ENERGY BALANCE AND PERFORMANCE OF BALI CATTLE FED WITH DIFFERENT TYPES AND COMPOSITIONS OF FORAGE

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ABSTRACT

An experiment was carried out to determine the energy balance and performance of bali cattle fed different forage compositions. Randomized Block Design consisted of four feed treatments with 3 block of weight live as replicates were used in this study. The initial weight of male bali cattle used range between 181-265 kg. These four treatments based on dry matter (DM) were: A (45% elephant grass + 0% rice straw + 15% glyricidia + 10% calliandra + 30% concentrate); B (30% elephant grass +10% rice straw + 20% glyricidia + 10% calliandra+ 30% concentrate) ; C (15% elephant grass +20% rice straw + 25% glyricidia +10% calliandra + 30% concentrate) and treatmen D (0% elephant grass + 30% rice straw + 30% glyricidia + 10% calliandra+ 30% concentrate) . Variables which were measured: nutrient consumption, balance energy, energy retention, weight gain and FCR. The results showed that Dry Matter and energy intake were highest in treatment C, but not significantly different ($P>0.05$) compare with the others. Weight gain was significantly the highest ($P<0.05$) in treatment C and FCR significantly the lowest ($P<0.05$). Energy retention treatments B, C and D did not show significant differences ($P> 0.05$) but in the A treatment significantly the lowest ($P<0.05$). Heat production significantly the lowest ($P<0.05$) in treatment D compared to treatment A and C. It could be concluded that the ration C gave lowest FCR and had higest weight gain compared to others treatment.

Key words : forage composition, energy balance, bali cattle productivity

INTRODUCTION

Forage is the largest component constituent in ruminant feeds. In the tropics, forage quantity and quality vary widely (Romney dan Gill, 2000). Traditionally kept forage given to cattle generally have a low quality of content and marked with low Total Digestible Nutrient (TDN), low protein, high crude fiber and low digestibility. Practically on the field, farmers often only give one type of forage. Although there are farmers who provide a variety of forage, but they do not provide it in a suitable composition so that the balance of nutrients needs for livestock are not met.

The use of a hundred percent of forage is still able to increase the productivity of livestock, provided that the proportion is arranged so that the balance of nutrients for livestock's physiological needs is met. Forage used should at least consist of forage as a source of energy and protein source as well as contained minerals and vitamins needed by livestocks (Putra, 1999).

Improving the balance of nutrients through feeding animals variety of forage as a source of energy and source of Rumen Degradable Protein (RDP) and Rumen Undegradable Protein (RUP) is important to stimulate rumen microbial activities. Increasing rumen microbial activity will have an impact in increasing the productivity of livestock. Widyobroto *et al.* (2008) stated that in high-producing ruminants, RUP supplementation is absolutely necessary yet still taking into account the availability of precursors of nitrogen for rumen microbes. When N precursor is sufficient for the synthesis of microbial protein, it will lead to optimal rumen microbial proliferation and increase fiber digestibility.

Although forage contains low energy, but it is the largest source of fiber. Fiber forage to ruminants play a fundamental role in maximizing Dry Matter Intake (DMI), stimulate chewing activity and fermentation in the rumen (Nadeem and Sufyan, 2005). NRC (2000) reported that there is a relationship between the energy content of feed and DMI. If the feed given is high in fiber so that the digestibility is low and energy content is low, the dry matter intake will be limited by the capacity of the rumen and digesta flow rate. Meanwhile, if the feed given low in fiber and high in concentrate so that digestibility of feed and energy content is high, the DMI will be limited by the fulfillment of livestock for energy

and metabolic factors. In other words, if the animal's energy needs are met, then the animal will stop eating.

Based on the ilustration above, strategies are needed to set a given forage according to the characteristics of the feed material, in order to reach a nutrients balance for the microbes and host animal. Forage feeding serves to complement a variety of nutrient deficiencies of each ingredient. This research was conducted by using elephant grass and rice straw as an energy sources, glyricidia as a source of RDP and calliandra as a source of bypass protein (RUP). In the particular feed composition, microbial nutrient demand is expected to be met, the microbial activity reached maximum, and the efficiency of feed use increase, with the result that the productivity of livestock is also increasing.

