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Growth Performance and Physiological Responses of Garut Lambs Fed Diets Mung Bean Sprout Waste at Different Times

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Abstract: This study evaluated the effect of a diet containing mung bean sprout waste (MBSW) as a fiber source and feeding time on the growth performance and physiological responses of Garut lambs. Feeding regimens generated by a factorial randomized block design with two factors- diet and feeding time-were assigned to twenty Garut male lambs aged 6-7 months (BW 15.42±2.42 kg). The two diets (D) formulated with a dry matter (DM) base were D1 (60% concentrate 1+40% natural grass) and D2 (60% concentrate 2+40% MBSW). Feeding times were in the morning (MF, 6:00-7:00 am) or the evening (EF, 5:00-6:00 pm). The animals were reared in individual cages and fed with 5% DM/kg body weight/day. Nutrient intake (DM, crude protein (CP), total digestible nutrient (TDN) and average daily gain (ADG) of lambs fed D2 was significantly ($p<0.01$) higher than that of lambs fed D1. The feed conversion ratio (FCR) of lambs fed with D2 at the EF feeding time was significantly improved (6.07, $p<0.05$) compared to lambs fed D1 at the MF and EF time, respectively (7.88 and 8.27), or lambs fed D2 at the MF time (7.84). Heart rates (HR) were higher in lambs fed D2 than lambs fed D1. In contrast, the respiration rate (RR) and rectal temperature (RT) were similar for all treatments. These results suggest that diets containing 40% MBSW as a fiber source together with an evening feeding time could increase growth performance while preserving normal physiological responses of Garut lambs.

Key words: Garut lamb, growth performance, physiological responses, sprouts waste, feeding time

INTRODUCTION

Sheep are an important commodity in Indonesia, where they provide a source of meat and sacrificial animals for religious rituals. Recent increases in the demand for lambs require increased productivity of sheep farms, both in terms of animal quantity and quality. Growth performance is one indicator of livestock productivity. For ruminants such as sheep, productivity in hotter climates is generally lower compared to that in temperate regions (Preston and Leng, 1987). However, in Indonesia several types of local sheep, including Garut sheep (thin tail) and fat tail sheep, have superior genetic potential that can translate into increased productivity (Sodiq and Tawfik, 2004; Sumantri *et al*., 2007).

In addition to genetic factors, environmental factors such as feed, management and microclimate can affect sheep growth. Low feed quality and traditional management systems, as well as a hot tropical climate can reduce the growth performance of lambs. Sheep farmers in Indonesia mainly rely on low quality natural grass forage for livestock feed, although some farmers supplement animal diets with legume fodder, crop residues, concentrate feed or agroindustrial by-products (Duldjaman, 2004; Handiwirawan *et al*., 2004; Herianti and Prawirodigdo, 2010).

In urban areas, increasing productivity of sheep can also be achieved by feeding animals market vegetable remainders or vegetable wastes. In Indonesia, various vegetable waste from traditional markets can serve as unconventional foodstuffs for ruminants. Such market vegetable waste includes corn husks, cabbage, carrots and mung bean sprout waste (MBSW). Although corn husks are used as feed for dairy cows and cabbage and carrots are common rabbit feed (Prawirodigdo and Andayani, 2005; Utama *et al*., 2011; Anindita *et al*., 2014), MBSW has not been widely used as an animal feed.

MBSW is composed of mung bean sprout seed coats mixed with bean sprouts that are retained after sifting to separate the sprouts from seed coats. In general, the separation of the seed coat from the bean sprouts is done at the market, such that MBSW can also include market vegetable waste. Although there are no specific data regarding the availability of waste sprouts in Indonesia, MBSW would be predicted to be readily available given that most of the population consumes sprouts. Indeed, the results of an initial survey conducted in the city of Bogor, which has a population of 949,066 (Rahayu *et al*., 2010), showed that the potential for MBSW in Bogor is 1.5 tons/day. With crude protein

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(CP) and crude fiber (CF) contents of 13.60 and 49.0%, respectively (Ifafah *et al*., 2011), MBSW is an excellent alternative feed for ruminants.

Improvements in sheep productivity can also be realized through a micro-climate approach. The average tropical ambient temperatures in Indonesia range from 24-34°C (Yani and Purwanto, 2006), with large temperature fluctuations between day and night that can cause heat stress in animals. Such heat stress can cause a decrease in feed consumption that in turn decreases energy consumption and nutritional adequacy status (Hahn, 1999; Kandemir *et al*., 2013). Since livestock body temperatures are influenced by both external factors and body metabolism, reducing the incidence of heat stress can be done by changing the composition of nutrients and feeding management (Brosh *et al*., 1998; Gaughan *et al*., 2002).

