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# The Effect Supplementation with High Protein from Different Supplement and Similar Energy Source on Intake, Digestibility and Liveweight Gain of Bali Bulls Fed Elephant Grass

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***Abstract***

*In fattening of Bali cattle (Bos sondaicus) in Central Sulawesi, farmers generally fed the animal with native grass or agro-industrial by products as single feed. Under this condition, cattle liveweight gain are low. This study aimed to compare the effect of supplementing Bali bulls with different protein supplements with similar energy source and basal diet on feed intake, digestibility, growth performance and income over feed costs. Twenty-four Bali bulls ranging in age from 8 to 12 months, averaging 154.29±6.40 kg (mean ± SEM) of live weight (W) were used. This experiment employed a randomized block design with four dietary treatments and six replications (6 Bali bulls per treatment). The dietary treatment employed in this experiment were (a) elephant grass (Pennisetum purpureum) ad libitum (EG) (b) EG + supplement (rice bran (RB) 1.25% liveweight (W) dry matter (DM)/day) and gliricidia (Gliricidia sepium) leaves 1.25% W DM/day (EGRBG), (c) EG, + supplement (RB 1.25% W DM/day + palm kernel meal (PKM) 1,25% W DM/day (EGRBPKM) (d) EG + supplement (RB 1.25% W DM/day and copra meal (CM) 1.25% W DM/day (EGRBCM). The duration of the experiment was 10 weeks, comprised of a two-week adaptation period and an eight-week measurement period. The observed variables were the total DM intake (DMI), the DM digestibility (DMD) of feed, average daily gain (ADG), and income over feed cost (IOFC). Bali bulls treated with EG and EGRBCM had the lowest and highest total DM intake, DMD, ADG, and IOFC, respectively. It was concluded that high protein and energy supplementation raised ADG and IOFC. Protein sources from CM increased ADG more than from G and PKM. Glicidia supplementation increased IOFC more than PKM and CM.*

**Keywords:** *Bali bulls, protein, liveweight gain, profitability*

## 1. Introduction

Beef is one of the national strategic food commodities and often becomes a national economic and social issue in Indonesia. Hence, the efforts to maintain the continuity of the supply and price of beef through the development of beef cattle farming must be carried out. Even though until now the contribution of beef to national meat fulfillment has only reached 9.95% (LAHS, 2021), the availability of beef must be maintained continuously to avoid price spikes in the community. Until now the demand for beef nationally still exceeds domestic production capacity, which has an impact on the gap in the supply of beef and soaring commodity prices. For example, based on data from the Ministry of Trade of the Republic of Indonesia (2020) it was noted that in 2020, the national production of beef is 442,533 tons, while the national demand for beef is 686,271 tons, so there was a shortage of beef of 294,617 tons. In addition, the price of beef in Indonesia was apparently more expensive than the international price of beef. According to the Ministry of Trade of the Republic of Indonesia (2020) the domestic beef price was 120,159 Indonesian rupiah (IDR)/kg, while the international beef price is US$ 5.88/kg or the equivalent of 85,231 IDR/kg.

The business of fattening beef cattle in Indonesia is closely related to the supply of beef, both nationally and in Central Sulawesi province in particular. Most of the beef cattle raised in Central Sulawesi as a fattening business are Ongole cross cattle, Bali and Donggala cattle. Bali cattle are one of the of Indonesian native cattle which has spread throughout Indonesia. More than 30% of the national cattle population are Bali cattle (Marsetyo et al., 2006). The majority of the fattening of Bali cattle is carried out according to the traditional pattern as a smallholder livestock business. Under this system, the feed given to cattle is generally low-quality forages such as agricultural by products or native grass. In their review, Marsetyo et al. (2006) obtained data that the average daily weight gain (ADG) of Bali cattle that received forage as a single feed was 0.2 kg/day. Marsetyo et al. (2012) reported that giving corn stover to young male Bali bulls only resulted in ADG of 232 g/day, far below its genetic potential. As a result of the low ADG for Bali cattle, it takes a long time (8-10 months) to reach selling weight. This is very unprofitable for farmers, especially from the aspect of labor and other operational costs. Feeding high quality Bali cattle, as carried out by Quigley et al.