MATERIAL AND METHOD

This research was conducted on Wibuh Mandiri farmers group at Banjar Tangkeban Batuyang Kangin village, Sub-district Sukawati Gianyar Regency. Feed adaptation was allocated for 10 days and data collection of nutrient intake, energy balance and cattle performance were conducted for 12 weeks.

Randomized Block Design consisted of four treatment rations three live weight groups as block or replicates were used in this study. A total 12 male bali cattle were devided into 3 groups with an average live weight 195.25 kg (group I), 230.5 kg (group II) and 241.75 kg (group III) respectively. All animal were fed *ad libitum* with mash form feed with compositions as shown in Table 1, its and nutrient content as shown in Table 2.

Tabel 1. Ration Composition (% DM)

Ration Component	Treatments			
	A	B	C	D
Elephant grass	45.00	30.00	15.00	0.00
Rice straw	0.00	10.00	20.00	30.00
Glyricidia	15.00	20.00	25.00	30.00
Calliandra	10.00	10.00	10.00	10.00
Concentrate	30.00	30.00	30.00	30.00
Total	100.00	100.00	100.00	100.00

Total collections of feces and urine was carried out within 7 days periode in the last week of the research. Observations made during the total collection start from 08.00 am until 8:00 am the next day. Ration and the remain of the ration were taken each 200 g per day and at the end the total collection were mixed and composited according to the animals. Once they were mixed, then they were taken each 200 g for chemical and energy determination following the method of AOAC (1980). The similar method also need for the feces. Fresh feces were collected immediately and weighed in order to know production within 24 hours. After drying in the sun and composited at the end of the research, 200 g of feces sample of each animal was taken for analysis.

Tabel 2. Nutrient Content of Rations

Nutrient content (% DM)	Treatments				Kearl Standard (1982)
	A	B	C	D	
Energy (kcal/kg)	3346	3307	3297	3109	
Crude protein	11.71	11.51	11.54	12.05	12.32
Crude fat	1.63	1.83	1.65	2.29	
Crude fiber	25.36	25.94	25.53	21.59	
TDN	60.98	59.65	58.65	60.91	66.07
Calcium	0.47	0.84	0.79	1.71	0.48
Phospor	0.10	0.12	0.12	0.09	0.30
NDF	62.57	58.23	56.23	59.40	
ADF	45.48	42.76	38.10	36.95	
ADL	3.45	4.78	5.23	7.78	

Analysis at Laboratorium Nutrisi Loka Penelitian Sapi Potong Grati (2011)

Animal urine was collected daily. A total of 100 ml urine sample was taken and soon was mix with 75% HCl to bind the N content of the urine.

All data obtained in this study were analyzed using analysis of variance and whenever treatments are significantly different ($P<0.05$), the analysis were continued using orthogonal contrast test at level 5% (Steel and Torrie, 1986).

RESULT AND DISCUSSION

Nutrient Intake

The average nutrient intake are presented in Table 3. The results showed that all treatments had no effect (P>0.05) on the dry matter intake, organic matter intake and energy intake, although cattle on treatment C consumed dry matter and and energy the higest.

Increasing glyricidia as RDP on level 25% and 30%, significantly increase (P <0.05) consumption of crude protein. Decrease in elephant grass which is counterbalanced by an increase in rice straw and glyricidia from treatment A to treatment D will increase the consumption of crude fat and reduce the consumption of crude fiber. Widyobroto *et al.* (2008) reported that high consumption of crude protein causes the high consumption of dry matter as well. This is because of the DMI had a positive response to the consumption of crude protein. This result is in line with Baumann *et al.* (2004) where supplementation of RDP increased total DMI.

Tabel 3. Average of Nutrient Consumption during Observation

Variables	Treatments				SEM
	A	B	C	D	
Dry matter intake (g/d)	6881.19[a]	6318.00[a]	7003.52[a]	6585.96[a]	262.56
Organic matter intake (g/d)	5991.69[a]	5487.82[a]	5891.47[a]	5528.60[a]	222,19
Energy intake (kcal/d)	23024.5[a]	20893.6[a]	23090.6[a]	20475.8[a]	842.92
Crude protein intake (g/d)	707.04[a]	752.74[a]	847.10[b]	838.00[b]	8.00
Crude fiber intake (g/d)	1741.46[a]	1636.75[a]	1693.51[a]	1412.26[b]	22.53
Crude fat intake(g/d)	120.07[a]	127.69[a]	123.70[a]	166.72[b]	3.84