Farm animals are conventionally fed in the morning and metabolic processes that occur during the daytime tend to increase body heat increments that may depress productivity. In contrast, an evening feeding time results in metabolic processes occurring during the night when ambient temperatures approach the thermoneutral zone. This reduction in heat increment may increase livestock productivity. However, assessment of whether sheep productivity can be improved in Indonesia using environmental approaches (e.g., waste utilization and feeding management) is needed. Therefore, this study aimed to evaluate growth performance and physiological responses of Garut lambs fed MBSW at different feeding times.

MATERIALS AND METHODS

These experiments were conducted at the Department of Animal Production and Technology and the Department of Animal Nutrition and Feed Technology, Faculty of Animal Science, Bogor Agricultural University, Bogor, Indonesia.

Animals, diets and experimental design: Twenty Garut male lambs (BW 15.42±2.42 kg, aged 6-7 months) were assigned into treatment groups using a factorial randomized block design with two factors-diet and feeding management. Two diets were formulated with a dry matter (DM) base: D1 (60% concentrate 1+40% natural grass) and D2 (60% concentrate 2+40% MBSW). MBSW was obtained from the Bogor traditional market and natural grass was collected from pastures at the Faculty of Animal Science. Concentrates consisted of cassava meal, coconut meal, soybean meal, molasses and minerals. The nutrient content of the experimental diets is presented in Table 1. All diets were formulated such that they were iso-nitrogenous and iso-energy/TDN (Table 2). Animals were fed either in the morning (MF: feeding between 6:00 and 7:00 am) or the evening (EF: feeding between 5:00 and 6:00 pm). The animals were reared in individual cages and fed the diets at a daily rate of 5% DM/kg of body weight (NRC, 1985) for three months. The animals were given water *ad libitum*.

Measurements and procedures: Growth performance and physiological responses were measured as variables. Growth performance variables were: dry matter (DM); nutrient intake (crude protein (CP)) and total digestible nutrient (TDN); average daily weight gain (ADG) and feed conversion ratio (FCR). Data for feed intake were obtained each day by weighing the feed given and the residual amounts. The DM, CP and TDN were calculated based on feed intake. Body weights were taken every two weeks to obtain data on ADG. The FCR was calculated from the DM intake and ADG (DMI/ADG).

Physiological responses included heart rate (HR), respiration rate (RR) and rectal temperature (RT). Values for these variables were collected three times during weeks 1, 4 and 8. Observations were made at 09:00 to 09:30 and 15:00 to 15:30 (light period), 21:00 to 21:30 and 03:00 to 03:30. HR was measured using a stethoscope and RR was determined by counting the rate of flank movement. RT was measured with a digital thermometer (accurate to 1°C). Meteorological data in the pen, including air temperature (AT) and relative humidity (RH) were measured every day at 6:00 am, 2:00 pm, 6:00 pm, 9:00 pm and 3:00 am.

Statistical analysis: Data were analyzed with ANOVA using SPSS Statistic version 16.0 (2007) to calculate the mean differences between treatments. These analyses were followed by a Duncan test.

RESULTS AND DISCUSSION

Growth performance: Observation of production performance included nutrient intake (dry matter (DM), crude protein (CP) and total digestible nutrient (TDN), average daily weight gain (ADG) and feed conversion ratio (FCR) (Table 3).

Statistical analysis showed that there was no interaction between diet type and feeding time with feed nutrient intake (DM, CP and TDN) and ADG of the lambs. However, nutrient intake (DM, CP and TDN) and ADG of lambs fed a diet with MBSW (D2) was significantly ($p<0.01$) greater than that for lambs fed a diet that included grass (D1). Meanwhile, changing the feeding time from the morning to the evening did not change nutrient consumption, but significantly ($p<0.05$) increased the lamb ADG (Table 3).