One strategy to accelerate the process of fattening beef cattle is to provide additional feed/supplements with high protein and energy content. There are some potentials for several inexpensive protein rich supplements available locally in Central Sulawesi and not yet utilized optimally by farmers, namely gliricidia, palm kernel meal, copra meal and energy sources such as rice bran. This experiment was conducted to examine the effect of adding high different protein supplement and similar energy sources on DMI, DMD, ADG and IOFC of Bali bulls given elephant grass as basal feed.

## 2. Materials And Methods

### Site, Animal and Experimental design

The feeding trial was done at the Mertasari experimental farm in Malonas village, Dampelas Sub District, Donggala District, Central Sulawesi province, Indonesia. Feed and faecal analysis was done at Nutrition Laboratory Department of Animal Science Tadulako University.

Twenty-four Bali bulls averaging 154.29±6.40 kg (mean ± SEM) of live weight (W) were used in the feeding trial. The bulls belonged to Malonas village farmers. A completely randomised block design was used for 10 weeks, with 2 and 8 weeks for adaptation and collection respectively. There were four dietary treatments and six block/replications in the experiment. Each of the four dietary treatments was assigned to six bulls. The four dietary treatments tested include (a) elephant grass ad libitum (EG) (b) EG + supplement (rice bran (RB) 1.25% liveweight (W) dry matter (DM)/day) and gliricidia (*Gliricidia sepium*) leaves 1.25% W DM/day) (EGRBG), (c) EG, + supplement (RB 1.25% W DM/day + palm kernel meal (PKM) 1,25% W DM/day (EGRBPKM) (d) EG + supplement (RB 1.25% W DM/day and copra meal (CM) 1.25% W DM/day (EGRBCM) The bulls were confined in individual concrete-floored pens. To control internal and external parasites, Ivomec was injected into all bulls (1 mL per 10 kg liveweight) at the start of the preliminary period. Supplement and basal diet were provided in two separate portions, scheduled at 0830 and 1600 hours. Both supplements and basal diet were offered to each bull individually.

### Measurements

The measurement of feed intake was carried out by reducing the amount of feed offered and feed refused to each bull on a daily basis for a period of ten weeks. During the weeks 10 of the collecting period, the digestibility run was performed over seven consecutive days. During the digestibility run, the total faeces that produced over 24 hours of each individual bull were collected and recorded. Approximately 5% of the daily faecal output was subsampled, consolidated over a period of 7 consecutive days, and afterwards preserved in a freezer set at a temperature of -20°C. The last day of the digestibility run consisted of thawing the frozen fecal samples that had been obtained from each individual bull. These samples were well mixed, and then a subsample was removed and put through a drying process in an oven with the temperature set to $60^0$ C, until they reached a constant weight throughout. For the purpose of determining DMD, a calculation was performed in which the difference was found between the amount of dry matter (DM) excreted in feces and the dry matter (DM) content of the feed that was ingested. This figure was then divided by the dry matter (DM) content of the feed that was consumed by each bull. The estimated metabolizable energy intake (MEI) (MJ/day) of each animal was calculated by multiplying the total DMI (kg/d) by the energy concentration (M/D) of the ration. Using the equation devised by CSIRO (2007) the feed's energy content (MJ/kg DM) was calculated as follows:

$$M/D = 0.172 \text{ (percentage) } DMD - 1.7072$$

Using the following equation from CSIRO (2007), an estimate of the animal's metabolizable energy for maintenance (MEm, MJ/day) was calculated: MEm = K.S.M. ($0.28W^{0.75}$ exp(-0.03A)/Km, where K is the type of animal (Cattle = 1.2), S is the sex (1.15 for male), and. M is the fracation of the digestible energy (DE) intake supplied by milk (M = 1 + 0.23 x proportion of DE from milk), W is the liveweight (kg), A is the age with a maximum value of 6, and Km is the net efficiency of using DE for maintenance. Energy retention is obtained by reducing estimated MEI with estimated MEM