Explanation :
A = 45% elephant grass + 0% rice straw + 15% glyricidia+10% calliandra + 30% concentrate
B = 30% elephant grass +10% rice straw +20% glyricidia +10% calliandra + 30% concentrate
C = 15% elephant grass +20% rice straw +25% glyricidia +10% calliandra + 30% concentrate
D = 0% elephant grass +30% rice straw + 30% glyricidia + 10% calliandra + 30% concentrate
Numbers with different superscript in the same row are significantly different(P<0,05)
SEM = "*Standard Error of the Treatment Means*"

In this study, glyricidia as a source of RDP on the provision level 25% in the ration combined with elephant grass and rice straw as an energy source causes the

highest DMI. Composition of the forage in the treatment C increasing palatability of the ration so increasing the DMI. The results of this study is lower than the results reported by Suryani *et al*. (2009), where the DMI of bali cattle fed with rice straw and concentrate supplemented with aloe vera waste as High Quality Feed Supplement (HQFS) was from 8.93 to 9.40 kg/d. If it is not supplemented with HQFS then the DMI is ranged from 9.43 to 9.58 kg/d.

Energy Balance

The provision of rations containing different elephant grass and rice straw composition as an energy source, had no significant differences (P> 0.05) on energy consumption, fecal energy, DE, urine energy, and the methane energy. The highest metabolizable energy (ME) is contained in the C-treated cattle that is 12137.49 kcal/d (Table 4).

Tabel 4. Effect of Ration Composition on Energy Balance (kcal/d)

Variables	Treatments				SEM
	A	B	C	D	
Energy consumption	23024.5[a]	20893.6[a]	23090.6[a]	20475.8[a]	1614.08
Energy fesses	8655.90[a]	9113.68[a]	8262.29[a]	8266.90[a]	556.12
Digestible energy	14368.55[a]	11779.95[a]	14828.33[a]	12208.86[a]	1535.24
Energy urine	762.63[a]	751.36[a]	843.60[a]	884.37[a]	92.78
Energy methan	1841.96[a]	1671.49[a]	1847.25[a]	1638.06[a]	129.13
ME	11763.97[ab]	9357.10[c]	12137.49[a]	9686.42[bc]	644.98
Energy retention	1602.41[a]	2022.03[ab]	2264.81[b]	2323.96[b]	141.67
Heat production	9760.96[a]	6862.85[b]	9306.47[a]	6781.47[b]	469.34
Heat production ($MJ/W^{0.75}$)	0.59[a]	0.43[b]	0.53[a]	0.40[b]	0.03

Explanation :
A = 45% elephant grass + 0% rice straw + 15% glyricidia+10% calliandra + 30% concentrate
B = 30% elephant grass +10% rice straw +20% glyricidia +10% calliandra + 30% concentrate
C = 15% elephant grass +20% rice straw +25% glyricidia +10% calliandra +30 % concentrate
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Numbers with different superscript in the same row are significantly different(P<0.05)
SEM = "*Standard Error of the Treatment Means*"

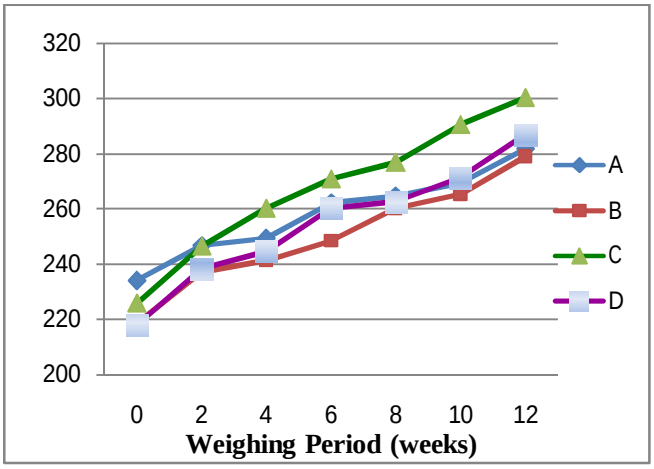
Amount of energy that can be utilized by the feed given to livestock can be seen from the metabolizable energy. The amount of metabolizable energy is the digestible energy reduced by the energy lost through the urine and energy of methane. The increase of glyricidia as a source of RDP and rice straw, also