The high nutrient feed intake (DM, CP and TDN) of lambs given diet D2 compared to lambs given diet D1 was influenced by feed palatability, wherein diet D2 was more palatable than diet D1. Several factors can affect feed material palatability, including physical form or texture, aroma or flavor and taste (Forbes and Mayes,

Table 1: Nutrient content of mung bean sprout waste (MBSW), natural grass and concentrates (100% Dry Matter)

	Ash	CP	CF	EE	NFE	Ca	P	TDN*
Feedstuff	%							
MBSW	2.81	13.76	30.14	0.43	52.87	0.91	0.27	70.23
Natural grass	7.58	9.56	23.61	0.82	58.43	0.33	0.19	68.39
Concentrate 1	14.29	16.35	27.26	1.42	40.28	1.48	0.56	62.10
Concentrate 2	14.57	14.17	25.97	1.73	43.57	1.46	0.54	62.95

CP: Crude protein, CF: Crude fiber, EE: Ether extract, Nitrogen Free Extract, Ca: Calcium, P: Phosphorus, TDN: Total digestible nutrient *calculated based on Hartadi *et al*. (1997)

Table 2: Nutrient content of experimental diets (100% DM)

Nutrient	D1	D2
Ash	11.60	9.86
Crude protein	13.63	14.00
Crude fiber	25.80	27.64
Extract ether	1.18	1.21
Nitrogen free extract	47.54	47.29
TDN	64.62	65.86

D1: Diet 1 (60% concentrate 1+40 % natural grass), D2: Diet 2 (60% concentrate 2+40%MBSW), TDN: Total digestible nutrient

Table 3: Nutrient intake, average daily gain and feed conversion ratio (FCR)

		Time of feeding		
Variables	Diets	Morning feeding	Evening feeding	Average
DM intake	D1	624.88±65.06	643.01±63.04	633.95±61.15[B]
(g/lamb/d)	D2	957.60±45.82	939.94±74.16	949.75±56.55[A]
	Average	791.24±183.21	774.98±168.94	
CP intake	D1	89.54±7.69	90.24±8.35	89.89±7.58[B]
(g/lamb/d)	D2	133.84±6.38	131.29±10.35	132.56±7.90[A]
	Average	111.69±24.32	110.76±23.30	
TDN intake	D1	399.75±43.19	413.11±41.21	406.43±40.42[B]
(g/lamb/d)	D2	633.82±30.75	625.24±49.57	629.53±37.64[A]
	Average	516.78±128.55	519.17±119.49	
ADG	D1	73.93±18.06	79.29±13.52	76.61±15.30[B]
(g/lamb/d)	D2	124.29±18.32	157.59±24.11	140.94±26.34[A]
	Average	99.11±31.60[b]	118.44±44.86[a]	
FCR	D1	7.88±1.09[b]	8.27±1.42[b]	8.07±1.21[b]
(DMI/ADG)	D2	7.84±1.28[b]	6.07±0.99[a]	7.05±1.44[a]
	Average	7.86±1.12	7.29±1.65	

D1: Diet 1(60%concentrate 1+40% natural grass), D2: Diet 2 (60% concentrate 2+40% MBS W), DM: Dry matter, CP: Crude protein, TDN: Total digestible nutrient, ADG: Average daily gain, Different superscripts in the same row or column (a, b) indicates significant differences (p<0.05), (A, B) (p<0.01)

2002). Notably, the diet D2 containing MBSW had a finer particle size, as well as a distinctive and fresher aroma, which may have resulted in the higher consumption than that seen for the grass-based D1 diet, which had a rougher texture.

The ADG of Garut lambs fed diet D2 was 140.94 g/lamb/d. This value was higher than that seen in previous studies of feed treatment improvement that yielded 117.7 g/lamb/d (Handiwirawan *et al*., 2004) in Garut sheep and 107.9 g/lamb/d (Herianti and Prawirodigdo, 2010) and 95.0 g/lamb/d (Duldjaman, 2004) in thin tailed sheep. Thus, the higher ADG of lambs fed a diet containing MBSW could be related to the digestibility of the nutrients, since nitrogen retention in lambs fed MBSW was higher (16.72 g/lamb/d) than that for lambs fed a grass-based diet (9.89 g/lamb/d).

For the FCR variable there was an interaction between different diets and feeding times (Table 3). The FCR of lambs fed diet D2 in the evening was significantly higher (6.07, p<0.05) than those given diet D1 in the morning or the evening (7.88 and 8.27, respectively) and lambs fed diet D2 (MBSW) in the morning (7.84). Moreover, the Garut lambs fed diet D2 in the evening in this study had FCR values that were higher than that seen in earlier studies wherein Jonggol and Garut sheep were fed pellets containing 30% waste sprouts (6.9 and 6.7, respectively; Rahayu *et al*., 2013), or Java thin tail sheep were given forage-based feed rations with added concentrate (7.2; Herianti and Prawirodigdo, 2010).

