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Research Article
Growth Performance of Male Bali Cattle Fattening Fed Ration with Different Protein Levels in Smallholder Farms, West Timor, Indonesia

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Abstract

Objective: The study was aimed to determine the effect of different protein level toward the growth performance of male Bali cattle fattened in smallholder farms. **Materials and Methods:** The male Bali cattle used were 18 heads aged 2-2.5 years with initial body weight of 229.86±12.46 kg. The cattle were randomly divided into three treatment groups. The group of T_0 given feed in accordance traditional practices of fattening cattle by farmers, T_1 group given ration of 12% Crude Protein (CP) and 72% Total Digestible Nutrients (TDN) and T_2 group given ration of 15% CP and 72% TDN. The cattle were fed individually for 90 days and drinking. The data collected were analyzed by one-way analysis of variance. **Results:** The results showed that the intake of Dry Matter (DM), CP, Crude Fiber (CF) and TDN of T_1 was higher ($p<0.05$) from T_2 and T_0. Similarly, T_2 group was higher than T_0. The digestibilities DM and CF of group T_1 and T_2 did not significant but were higher ($p<0.05$) than T_0, while the digestibility of CP of T_0, T_1 and T_2 were not significant. The daily body weight gain of T_0 and T_2 were not significant but lower ($p<0.05$) than T_1, while the Feed Conversion Ratio (FCR) were not significantly different among the group cattle. **Conclusion:** The traditional practices of male Bali cattle fattened on smallholder farms did not have a positive impact on improving the performance of the cattle. Male Bali cattle fattening fed ration with composition of 12% CP and 72% TDN showed intake, nutrient digestibility and growth performance that was higher compared to the other treatments. The use of ration with 15% CP and 72% TDN had no positive effect on the cattle performance. Paying attention to balancing and adequacy of protein and energy of feed was an important factor, because it proved can be improving performance of the male Bali cattle fattened in smallholder farms.

Key words: Bali cattle, protein level, fattening, smallholder farms, feed intake, growth performance

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Smallholder farms are still the biggest component that contributes to the fulfillment of national meat. Almost 90% of cattle ready for slaughter in slaughterhouses produced by smallholder farms, while the remaining 10% coming from the feedlot entrepreneur of cattle. Despite a focus on providing cattle that was ready to be slaughtered to meet the needs of meat, a classic problem in smallholder farms that still became limiting factor was the shortage of both quality and quantity of feeds throughout the year. Cattle fed sufficient forage during the rainy season, in contrast, during the dry season sufficient quality and quantity of feeds is not available to cattle. This resulted in significant growth of cattle during the rainy season but during the dry season the growth begun to slow down and even can cause death[1].

Activity fattening of male Bali cattle in West Timor, East Nusa Tenggara, Indonesia had been conducted for generations. However, innovation to improve the quality of the feed on fattening had not much to do[2]. Farmers still rely on forage as a single feed regardless of the balance of required nutrients for cattle. Be observed from nutrients obtained by the cattle, hence the need for protein as a body builder was relatively an abundant availability in farms. It was because the forage used in the fattening process was mostly good legume fodders including *Leucaena leucocephala*, *Gliricidia sepium* and *Sesbania grandiflora*[3]. Conversely, the fulfillment energy needs in cattle was less because it was only from the structural carbohydrates, mainly native grass and its availability was determined by the season and level of digestibility. At the beginning of growth, the needs of energy were available because of the level of digestibility of native grass that was high enough[4]. However, dried forage had low digestibility levels, consequently was not enough energy required for the cattle. Theoretically, if the energy obtained only from forage as a source of undigested carbohydrates, it is concerned that there was not enough energy so the impact on the utilization of feed protein was not optimal[4].

The use of digestible carbohydrate was an alternative to fulfill the energy requirements so that the abundance of protein used in male Bali cattle fattened in smallholder farms can be fully utilized. It was expected that the use of digestible carbohydrates can ensure a balance of protein and energy as well as improve the productivity. This study aimed to determining the feed intake and digestibility, as well as the growth performance in male Bali cattle fattened in smallholder farms with different of feed protein levels.

