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THE EFFECT OF ENERGY LEVEL OF FEEDING ON DAILY GAIN, BLOOD GLUCOSE AND UREA ON MADURA CATTLE

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ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi pengaruh tingkat energi pakan terhadap pertambahan bobot badan harian sapi Madura melalui metabolisme darah (glukosa dan urea darah). Dua belas (12) sapi Madura jantan umur 2 tahun dengan bobot badan 156,27 ± 6,92 kg (CV 4,43%) digunakan sebagai materi penelitian. Rancangan acak lengkap diaplikasikan untuk tiga perlakuan pakan (tingkat energi rendah, menengah dan tinggi) dengan empat ulangan. Pertambahan bobot badan diukur selama 90 hari, sedangkan metabolit darah diukur pada tengah penelitian. Hasil penelitian menunjukkan bahwa tingkat energi pakan tidak berpengaruh (P>0,05) pada PBBH, asupan bahan kering, kecernaan bahan kering, asupan energi dan konversi pakan. Konsentrasi glukosa darah berkisar 67-75 mg/dL, sedangkan konsentrasi urea darah berkisar 35-50 mg/dL, dengan efisiensi energi pakan mencapai 0,145 MJ/g PBBH. Disimpulkan bahwa pakan berenergi tinggi tidak mampu memberikan performa yang lebih baik pada sapi Madura karena dipengaruhi oleh faktor pembatas dalam mengkonsumsi BK.

Kata kunci: energi pakan, glukosa darah, urea darah, efisiensi pakan, sapi Madura.

ABSTRACT

This study was aimed to evaluate the effect of dietary energy level on daily gain of Madura cattle and their blood metabolites (glucose and blood urea). Twelve (12) male Madura cattle aged at 2 years old, 156.27±6.92 kg (CV 4.43%) of body weight were used in this study which was assigned to completely randomized design for three feeding treatments (low, middle and high energy contents) and four replications. The daily gain was measured for 90 days, while the blood metabolites were measured at the middle of experiment. Results showed that dietary energy levels did not affect (P>0.05) average daily gain, dry matter intake, dry matter digestibility, energy intake and feed conversion ratio. Blood glucose and blood urea concentration were ranged at 67-75 and 35-50 mg/dL, respectively, while feed energy efficiency reached 0.145 MJ/g ADG. In conclusion, high-level energy could not provide better performance in Madura cattle because of a limitation factor on the DMI.

Keywords: dietary energy, blood glucose, blood urea, feed efficiency, Madura cattle

INTRODUCTION

Madura cattle is one of indigenous cattle live in Indonesia, has several physical characteristic showing this cattle generated from Bali cattle (*Bos sondaicus*) such as small frame, brown brick color and dark brown to black color for mature bull. But, the white color in bottom of legs and buttock was vague and unclear. These cattle were raised and developed in Madura Island. However,

the potency of these cattle was not attracting the feedlot company yet, due to low daily gain reported based on their performance under smallholder farmers. The reason for this low performance might be pointed to insufficiency in nutrients requirement by the cattle (Brithal dan Ravishankar, 1999).

The productivity was not merely depend on genetics potential, but mostly depend on fulfilling nutrients requirements for animal production. Dietary energy plays an important role to support the daily gain as well as the animal health (Katungaka-Rwakishaya *et al.*, 1999, Austin, 2001). In ruminant, the dietary energy and protein affects ruminal fermentation related to total amino acids and its composition as well as microbial synthesis (Asplund, 1994). High energy content in the diet will lead carbohydrates fermentation and resulting in increasing VFA in the rumen which will be absorbed and changed to be glucose as energetic compound for the body (Richards *et al.*, 1995). On the other hand, lack of energy in feeding will lead the animal to catabolize the body reserve including body protein which will lift urea concentration in blood (Greenwood *et al.*, 2002). The sufficient dietary energy intake could support microbial protein synthesis in the rumen that may reduce ammonia concentration in the rumen and in turn urea in blood (Katunguka-Rwakishaya *et al*., 1999).

