.644

No significant differences at 5%.

significant differences, its average was 6.62% of gross energy. The finding was higher than the reported data by van Koyserlingkand Mathison (1993), in which the average of methane energy was 6% of the energy consumed. Feeding at day and/or night did not cause different of dry matter intake and feed digestibility, the average of 1006 g/day and 68.58%, respectively. The increasing of feed consumption will increase methane gas, the process of feed digestion in the rumen also increased because of consumption increased. The end result of of feed digestion process were methane, carbon dioxide, and VFA. Methane energy was influenced by several factors, i.e. the

quality of feed, crude fiber content, feed intake, and feed digestibility (Kurihara *et al.*, 1997). Although the ambient temperature and variations were able to affect the amount of methane gas production from various kinds of feed (Moss, 2002), but the data in this study were not significant different because of the type of feed was same for all treatments.

There was no significant difference among the treatments in DE intake, the average was 74.03%. This is presumably due to feeding at night did not influence the digestibility and DMI, and feed metabolism processes in the animal body. Rianto (1997) reported that energy

digestibility of cross Merino lambs live at 20°C and 30°C were 69.70% and 70.70% of gross energy, respectively. Feed intake will decrease in heat stress condition, but in common not affect digestibility (Rianto *et al.*, 2005). Factors affecting digestibility of energy were the quality of the feed, the amount of dry matter consumed, feed flow rate in the gastrointestinal tract (Ranjhan and Pathak, 1989).

Metabolizable energy in this research showed no significant differences ($P>0.05$) among the treatments, the average was 12.89 or 66.24% of gross energy. The lack of difference in metabolizable energy affected by fact that feeding at night did not reduce heat load, so that rams being fed during the day and/or at night had similar requirement of metabolizable energy. Having similar DMI, the rams had similar energy digestibility and matabolizability. Energy metabolizability in this research (66.24% of gross energy) was similar to the finding of Bhattacharya and Husein (1974) that energy metabolizability of Awasi lambs was 65.61% of gross energy. Mohamed (2012), reported that the metabolizable energy of Desert lambs fed *medicago sativa* in summer season was 8.48 MJ/day.

Efficiency of Energy Utilization

The data of feed efficiency ratio (FCR), efficiency of gross energy (GE), efficiency of digestible energy (DE), and efficiency of metabolizable energy (ME) are presented in Table 4. The results of this study showed no significant effect of feeding during the day and/or at night on efficiency of metabolizable energy ($P>0.05$). The lack impact of feeding during the day and/or at night to efficiency of energy utilization in this

study due to no differences in nutrient and energy digestibility. Having similar nutrient and energy digestibility, animals also had similar ability in utilizing energy for productive purpose (e.g. ADG) and that efficiency of energy utilization would be similar.

There was no significant difference in FCR among the treatments, the average was 7,38%. This was so because no differences in DMI and ADG, so that rams had similar feed utilization. This feed efficiency was higher than that of Setyaningsih *et al.* (2008) who reported that feed efficiency of rams was 6.77%. This difference might be affected by different quality of feed given in this study and previous study.

The average of efficiency of GE, DE, and ME were 3.86, 5.24, and 5.84 g ADG/MJ, respectively. The efficiency of GE in this study was lower than that of Setyaningsih *et al.* (2008), who reported that efficiency of GE of sheep fed 1.5% of maintenance was 4.25 g ADG/MJ. The efficiency of digestible energy in this study was lower than previous study that of Rianto (1997) who reported that cross Merino lambs live at 30oC was 7.75 g ADG/MJ. Purbowati *et al.* (2008) reported that efficiency of ME of sheep fed complete feed (CP: 14.48, TDN: 50.46) was 26.40 g ADG/MJ. The low value of energy efficiency in this study compared to previous studies might be caused by differences in the feed quality and the breed of the sheep that were used in the research.

CONCLUSION

Feeding during the day and/or at night was not alter the efficiency of dietary energy utilization in local rams. Therefore, feeding

Table 4. Feed Efficiency, Efficiency of Energy Consumed, Efficiency of Digestible Energy, and Efficiency of Metabolizable Energy

Parameter	Treatment				P Value
	DF	NF	DNF	Average	
Feed Efficiency Ratio (%)	5.58	7.40	9.15	7.38	0.182
Efficiency of Energy (g ADG/MJ)					
Gross energy	2.92	3.88	4.79	3.86	0.182
Digestible energy	3.89	5.38	6.45	5.24	0.178
Metabolizable energy	4.41	6.01	7.11	5.84	0.203

No significant differences at 5%. Data points are mean value based on fouruplicate determination

during the day and night was considered as reasonable choice to be applied for fat tailed sheep, in order to the rams were able to access the feed all along the day and to increase its energy utilization.

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