MATERIALS AND METHODS

Research location, cattle, research design and animal feed: The study was conducted for 90 days in Nekmese Farmer group, Usapinonot village, West Insana district, North Central Timor, East Nusa Tenggara, Indonesia. Feed and feces analysis were conducted in the Laboratory of Nutritional Biochemistry, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia.

Research used 18 male Bali cattle aged 2-2.5 years based on the initial body weight of 229.86±12.46 kg. The expected daily body weight gain was 0.75 kg day^{-1}. Each animal was placed randomly in individual cages within 18 plots sized 1.5×2.0 m equipped with a separate feed and water box. Cattle raising were conducted for 90 days, including the adjustment period for 14 days. Feed distribution was conducted 3 times a day at 7:00 am, 12:00 am and 17:00 pm local time. Drinking water was available *ad libitum*. Distribution of forages and concentrates were conducted separately, in which the cattle were given forage first, then concentrate in 60 min as needed.

Study design used was completely randomized design. The cattle were divided into three treatments, one group as control (T_0) and two group with ration treatments (T_1 and T_2). The each group consisted of six cattle. Rations for T_0 was variaed, according to the traditional practice of farmers in fattening the cattle. For the group of T_1 and T_2 rations were prepared with different levels of crude protein with isoenergy in the form of Total Digestible Nutrients (TDN). The group of T_1 get ration in 12% of crude protein and 72% of energy (TDN) and the group of T_2 get ration 15% crude protein and 72% energy (TDN). Ration was composed of native grass, *Gliricidia sepium*, corn meal and rice bran (Table 1, 2). In order to avoid a shortage of nutrients, especially minerals during fattening process, cattle were given additional feed of mineral supplement in the form of mineral produced by Medion, Bandung with composition of calcium 165.000 mg, phosphorous 52.000 mg, sodium 157,000 mg, iron 2500 mg, 2500 mg copper, manganese 2000 mg, 125 mg iodine, cobalt 50 mg, selenium 5000 mg and zinc 10 mg. The distribution was 2% per 100 kg of concentrate mixture used.

Measurement variable and data collection: Variables measured in this study included the feed intake and digestibility and growth performance of male Bali cattle. Feed intake was the difference between the amount of feed given and the rest of the feed for 24 h. Dry Matter Intake

Table 1: Chemical composition of feedstuffs on male Bali fattening with different protein levels in smallholder farms

Ingredients	DM (%)	OM	Ash	CP	EE	CF	NFE*	TDN**	NDF	ADF
		DM (%)								
Native grass	36.54	84.71	15.29	6.08	4.11	32.80	41.72	57.30	68.72	39.74
Gliricidia sepium	24.27	87.56	12.44	24.19	12.55	14.51	36.31	72.21	32.98	21.87
Leucaena leucocephala	25.25	90.19	9.81	25.65	8.41	18.96	29.52	79.79	34.11	18.47
Sesbania grandiflora	20.33	85.29	14.71	21.77	8.90	13.18	32.94	75.06	24.72	15.85
*Pennisetum purpuroides*s	25.24	86.62	13.38	11.98	4.68	31.07	32.37	46.69	68.09	36.24
Banana stem (*Musa* × *paradisiaca*)	10.40	85.49	14.51	3.31	7.57	32.36	32.08	54.77	47.65	25.85
Banana leaves (*Musa* × *paradisiaca*)	22.12	91.06	15.01	4.37	23.17	8.90	39.87	50.69	-	-
Cassava leaves (*Manihot utilissima*)	24.42	90.34	9.66	24.52	8.23	19.47	31.16	79.45	-	-
Corn meal	90.09	98.81	1.19	7.89	1.44	1.82	87.66	87.66	22.14	1.99
Rice bran	90.42	84.49	8.26	6.97	2.03	17.37	65.37	65.37	54.67	40.32

DM: Dry matter, OM: Organic matter, CP: Crude protein, EE: Extract eter, CF: Crude fiber, NFE: Nitrogen free extract, TDN: Total digestibility nutrients, NDF: Neutral detergent fiber, ADF: Acid detergent fiber. *NFE: [100-(Ash+CF+EE+CP%)][36], **TDN: According to equation of Harris *et al.*[37] cited by Hartadi *et al.*[38]