Physiological responses: Physiological response is a parameter that indicates bodily reactions to a variety of factors, including physical, chemical or environmental (Yousef, 1985). In this study, physiological responses were described in terms of rectal temperature (RT), respiration rate (RR) and heart rate (HR) (Table 4).

Statistical analysis showed that HR was significantly influenced by diet (p<0.01) and the interaction between

Table 4: Physiological responses

Variables	Diets	Morning feeding	Evening feeding	Average
		Time of feeding		
Respiration rate	D1	42.27±2.84	46.23±8.28	44.25±5.56
(freq./minute)	D2	50.33±6.04	48.27±7.57	49.30±6.81
	Average	46.30±4.44	47.26±7.93	
Heart rate	D1	93.97±3.68[b]	99.60±9.99[a,b]	96.78±6.83[A]
(beats/minute)	D2	107.97±5.84[a]	103.80±3.59[a]	105.88±4.71[B]
	Average	100.97±4.76	101.70±6.79	
Rectal temp	D1	38.84±0.18	38.96±0.15	38.90±0.16
(°C)	D2	38.99±0.09	39.10±0.21	39.05±0.15
	Average	38.92±0.14	38.98±0.18	

D1: Diet 1 (60%concentrate 1+40% natural grass), D2: Diet 2 (60% concentrate 2+40% MBSW), Different superscripts in the same row or column (a, b) indicates significant differences ($p<0.05$), (A, B) ($p<0.01$)

diet type and feeding time ($p<0.05$). Meanwhile, both treatments and their interaction did not affect other physiological parameters, including RR and RT. HR was higher in lambs given the MBSW diet D2 than lambs fed the grass diet D1. This result is likely due to compounds found in MBSW nutritional content, including haemagglutinin, antitrypsin, tannin and phytic acid (Mubarak, 2005). For example, haemagglutinin can cause clumping of red blood cells that induces an increased heart rate and enhanced blood circulation (Marquadt *et al.*, 1975). However, the overall lamb HR in this study (93.97-107.97 beats per minute) still fell within the normal range of 60 and 120 beats per minute as described by Duke (1995). The RR in all treatments in this study ranged from 42.27-50.33 with an average of 46.77/per minute, which is higher than that of normal sheep and falls within defined ranges for sheep experiencing mild heat stress. According to Silanikove (2000), the normal RR of sheep ranges between 20 and 40 freq per minute, while mild and high heat stress produced ranges of 60-80 and 80-200/min, respectively. Thus, the mild heat stress conditions seen for lambs in this study may have arisen from uncomfortable microclimates in the pens. The meteorological data collected during the study showed average pen temperatures ranging between 24.41 and 30.95°C and a humidity of 77.59-89.72%. Considering that Yousef (1985) described comfortable temperatures for sheep as ranging between 22 and 31°C with humidity <75%, the temperatures in this study were within the comfort range but the humidity was high. Meanwhile, the RT for the animals in this study ranged from 38.84 to 39.10°C, which falls within the normal category (38.80-39.90°C; Marai *et al.*, 2007).

Conclusion: Diets containing 40% MBSW as a fiber source substitute and evening feeding times could increase growth performance with normal physiological responses in Garut lambs. The Average Daily Gain (ADG) and Feed Conversion Ratio (FCR) of Garut lambs fed a MBSW diet in the evening (157.59 g/lamb/d and 6.07, respectively) were higher than those for lambs fed a grass diet in the morning (73.93 g/lamb/d and 7.88, respectively).

REFERENCES

Anindita, D.U., R. Dewanti and Sudiyono, 2014. The effect of fresh corn husk supplementation in the diet on performance of male New Zealand White crossbred rabbits. Bull. Peternakan, 38: 90-94.

Brosh, A., Y. Aharoni, A.A. Degen, D. Wright and B.A. Young, 1998. Effects of solar radiation, dietary energy and time of feeding on thermoregulatory responses and energy balance in cattle in a hot environment. J. Anim. Sci., 76: 2671-2677.

Duke, N.H., 1995. The Physiology of Domestic Animal. Comstock Pub., New York.

Duldjaman, M., 2004. The use tofu by product to improve the nutrition of the local sheep feed. Med. Pet., 27: 107-110.

Forbes, J.M. and R.W. Mayes, 2002. Food Choice. In: Sheep Nutrition, edited by M. Freer and H. Dove. CABI and CSIRO Publishing, Canberra.