Concentration of blood metabolites are the integrated index of nutrients sufficiency related to nutrients utilization (Chester-Jones *et al.*, 1990). The blood glucose and blood urea-N could be used to monitor the nutritive status of ruminant (Doornenbal *et al.,* 1988; Hammond *et al*., 1993; Grunwaldt *et al.*, 2005), at least for certain period of time (Pambu-Gollah *et al*, 2000). The study on Belgian Blue cattle by Fiems *et al*. (2013) showed that energy intake at 30% below the maintenance requirements was not change the level of blood glucose, but energy intake at 30% higher than maintenance requirements tended to increase the blood glucose. Similar results were reported by Fujita *et al*. (2006) who found that blood glucose was at similar level although the goat was fed 1x, 1.5x and 2x of maintenance level. However, the blood glucose was decreased and blood urea was increased in animal fasted for 36 hours, as a result of body protein catabolism (Schaefer *et al.*, 1990; Gregory, 1998) resulted in decreasing the body weight.

Some researchers reported that blood glucose was also influenced by animal breed. Matsuzaki *et al.* (1997) studied using 3 (three) breeds of Japanese cattle (Japanese Black, Japanese Brown, and Holstein) found that blood glucose among the cattle breeds was at different levels. However, Madziga *et al.* (2013) reported that there were no differences on blood glucose among 4 (four) breeds of African cattle, i.e. Bunaji, Rahaji, Sokoto Gudali dan Azawak.

Based on the above explanations, the similar study on Madura cattle is needed due to the important role of blood metabolites for monitoring the nutrients utilization and nutrients sufficiency, especially on dietary energy in beef cattle.

MATERIALS AND METHODS

Animal Management and Feeding Treatments

Twelve (12) male Madura cattle aged about 2 years old, 156.27±6.92 kg (CV 4.43%) of body weight and at similar health condition was used in this study. The cattle were purchased from Madura island and brought to Semarang. The cattle were grouped into three for feeding treatments (each consisted 4 animals as replication) and were placed in individual barn equipped with feeding bunk and drink water. The experimental feeding was consisted of Napier grass (30%) and concentrate feeding (70%) composed of soybean meal, wheat bran and dried-cassava powder. The feed was formulated to give protein at around 14% and three levels of dietary energy calculated based on total digestible nutrients (TDN) content.

Feeding treatments were feeds containing TDN 50% (low energy; LE), 55% (mid energy; ME) and 60% (high energy; HE), which was given to fulfill the requirements of dry matter at 3.0% of body weight and was adjusted by weekly body weight measurement. The formula of feed and its chemical compositions are presented in Table 1. The feed was given at twice daily at 0600 and 1400 for Napier grass while the concentrate was 1 hour after grass allowance. Water was freely allowed. Animal was weighed weekly to adjust the feed given in the next week

Data Collection

This study was done following 4 (four) periods i.e. preparation, adaptation, preliminary and data collection periods. The first two periods were aimed to introduce feedstuffs to animal and adapted animal to the new management and environmental conditions. At this period, the

animals were also randomly placed for the treatments.

Feed sample was composited from weekly collection during the experimental period. The feed given and the orts were weighed daily to determined dry matter intake. Feed utilization was measured by 7 days total collection methods, in which during this period the feed, feces and urine were collected and sampled for Wendee proximate analysis as described by AOAC procedure (2000), while the energy was determined by bomb calorimeter. The intake of nutrients and dietary energy were calculated by multiplying dry matter intake to the nutrients and energy contents in the feed, while the nutrients utilization were determined by subtracting nutrients excreted in feces and urine to nutrients intake from feed.

Parameter Analysis Procedure

All samples were oven-dried at 60^{o}C to obtain constant weight for storage prior to further analysis. During total collection period, feed, feces and orts were analyzed for dry matter, crude protein, ether extract, crude fiber, nitrogen free extract and energy. Dry matter of feed and feces was determined according to AOAC (2000). Dry matter content was determined by oven-drying at 100ºC for 24 hours, while crude ash was determined by using combustion at 550ºC for 3 hours (AOAC, 2000). Organic matter (OM) was calculated by subtracting crude ash from dry matter. Crude protein was measured by Kjeldahl Procedure using Kjeltec Auto 1013 Analyzer, Tecator, Swedia. Extract ether was determined by extracting sample using petroleum ether (60 - 80ºC) for 8 hours, while crude fiber (CF) was determined using 1.25% H_2SO_4 and 1.25% NaOH. NFE was calculated by subtracting CP, EE, and CF from 100 (Van Soest *et al*., 1991).