Table 2: Ration for male Bali cattle on fattening with different level of protein in smallholder farms

Treatments	Feedstuff	No. of usage (DM%)	Ration nutrient composition (%)	
			CP	TDN
T_0*	Forage	100.00	17.09	65.51
T_1	Native grass	14.00	0.85	9.92
	Leaves of *Gliricidia sepium*	30.00	7.26	21.66
	Corn meal	39.00	3.08	32.66
	Rice bran	17.00	1.18	8.61
	Total	100.00	12.37	72.85
T_2	Native grass	13.00	0.79	9.21
	Leaves of *Gliricidia sepium*	46.00	11.13	33.22
	Corn meal	28.00	2.21	23.45
	Rice bran	13.00	0.91	6.58
	Total	100.00	15.03	72.46

*Adjusted with feed provision by the farmers. Forage proportion including: Native grass 33.76%, *Gliricidia sepium* 26.71%, *Leucaena leucocephala* 26.99%, *Sesbania glandiflora* 3.52%, *Pennisetum purpuroides*s 1.78% and others feedstuffs 7.24%

(DMI) (kg) was obtained from the feed intake multiplied by the content of the DM feed (%). Nutrient intake was obtained by multiplying the DMI with nutrient content of feed. Digestibility of feed nutrients was measured by using total collection method[5]. The proximate analysis of the chemical composition of feed and feces were calculated by following the procedure of AOAC[6].

Daily body weight gain of male Bali cattle were measured every 30 days by subtracting the current weight with the initial body weight divided by the length time of the research. Feed Conversion Ratio (FCR) was measured by comparing the intake of dry matter (kg) and daily body weight gain (kg).

Statistic analysis: Data was analyzed by one way analysis of variance. If there were differences among the treatments, it will be tested further by Duncan's Multiple Range Test (DMRT)[7]. The SPSS software version 19 is used to facilitate the analysis.

RESULTS AND DISCUSSION

Feed intake: The intake of DM, CF and TDN of male Bali cattle (kg head^{-1}day^{-1}, BW$^{0.75}$) of T_1 group was higher ($p<0.05$) than T_0 and T_2. Also, group T_2 was higher ($p<0.05$) than T_0. Similarly, CP consumption on T_1 group was higher ($p<0.05$) than T_0, while T_2 was not different to T_1 and T_0 (Table 3, Fig. 1). The results of this study indicate that DM intake differences have an impact on the high and low nutrient obtained by the cattle. The high feed intake in T_1 group illustrated that the nutrients used to have fairly balanced between protein and energy, so that it had a positive impact on increasing the activity of rumen microbes to degrade the feed rate. The feed that had a high degradation impacted on the short duration of feed to stay in the rumen, thereby stimulating livestock can increase feed intake[4]. In addition, the proportion of constituents of the ration which was dominated by digestible carbohydrates consisting of corn meal and rice bran reached 56%, while only 44% forage. Digested carbohydrate source that was used had a higher palatability thereby it increased livestock consumption. This resulted in adequate nutrient needs of cattle for both maintenance activities and increased growth. The low feed intake of male Bali cattle in T_2 group relates to the proportion and palatability of feed. The cattle preferred concentrate rather than forage to be consumed. In addition, the use of *Gliricidia sepium* in group T_2 reached 46% of the total feed decrease the response of cattle to consume. According to Simons and Stewart[8], *Gliricidia sepium* plants

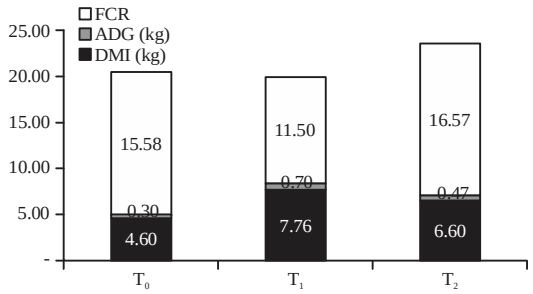

Fig. 1: Graph of dry matter intake and daily weight gain (kg head^{-1} day^{-1}) and feed conversion ratio of Bali cattle male with different levels of protein in smallholder farm. T_0: Control, according to the traditional practice of farmers in fattening the cattle, T_1: 12% crude protein, 72% TDN, T_2: 15% crude protein, 72% TDN