Gaughan, J.B., T.L. Mader, S.M. Holt, G.L. Hahn and B.A. Young, 2002. Review of current assessment of cattle and microclimate during periods of high heat load. Anim. Prod. Aust., 24: 77-80.

Hahn, G.L., 1999. Dynamic responses of cattle to thermal heat loads. J. Anim. Sci., 77: 10-20.

Handiwirawan, E., H. Hasinah, I.G.A.P. Mahendri, A. Priyanti and I. Inounu, 2004. The Productivity of Garut Lambs in Two Different Agroecosystem. Pros. Seminar Nasional Teknologi Peternakan dan Vet., pp: 335-340.

Herianti, I. and S. Prawirodigdo, 2010. Introduction of Formula for Improving Diet Quality in the Sheep Fattening Farm at Pringsurat Village of Temanggung District. Pros. Seminar Nasional Teknologi Peternakan dan Vet., pp: 593-598.

Ifafah, W.W., S. Rahayu, D. Diapari and M. Baihaqi, 2011. The utilization of bean sprout waste as a sheep feed in order to reduce waste pollution in Indonesian traditional market. Proceedings of the 18th Tri-University International Joint Seminar and Symposium 2011 Jiangsu University, China. October, 26-31.

Kandemir, C., N. Kosum and T. Taskin, 2013. Effects of heat stress on physiological traits in sheep. Macedonian J. Anim. Sci., 3: 25-29.

Marai, I.F.M., A.A. El-Darawany, A. Fadiel and M.A.M. Abdel-Hafez, 2007. Physiological traits as affected by heat stress in sheep. Small Ruminant Res., 71: 1-12.

Marquadt, R.R., J.A. McKirdy, T. Ward and L.D. Campbell, 1975. Amino acid, hemaglutinin and trypsin inhibitor levels and proximate analysis of faba beans, faba beans fractions. J. Anim. Sci., 55: 421-429.

Mubarak, A.E., 2005. Nutritional composition and nutritional factors of mung bean seeds (Phaseolus aureus) as affected by some home traditional precesses. Food Chem., 89: 489-495.

NRC, 1985. Nutrient Requirements of Sheep National Academic Press, Washington DC.

Prawirodigdo, S. and D. Andayani, 2005. Health condition of the Rex rabbits fed on diets containing fermented vegatable and fruit waste using Aspergillus niger. J. Indon. Trop. Anim. Agric., 30: 75-80.

Preston, T.R. and R.A. Leng, 1987. Matching ruminant production system with available resources in the tropics. CAB Direct. www.cabdirect.org. ISBN 09588290-1-2.

Rahayu, S., D.S. Wadito and W.W. Ifafah, 2010. Survey Potensi Limbah Tauge di Kotamadya Bogor. Laporan Penelitian Fakultas Peternakan Institut Pertanian Bogor, Bogor.

Rahayu, S., M. Yamin, D.A. Astuti, R. Priyanto and M. Baihaqi, 2013. Growth Performance of Local Sheep Fed with Mung Bean Sprouts Waste. Proc. Seminar of SAADC in China, pp: 248-249.

Silanikove, N., 2000. Effects of heat stress on the welfare of extensively managed domestic ruminants. J. Livest. Prod. Sci., 67: 1-18.

Sodiq, A. and E.S. Tawfik, 2004. Productivity and breeding strategies of sheep in Indonesia: A Review. J. Agric. and Rur. Development in Tropics and Subtropics, 105: 71-82.

Sumantri, C., A. Einstiana, J.F. Salamena and I. Inounu, 2007. Keragaan dan hubungan phylogenic antar domba lokal di Indonesia melalui pendekatan analisis morfologi. J. Ilmu Ternak and Vet., 12: 42-54.

Utama, C.S., N. Suthama, B. Sulistiyanto, S. Sumarsih and R.I. Pujaningsih, 2011. Rice bran quality change that enriched vegetable market waste extract as potential fungtional feed as probiotic. Laporan Penelitian, 15: 13-16.

Yani, A. and B.P. Purwanto, 2006. Pengaruh iklim mikro terhadap respon fisiologis sapi peranakan Fries Holland dan modifikasi untuk meningkatkan produktivitasnya. Med. Pet., 29: 35-46.

Yousef, M.K., 1985. Stress Physiology in Livestock. Volume I. CRC Press Inc., Boca Raton, Florida.