Blood samples were collected through jugularis vein an amount of 10 ml by using steril disposible syringe at 0, 3, and 6 hours after feeding. The blood samples were placed on test tube then was centrifuged at 3000 rpm for 10

Table 1. The Chemical Composition of Feedstuffs and Nutrients Contents of Experimental Diets (at 100% DM) for Each Energy Level

	Feeding Treatments*		
	LE	ME	HE
Feedstuff Components	---------- (% of total amount) ----------		
Napier grass	30.0	30.0	30.0
Rice bran	45.4	26.5	6.7
Dried-cassava powder	3.3	6.5	8.3
Wheat bran	8.0	29.0	42.0
Soybean meal	13.3	8.0	13.0
Nutrient Contents	---------- in 100% DM ----------		
Crude Protein	14.5	15.9	15.2
Ether Extract	2.4	2.2	2.3
Crude Fiber	31.4	21.5	16.8
Ash	17.8	13.7	12.0
NFE	33.9	47.3	53.5
TDN	48.2	55.1	62.4
Gross Energy (kcal/g)	4.8	4.9	5.0

*) LE : low energy; ME : mid energy; HE ; high energy; nutrients contents was obtained from sampling during whole experimental period, while TDN was obtained by digestion trials.

minutes to obtain blood plasma for further analysis of blood glucose and blood urea using glucose and urea commercial kits (Bavaria diagnostica, Hamburg, Germany), respectively. The average daily gain (ADG) was calculated by dividing the body weight gain during the experiment with measurement day (90 days).

Statistical Analysis

The parameters observed were analyzed by ANOVA. When there was a significant difference ($P<0.05$) among the treatments, the further test by multiple t-test was carried out using SPSS for Windows series 20.0.

RESULTS AND DISCUSSIONS

Feed Intake

The feeding treatments had no significant effect on the DMI, DM digestibility, energy intake, body weight gain and feed conversion ($P\geq 0.05$) (Table 2). Nevertheless, the feeding system had significant effect on digestibility ($P\leq 0.05$). This was pointed to the similar feedstuffs, breed, and physiological condition used in this study. Lapitan *et al*. (2008) reported that DMI was influenced by CP, CF and energy of feedstuffs as well as genetic and age of animals. NRC (2000) revealed that DMI had positive correlation with energy intake as well as OM and CP.

Energy consumptions were not different ($p>0.05$) among treatments (Table 2). The higher-level energy in the diet gives higher body weight gain. However, the fact occurred was agree to that described by McDonald *et al.* (1996), that the higher level of energy in the diet gives the lower feed intake. This made ADG reached on HE equal to ME and LE, as a result of energy intake that was not different from other treatments. Energy intake was not different at HE treatment and it was explained that the threshold of satiety and metabolic requirements have been fulfilled (Grovum, 1995).

Energy efficiency of Madura cattle in this study (0.145 MJ/gADG) was more efficient than that reported by Umar (2007), being 0.166 MJ/gADG. It was caused by the quality of feed in this study better than the feed of Umar (2007). The better feed quality gives the higher efficiency. Other results indicated by Jabres (Jawa-Brebes strain) cattle who has the blood of *Bos taurus* (Sutopo, 2001; Rouse, 1976), has a value of efficiency at 0:11 MJ/gADG (Lestari, 2012) showed that *Bos taurus* has a better feed metabolism than *Bos indicus* (Sumedi *et al.*, 1991). In addition, the energy efficiency of animal was affected by genetic factors, energy consumption and feed quality (Greenwood *et al.*, 2002).

Feed conversion was influenced by biological capabilities and interaction with the environment (Carstens and Tedeschi, 2006; Arthur

Table 2. Dry Matter Intake, Energy, and Crude Protein on Fattened Madura Cattle

Variables	Treatments*			P_{value}
	LE	ME	HE	
Initial weight, (kg)	152	156	162	0.19
Final weight, (kg)	204	210	210	0.60
ADG, (g/d)	771	810	709	0.68
DMI, (kg/d)	5.5	5.8	5.0	0.25
DM digestible, (kg/d)	2.9	3.3	3.3	0.14
DM digestibility, (%)	52.5^{a}	56.6^{b}	66.0^{c}	0.00
Gross energy intake, (MJ/d)	112	117	104	0.39
CP intake, (kg/d)	0.52	0.61	0.51	0.07
FCR	7.2	7.2	7.5	0.93