Table 3: Feed intake of male Bali cattle on fattening with different levels of protein in smallholder farms

Variables	T_0	T_1	T_2
DM intake (BW%)	1.76±0.19^a	2.71±0.12^c	2.40±0.14^b
Feed intake (kg head^{-1}day^{-1})			
Dry matter	4.60±0.60^a	7.76±0.28^c	6.60±0.24^b
Crude protein	0.79±0.11^a	0.94±0.06^b	0.85±0.04^{ab}
Crude fiber	1.07±0.14^a	1.37±0.04^c	1.22±0.05^b
TDN			
TDN (kg)	2.86±0.57^a	7.21±0.44^c	6.03±0.56^b
TDN (%)	61.03±3.77^a	81.30±1.73^b	80.46±3.31^b
Feed intake (g kg^{-1} BW$^{0.75}$ day^{-1})			
Dry matter	70.82±7.721^a	111.59±4.57^c	97.62±3.61^b
Crude protein	12.11±1.46^a	13.46±0.87^b	12.58±0.41^{ab}
Crude fiber	16.40±1.80^a	19.72±0.76^c	17.99±1.10^b
TDN	43.85±3.15^a	103.75±7,09^c	89.15±5.89^b

Data were presented in average ±SD, $^{a\text{-}c}$Different superscript in the same row shows differences at p<0.05, DM: Dry matter, TDN: Total digestible nutrients

commonly used as a high protein supplement for low-quality basal forage such as grass, straw and other crop residues. The utilization for supplementation may varies but was usually in the range of 20-40% or an average of 30%, higher usage reduced the response of cattle to consume. The T_2 diet had high amount of tree leaves. Tree leaves contains some anti-nutritional factors such as tannins and saponins, which may reduce feed intake in ruminants[9]. Generally, high amount of tree leaves (30-40%) in basal low quality diets resulted in improved total feed intake[9].

The data shown by group T_2 shows that increased levels of proteins, especially protein from forage was not always able to increase their intake of protein in cattle as it related to the level of palatability of feed. Feed that had high protein content would not show high levels of intake as if it had a low palatability. The CP intake was not only influenced by the DM intake but it was influenced also by digestibility, influence of fermentation in the rumen, the influence of digestive enzymes, metabolism by microbes and feed quality[10].

The T_0 group of male Bali cattle showed lower feed intake than group T_1 and T_2 (1.76% DM of BW). It illustrated that male Bali cattle fattened in smallholder farms that relied on 100% forage as a single feed did not guarantee the adequacy of DM and nutrient intake. Forage had bulky properties in the rumen, in which if the degradation was slow, it will reduce the level of feed intake[4]. In addition, the low palatability factor of feed impacted on the cattle incentives to consume was lower anyway. According to Fluharty[11], the undigested section of the forage stayed longer in the digestive tract, causing low intake of dry matter. Although the DM intake was low, the consumption of CP in group T_0 was high enough to fulfill the needs of the cattle. On the other hand, the TDN intake was low so that the energy supply was not sufficient. Thus, the problems faced in male Bali cattle fattened on smallholder farms was the insufficient energy intake, while protein need was fulfilled.