decrease of elephant grass cause the highest metabolizable energy in the ration C. Amount of energy retention obtained through calculation using the equivalent calorific amount of protein and fat in body composition with urea space technique. Energy retention of this study ranged from 1602.41 to 2323.96 kcal/d. equal to 23.29 to 33.33 kcal/$W^{0.75}$. Research conducted by Partama *et al.* (2010) on bali cattle fed with rice straw amoniation and waste of agro-industry supplemented with a multi vitamin mineral produce higher energy retention is 29.52 to 43.27 kcal/$W^{0.75}$. The amount of energy retention gives a positive impact on weight gain. Table 4 shows that cows given treatment B, C and D increase along with the increase in energy retention.

Cattle fed with treatment B. C and D had a significantly higher in energy retention compared with cattle treated with treatment A. This is due to the composition of the rations B, C and D make livestock are able to take advantage of feed efficiently proven by lower FCR number and less energy wasted through heat production compared with treatment A. In this study. heat production is range from 0.40 to 0.59 MJ/$W^{0.75}$. Mahardika (1996) found the heat production in resting buffaloes are 0.42 MJ/$W^{0.75}$. meanwhile Sukarini (2000) get the heat production of pregnant bali cattle is 0.69 to 0.77 MJ/$W^{0.75}$

Bali Cattle Performance

Performance of bali cattle during the study are presented in Table 5. The lowest daily weight gain during the study was demonstrated by cattles received treatment A (0.57 kg/d) and the highest was presented by cattles received treatment C (0.88 kg/d). The results of this study was higher than daily weight gain of bali cattle found in previous studies. Bali cattle fed rice straw and concentrate supplemented by waste of aloe vera as HQFS showed daily weight gain ranged from 0.57 to 0.64 kg/d (Suryani *et al*., 2009), Partama *et al.* (2010) found daily weight gain of bali cattle ranged from 0.45 to 0.67 kg/d by feeding the cattle with amoniated rice straw and wastes of agro-industry supplemented with multi vitamin mineral.



Picture 1. Performance of Bali Cattle Treated by A, B, C and D Rations

The increase of glyricidia as RDP and rice straw in the treatment B, C and D, significantly (P<0.05) increased the efficiency of the feed utilization indicated by lower FCR, so the impact on weight gain is higher for cow received three treatment of this rations. Based on the results of this study. the highest crude protein intake and dry matter intake was there in cattle treatment C (Table 3). High dry matter and crude protein consumption have impact in increasing the digesta flow rate thus increasing the absorption of nutrients for animals to increase weight gain.

Tabel 5. Bali Cattle Performance

Variable	Treatment				SEM
	A	B	C	D	
Initial weight (kg)	234.11[a2)]	218.83[a]	226.00[a]	218.17[a]	6.03
Final weight (kg)	281.85[a]	279.00[a]	300.32[a]	287.00[a]	6.41
Total weight gain (kg)	47.74[a]	60.17[ab]	74.32[b]	68.83[b]	2.74
Weight gain (kg/d)	0.57[a]	0.72[ab]	0.88[b]	0.82[b]	0.03
Feed Convertion Ratio	12.19[a]	9.09[b]	8.08[b]	8.10[b]	0.32

Explanation :
A = 45% elephant grass + 0% rice straw + 15% glyricidia+10% calliandra + 30% concentrate
B = 30% elephant grass +10% rice straw +20% glyricidia +10% calliandra + 30% concentrate
C = 15% elephant grass +20% rice straw +25% glyricidia +10% calliandra +30 % concentrate
D = 0% elephant grass +30% rice straw + 30% glyricidia + 10% calliandra + 30% concentrate
Numbers with different superscript in the same row are significantly different(P<0.05)
SEM = "*Standard Error of the Treatment Means*"

CONCLUSION

Based on the results of this study, it can be concluded that:

1. Decreasing elephant grass 45% to 0%, accompanied by increasing rice straw from 0% to 30% as a source of energy needs supplementation of glyricidia as RDP by 15% to 30% to increase energy retention and decreasing heat production in bali cattle.
2. The best performance of bali cattle was showed by feeding with rations C based on their higest daily weight gain and the lowest Feed Convertion Ratio.

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