Over the period of ten weeks, the liveweight change of each individual bull was measured on a weekly basis. To determine each animal's ADG, the difference in weight between the animal at the end of the experiment and its starting weight was divided by the total number of feeding days. For the purpose of computing the IOFC, Bailey et al. (2009)'s methodology was adopted. This required calculating the cost of daily feed from the income that was created while also taking into consideration the price that was paid and the price that was sold per kilogram of bulls' liveweight.

**Chemical analyses**

In order to prepare for the chemical analysis, the dried samples were first ground using a blender and then passed through a 1 mm screen. The DM of feed offer, refusal and faeces, and OM, CF, EE of feed offer was determined by AOAC (1990) method. Crude protein (CP) content of samples was recorded after determining the nitrogen concentration by the Kjeldahl method (AOAC, 1990), the value was then translated to CP concentration through the process of multiplying by 625.

**Statistical analysis**

The Minitab statistical package was used to conduct the analysis of variance. The differences in mean values between dietary treatments were compared using the least significant difference test (Stell and Torrie, 1991).

## 3. Results and Discussion

**Chemical composition of feed**

The nutrient content of the experimental feed is shown in Table 1. Elephant grass contains the lowest DM and CP compared to other feed ingredients. The OM content is relatively the same between ingredients. The highest CP content is CM. Rice bran contains the lowest CF, while elephant grass has the lowest CF value and the highest CM value. Elephant grass has the lowest EE content, whereas PKM contains the highest EE.

**Table 1.** Chemic of feed offered during feeding trial

| Feedstuffs | DM (%) * | OM (% DM) * | CP (% DM) * | CF (% DM) * | EE (%DM) * |
|---|---|---|---|---|---|
| Elephant grass | 28.01 | 89.23 | 6.17 | 30.21 | 1.37 |
| Rice bran | 88.62 | 90.76 | 11.69 | 11.26 | 5.75 |
| Gliricidia | 30.04 | 90.57 | 20.68 | 12.34 | 4.76 |
| Palm kernel meal | 90.08 | 91.54 | 18.26 | 14.46 | 12.65 |
| Copra meal | 89.95 | 92.67 | 22.12 | 11.02 | 10.08 |

*DM = dry matter, * OM = organic matter, * CP = crude protein, * CF = crude fibre, EE = ether extract

The chemical composition of the various protein sources is good (ranged 18.26-22.12%), making them one of the supplementary protein sources for farm animals, particularly beef cattle (Marsetyo et al., 2012; Heuze et al., 2015; Abdeltawab and Khattab, 2018; Marsetyo et al., 2021). Marsetyo et al. (2012) discovered that gliricidia is the most applicable protein supplement in villages due to the fact that this legume tree grows readily in villages. While PKM and CM are also excellent protein supplements, however their high fibre and EE content may inhibit the proliferation of microorganisms in the rumen (Henessy et al., 1989; Abdeltawab and Khattab, 2018).