The need for DM, CP and TDN of cattle in Body Weight (BW) 250 kg with daily Body Weight Gain (BWG) of 1,100 kg day^{-1} according to recommendation of Kearl[12] were respectively 6.60, 0.78 and 4.60 kg day^{-1}. The DM intake of group T_1 and T_2 were 7.76 and 6.60 kg head day^{-1}, respectively were higher and the same level with the above recommendations. Nonetheless, the group T_0 cattle that had DM intake amounted to 4.60±0.60 kg head^{-1} day^{-1} was lower than the standard requirements because it was only equivalent to the DM needs of male cattle with the daily BWG target 0 kg day^{-1} in the same body weight. The CP intake of groups T_1, T_2 and T_0 exceeded the needs of male cattle according to the recommendation. The TDN intake of groups T_1 and T_2 were respectively higher than the above recommendations of 36.20 and 23.71%. Nonetheless, the TDN intake of group T_0 (kg day^{-1}) (2.99±0.19) was lower because only it only reached 60.84% of the Kearl's recommendation[12]. The TDN intake of T_0 group almost was equivalent with the needs male cattle in BW 250 kg with a target of daily BWG in 0.25 kg day^{-1}.

According Anganga and Monyatsiwa cited by Aregheore and Yahaya[13], the amount of ruminant feed intake ranged from 40-90 g kg^{-1} BW$^{0.75}$ day^{-1} or 1-2.8% of his body weight. Thus, DM intake in this study was still in accordance with the normal standards mentioned above. The cattle feed intake varied greatly depending on the species of animal, body weight, body size, age and condition of the cattle, physiological status, digestive tract condition and capacity, feed material palatability, type and physical properties of the feed, energy content, the availability of water and the

Table 4: Feed digestibility (%) by male Bali cattle on fattening with different levels of protein in smallholder farms

Variables	T_0	T_1	T_2
Dry matter	62.86±5.43[a]	76.01±1.92[b]	75.50±4.02[b]
Crude protein	68.89±6.98	73.36±2.94	74.64±5.00
Crude fiber	70.58±5.39[a]	81.95±3.06[b]	81.47±3.39[b]

Data were presented in average ±SD, [a,b]Different superscript in the same row shows differences at p<0.05

environment[14,15]. The DM intake had a close relationship with the Digested Energy (DE) and Metabolized Energy (ME) intake[16]. According to Pond *et al.*[17], nutrient needs of different cattle conditions were also causing differences in the level of feed intake.

Feed digestibility: Dry matter and CF digestibility (%) of male Bali cattle of group T_1 was not insignificant with T_2 but was higher ($p<0.05$) than group T_0 (Table 4). Conversely, CP digestibility showed no significant difference among all groups of cattle. Increased feed intake of group T_1 and T_2 groups illustrated that the quality of rations supplemented for T_1 and T_2 were digestible carbohydrates from corn meal and rice bran had a higher microbial activity in degrading the feed compared to the T_0 which 100% relied on forage. Digestibility of DM obtained in this study had a quite high positive impact on the sufficient nutrient needed for cattle to do maintenance activities and production. Conversely, on group T_0, the low of DM digestibility impacted on the low nutrient derived to meet the needs of the body and the maintenance of optimal growth.

The proportion of corn meal on rations group T_1 and T_2 was 39 and 28%, respectively with the content of CF on *Gliricidia sepium* which fairly had a low contribution to the increase of CF digestibility. However, although native grass and rice bran contained a quite high CF, ADF and NDF, due to the lower proportion of usage instead of the active rumen microbes to digest the fiber, they did not give much influence on the decreased fiber digestibility. In this study, the intake of CP reached 12.11% for group T_1 and 12.88% for group T_2 of the total DM intake. It had been optimum for rumen microbial activity.

The low digestibility of DM and CF in group T_0 was considered to be associated with low activity of the rumen microbes to digest food due to a lack of energy intake derived. Moreover, the content of the plant cell wall (NDF and ADF) of the forage used were high enough to protect the cellulose and hemicelluloses when it was digested by rumen microbes (Table 1). This was in accordance with the opinion of Minson[4] which stated that the increase in the plant cell wall contributed to the digestibility decline. Pond *et al.*[17] also reported that there was a negative correlation between the lignin content of plants and its digestive ability. The higher was the lignin content, the digestibility would be lower.