*) LE : low energy; ME : mid energy; HE ; high energy; ADG: average daily gain; DMI: dry matter intake; DM: dry matter; CP: crude protein; FCR: feed conversion ratio. ^{abc} superscripts in the same row indicates differ significantly ($P<0.05$).

and Herd, 2008). Generally, the good value of feed conversion was ranged at 4.5-7.5 (Shike, 2013). In this study, the feed conversion value (7.3) was quite good when compared with the results of other studies from different types of cattle, such as Jabres cattle (12.80; Lestari, 2012), Ongole crossbred (8.12 - 11.20; Hamdan *et al*., 2004; Umar *et al*., 2007; Purnomoadi *et al.*, 2007), Bali cattle (7.55; Tahuk and Dethan, 2010) and Limousin crossbred cattle (7.90; Juergenson, 1980), respectively, showing that breeds or genetic factors influenced feed conversion by the biological capability in feed utilization.

Blood Glucose

The changes of blood glucose concentration in Madura cattle by different energy level are shown in Table 3. The blood glucose concentration was not affected by energy level of feeding, however, the concentration of blood glucose in LE and ME was high at h-0 and h-6 post-feeding indicated that the nutrients intakes provided sufficient amounts, so that the glucose would be available for daily activity and production. However, in HE treatments, the blood glucose concentration in h-0 was lower than that in other treatments, despite it was still in a normal range of 43-100 mg/dL as stated by Mitruka *et al*. (1977).

This phenomenon indicated that the Madura cattle fed with high-level energy could still utilize carbohydrates properly, though the energy consumption was lower than other treatments, resulted in similar ADG. Glucose concentration was related to energy intake. When the energy intake was high, then glucose concentration would be high.

The concentration of blood metabolites (glucose and urea) is an index of the integrated supply sufficient nutrients to the nutrient utilization (Chester-Jones *et al*., 1990; Ndlovu, 2007). The blood glucose of Madura cattle in this study ranged at 67-75 mg/dL (Table 3), and was finding with other reports (Umar, 2007; Lestari, 2012). Umar (2007) reported that blood glucose in Ongole Grade cattle was ranged at 66-88 mg/dL, and it was higher than Jabres cattle ranged at 63-81 mg/dL (Lestari, 2012). However, the consistent results of blood glucose concentration on Madura cattle was high energy level did not lead to increase body fat.

Blood Urea Nitrogen

Blood urea concentrations in this research are shown in Table 3, and found that there was no differences (P>0.05) among the treatments. This was due to the similarity in crude protein intake (see Table 2).

Blood urea nitrogen (BUN) could be used as an indicator of the changes of nutritional status due to its associated with rumen ammonia, feed intake, and energy intake. The concentration of BUN in this study ranged at 35-50 mg/dL, was still in the normal range of 1.6-3.4 mmol/L, equivalent to 26.6 to 56.6 mg/dL stated by Hungate (1966) as well as far from the maximum limits at 80 mg/dL Bondi (1987). This study was high compared to the study on 2 years old Nellore

Table 3. Blood Glucose and Urea Concentration of Fattened Madura Cattle

Parameters	Treatments*			Average
	LE	ME	HE	
Blood glucose (mg/dL)				
0 h	74.08	78.33	62.67	71.69
3 h	63.53	69.28	67.73	66.85
6 h	67.80	76.08	72.40	72.09
Blood urea N (mg/dL)				
0 h	54.66	39.50	56.93	50.36
3 h	60.18	43.01	60.69	54.63
6 h	32.11	24.04	31.94	29.36

*) LE : low energy; ME : mid energy; HE: high energy

cattle in Eastern Gurguéia which found 26.68 mg/dL (Saraiva *et al*., 2014) and FH cross ranged at 19-23 mg/dL (Wahjuni and Bijanti, 2006). The study by Preston *et al*. (1978) in the cattle at finishing period had BUN ranged from 7 to 8 mg/dL, while Mitruka (1981) reported at 6-27 mg/dL. Carvalho *et al*. (2010) reported that high concentrations of BUN causes inefficient in the using of energy. The concentration of BUN that achieved in this study indicated that Madura cattle had a good ability to utilize nutrients.

CONCLUSION

The result of this study showed that high-level energy (HE) could not provide better performance in Madura cattle due to limited factor in the DMI that made the productivity did not achieve optimally. This was approved by the blood glucose and urea recorded during treatment. High level energy was considered resulted in low blood glucose and high blood urea nitrogen.

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