Moreover, CP intake of group T_0 exceeded the cattle's' optimum needs for achieving 17.17% of the total DM consumed. The high CP intake that was not be balanced with the energy derived from digestible carbohydrates would not be beneficial for the cattle to improve its performance. The sufficient N content of the feed will increase the fiber degradation, in which the sources of N for the rumen microbes were feed, saliva and blood urea. The minimum N requirement for microbes was 0.6-0.8%. If 1% of N was available, then it was optimum for the fiber degradation by rumen microbes[18].

Crude fiber digestibility in group T_1 and T_2 were high enough to positive influence on nutrient utilization of feed consumed by cattle, mainly structural carbohydrates from forage. Factors affecting forage feed digestibility in particular was the species/varieties of plants, the growth phase of the plant, the fertility of crops and the temperature where the plants was grown[19]. Variations and composition of the feed used in cattle fattening were also considered to be one reason for the low digestibility of the feed. According to Van Soest[10], the chemical composition that included CP, CF, ETN and feed mineral and how long been the feed inside the rumen can affect the digestibility of a feed material. The different types of feed influenced the digestibility as well as the rumen conditions.

Tillman *et al.*[20] stated that factors affecting the degradation of fibers covered the particle size of the feed, N forage content, the solubility of carbohydrates and lignin. The factors that influence starch digestibility were the type of grains, processing, mix grain and a mix of whole grains and fiber. High lignin content decreased the microbial degradation of the fiber by the absence of a sufficient energy source. Percentages of digestibility and consumption levels were not only influenced by the proportion of the cell walls of the feed but the physical form of the cell wall. According to Anggorodi[21], an increase in the content of CF in a feed ingredient impacted on the lower digestibility of feed. Cellulose and hemicelluloses were included in fractions of structural carbohydrates (fiber fraction) which was the main component of plant cell walls that often binds with lignin, making it difficult to be digested by rumen microbes[4].

Dry matter digestibility obtained in this study was higher than what was reported by Koddang[22], amounted to 51.92% for male Bali cattle without obtaining a concentrate of *Pennisetum purpuroides* 100% *ad libitum* and those which got concentrates from 1.5-2.0% of BW, with a *Pennisetum purpuroides* 100% *ad libitum* which has a DM digestibility of 59.63-64.11%. Similarly, CF digestibility in

this study was higher than the study report of Da Cruz de Carvalho *et al.*[23] in cattle and male SimPO which obtained feed with different concentrates on the maintenance of fattening respectively 58.82 and 57.06%.

Crude protein digestibility (%) of male Bali cattle of group T_0, T_1 and T_2 were not different from each other because of the quality of forage legume that was primarily used by the farmers in fattening on the smallholder farms were not much different from the ration of groups T_1 and T_2. Farmers usually utilized forage *Leucaena leucocephala*, *Gliricidia sepium* or *Sesbania grandiflora* and native grass as feed for male Bali cattle fattened.

Digestibility of CP was quite high among these three treatments. This was illustrated the rumen microbial activity in degrading optimum protein feed, in addition to the feed materials quality of protein used in raising livestock farmers was also quite good. Microbial activity in the rumen to digest the feed would increase when it was supported by adequate nutrition, especially protein and energy. According to McDonald *et al.*[24], digestibility values were not fixed for every meal or every head of cattle but were influenced by several factors: Chemical composition; food processing, the amount of food given and the type of animal. Factors affecting the digestibility of feed were the amount of the chemical composition of the feed, indigestion, feeding frequency, feed processing, as well as associations and interaction effects in feed[17].

Digestibility of CP in this study was sufficient to meet the maintenance needs of cattle, so that the excessive digestible protein can be utilized to improve body weight gain and meat production. Group T_1 obtained digestible CP gain of 689.58 g, T_2 was 634.44 g and T_0 was 544.00 g. Digestible crude protein derived in this study was higher than the protein requirements for the male cattle in 250 kg BW with daily BWG of 1.10 kg day^{-1} in the amount of 782 g or 514 g day^{-1} of CP digested[12].

If the CP digestibility was compared with other Bali cattle, the CP digestibility of group T_0 was lower, but groups of T_1 and T_2 were higher than Koddang's study report[22], which gained 58.58% of CP digestibility for male Bali cattle which got *Pennisetum purpuroides* 100% *ad libitum*. However, it was almost the same as the CP digestibility 72.48-74.66% of male Bali cattle on who obtain concentrates from 1.5-2.0% of BW in the delivery of *Pennisetum purpuroides* 100% *ad libitum*. The results of this study were higher than the digestibility of male Ongole crossbreed amounted to 51.74% and male SimPO cattle of 50.02% which was obtained concentrate on the fattening process[23]. The difference this study had to do with genetic factors, physiological status of the animal as well as the composition of the different constituents of the feed.

Table 5: Performance of male Bali cattle on fattening with different levels of protein in smallholder farms

Variables	T_0	T_1	T_2
Initial body weight (kg)	233.33±13.80	222.75±9.74	233.50±12.31
Final body weight (kg)	260.67±15.31	286.08±9.11	275.92±25.33
Body weight gain (kg)	27.33±4.50^{a}	63.33±14.63^{b}	42.42±18.5^{a}
Daily body weight gain (kg)	0.30±0.05^{a}	0.70±0.16^{b}	0.47±0.47^{a}
FCR	15.58±3.45	11.50±2.54	16.57±7.52

Data were presented in average ±SD, ^{a,b}Different superscript in the same row shows differences at $p<0.05$, FCR: Feed conversion ratio

Growth performance

Daily weight gain: Body weight gain and daily body weight gain of treatment T_1 was higher ($p<0.05$) than T_0 and T_2. Conversely, it did not differ between T_0 and T_2 (Table 5). This study illustrates that the ration of 12% protein and 72% TDN contributed positively to the cattle performance. Increased energy rations had improving nutritional status and adequacy of the cattle, thus increasing the synthesis of body tissue which affected the increase of body weight. The production of propionic acid as a precursor of glucose was increased in the treatment to trigger the synthesis of animal body tissue.

Although, the source of energy of treatment T_2 was obtained in the same way with the treatment T_1, allegedly the different proportion of feed constituent rations resulted in insignificant response. In addition, the use of protein feed which reached 15% had exceeded the optimum requirements to be used by rumen microbes maximally if it did not supported by sufficient energy. This is in line with reports of Gleghorn *et al.*[25] which stated that the optimum use of crude protein ration for cattle fattening was 13%, because the range of CP showed dry matter intake, daily weight gain and higher gain:feed. The use of CP that was less than 13% (11.5%) and more than 13% (14.5%) decreased the cattle fattening performance if it was seen from the above observation parameter.

The use of corn meal and rice bran in treatment T_2 as a source of digestible carbohydrates respectively reached 28 and 13% was considered to give influence on the availability of energy, resulted in protein feed that cannot be utilized, which reached 15% for the synthesis of body tissue. Moreover, rice bran used had a low quality seen from the level of digestibility DM 42.10% and OM 44.58%[26]. Therefore, the reliable energy source in the ration was only corn meal. High amount of tree forages in T_2 might have impacted total feed intake and thereby reduced growth rate compared with the T_1 group. In a meta-analysis study, it has been reported that high concentrations of tree leaves in diets may decrease growth performance[27].

Treatment T_0 showed the lowest performance of body weight gain and daily body weight gain although CP intake 17.17% was a very high. This was due to the use of N was

limited by low energy obtained. The T_0 only rely on the energy derived from structural carbohydrates and its availability was highly dependent on the level of feed digestibility in the rumen. Slow digestibility resulted in insufficient energy needed by cattle. Phenomena on treatment T_0 were line with various previous opinions stating that the intake of high protein must be balanced with digestible carbohydrates intake to provide sufficient energy. The adequacy of energy was intended to fulfill the energy needs for rumen microbial degradation activity, as well as a source of carbon skeletons for microbial protein synthesis together with the $N\text{-}NH_3$[28]. Lack of energy gave negative impact on the cattle rumen microbial activity to be suboptimal and low utilization of $N\text{-}NH_3$ rumen for microbial protein synthesis. Cattle can only achieve a potential growth rate when it was obtaining sufficient high quality feed[29]. The bulls that only consumed forage will show lower growth when compared to those which consumed concentrate[30].

Cattle consumed feed to fulfill energy needs. Inadequate feed will result in body weight loss or decrease in production processes such as body growth and milk secretion[29]. The less feed intake problems (underrating) mostly occurred to the cattle which obtained high coarse fibrous feed with bulky characteristic and a low level of digestibility that may limiting the amount of feed consumed.

Feed conversion ratio: The Feed Conversion Ratio (FCR) of treatment T_0, T_1 and T_2 were similar ($p>0.05$) (Table 5, Fig. 1). Although, not significant, the FCR of treatment T_1 tended to be lowest and followed by treatment T_0 and T_2 as the higher ($p<0.211$). Treatment T_1 required relatively less feed to raise a unit of body weight. Meanwhile, treatment T_0 and T_2 required a relatively high amount of feed to raise a unit of body weight. However, feed conversion ratio value of treatment T_0 to T_2 was still in the high category for DMI and it had not been followed by higher body weight gain. According to Shike[31], feed conversion ratio was a good measure for monitoring or describing the cattle fattening performance in correlation with the growth rate. The lower the value, the better feed conversion was in which the best feed conversion value ranged 4.5-7.5. Similarly, Lunn[32] explained that if the ratio of feed toward body weight gain was lower, it meant that the cattle were more efficient. The ratio of feed (dry matter) toward body weight gain for cattle growing was 4:1 and for finishing cattle was 6-8:1. Feed conversion ratio value will be ugly if the number becomes larger[33].

The high feed conversion was also probably related to nutrient intake which was concentrated on maintenance needs related to the body's normal activities. Therefore, fulfilling the needs of nutrients for the synthesis of body tissue was not maximized. According to Shike[31], 70% of feed consumed by the cattle was used for maintenance of the body. The rest was for increased production. Therefore, cattle should have adequate nutrition to sustain life substantially before any bone or muscle growth and this should be happened before fattening process[11].

This study results illustrated that male Bali cattle fattened with protein 12, 15% and TDN 72% had not significantly affected the efficiency of feed utilization. According to Lunn[32], increasing body weight (ADG) had become a standard in measuring the fattening performance but improving feed efficiency was more important to obtain profitability in fattening. It had been explained that there were many components affecting feed efficiency. Environmental factors, nutrition and resting management, the use of feed additives and animal factor. Enhancing the role of these factors can increase the profitability in fattening.

Feed conversion value in this study was greater than study report by Tahuk and Dethan[2] on the male Bali cattle aged from 2-2.5 years at greenlot fattening with a feed conversion of 7.55, Oematan[34] of 6.01-7.56 on male Bali cattle aged 1.5-2.5 years old which received concentrate rations with a different ratio of protein and energy and Hafid and Rugayah[35] of 9.89-10.40 on thin male Bali aged 2 years old in the concentrate ration of local raw material.

CONCLUSION

The traditional practices fattening of male Bali cattle in smallholder farms that relied on legumes as the dominant forage resulted in the abundance of the protein consumed by the cattle. However, the utilization of protein consumed was low because the energy derived only from structural carbohydrates, so the impact on feed intake and digestibility and growth performance were lower. Improving the fattening feed with the addition of digestible carbohydrates with the formulation of 12% crude protein and 72% energy were optimal because it influenced higher performance of male Bali cattle. The use of 15% crude protein had exceeded optimal need of rumen microbes, although the energy supplied was high enough and influenced the above observed variables. It had been proved that a balance of protein and energy in fattening process gave positive impact in improving the performance of male Bali cattle in smallholder farms.

SIGNIFICANCE STATEMENTS

The male Bali cattle fattened by traditional practices in the smallholder farms showed lower performances due to less intake of dry matter and nutrients, especially energy.

Based on feed intake and digestibility, as well as daily body weight gain, ration with 12% CP and 72% TDN improved quality and adequacy of feed, thus positively affect the performances of male Bali cattle fattened in smallholder farms. The adequacy of feed, especially protein and energy balance is one of important factor that needs to be focus on since it has been proven could increase male Bali cattle performance fattened in smallholder farms.

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