**Feed Intake, Digestibility, Liveweight Gain and Income Over Feed Cost**

All bulls receiving supplements, consumed 72, 73 and 78% from their total allocation of supplement for treatment EGRBG, EGRBPKM and EGRBCM, respectively. The bulls remained in good health throughout the experiment. Feed intake of Bali bulls supplemented with different protein sources is presented in Table 2. The addition of G, PKM, and CM to the diet of Bali bulls significantly affects (P<0.05) their basal diet and total DMI. With the addition of G, PKM, and CM, the basal diet DMI decreased significantly (P<0.05). In contrast, the addition of these protein supplements to the diet increased total DMI significantly (P<0.05). Treatment EG - and EGRBCM-fed to Bali bulls resulted in the lowest and highest total DMI, respectively. The decrease in basal diet DMI in association with the inclusion of feed supplement is known as substitution. This prevalent occurrence is observed in ruminants (Marsetyo et al., 2012; Marsetyo et al., 2021). The substitution rate for the EGRBG, EGRBPKM, and EGRBCM treatments was 0.50, 0.58, and 0.42, respectively. The data revealed that supplementation with PKM led to the highest depression in basal diet DMI. PKM contained high EE and kernel oil residue, which may inhibit the growth and activity of microorganisms in the rumen. This is evident from the digestibility data, which revealed that PKM supplementation had the lower DMD value (P<0.05) compared to G and CM treatment. In general, however, protein supplementation led to a substantial increase in total DMI. Incorporating protein sources into the diet generally increases the concentration of ammonia-nitrogen in the rumen (Baldwin and Allison, 1983), which promotes the growth and activity of microorganisms in the rumen. In addition, a high dose of supplements was administered, allowing the rumen to accommodate more digestible feed than the high-fibre basal diet. Poppi et al. (2000) noted that an increase in total DMI caused an increase in digestibility and a reduction in the effect of gut fill on the reticulo-rumen.

**Table 2**. Effect of supplementation with high protein from different supplements and similar energy sources on dry matter intake (DMI), dry matter digestibility, estimated energy metabolism (ME) for maintenance (MEM), estimated ME intake (MEI), ME retention, average daily gain of Bali bulls given elephant grass

| Parameters | Dietary treatments | | | |
|---|---|---|---|---|
| | **EG** | **EGRBG** | **EGRBPKM** | **EGRBCM** |
| Elephant grass DMI (kg/day) | 4.34±0.07 | 2.37±0.04 | 1.94±0.02 | 2.66±0.03 |
| Elephant grass DMI (%W/day) | 2.62±0.00 | 1.30±0.01 | 1.10±0.01 | 1.51±0.02 |
| Supplement DMI (kg/day) | 0.00±0.00 | 3.29±0.02 | 3.22±0.01 | 3.45±0.03 |
| Supplement DMI (%W/day) | 0.00±0.00 | 1.81±0.01 | 1.83±0.01 | 1.96±0.02 |
| Total DMI (kg/day) | 4.34±0.05 | 5.65±0.06 | 5.20±0.08 | 6.22±0.23 |
| Total DMI (%W/day | 2.62±0.03[a] | 3.11±0.07[b] | 2.96±0.04[b] | 3.53±0.05[c] |
| Dry matter digestibility (%) | 55.43±0.47[a] | 63.37±0.73[c] | 58.07±0.59[b] | 68.13±0.81[d] |
| Estimated MEM (MJ ME/day) | 26.03 ± 0.67 | 24.57 ± 0.87 | 23.55 ± 0.90 | 24.65± 1.00 |
| Estimated MEI (MJ/day) | 34.01 ± 0.79[a] | 51.89 ± 3.56[c] | 43.03 ± 1.03[b] | 62.35 ± 5.48[d] |
| ME retention (MJ ME/day) | 7.98 ± 0.66[a] | 27.32 ± 3.94[c] | 19.48 ± 0.75[b] | 37.71 ± 6.11[d] |
| Average daily gain (kg/day) | 0.28±0.13[a] | 0.54±0.18[b] | 0.45±0.18[b] | 0.60±0.21[c] |
| Income over feed cost (Indonesian rupiah (IDR/day)) | 1024±276 [a] | 8185±927[c] | 5126±512[b] | 6453±728[b] |

EG = elephant grass ad libitum, EGRBG (EG + supplement (rice bran (RB) 1.25% liveweight (W) dry matter (DM)/day) and gliricidia (*Gliricidia sepium*) leaves 1.25% W DM/day), EGRBPKM =(EG, + supplement (RB 1.25% W DM/day + palm kernel meal (PKM) 1,25% W DM/day, EGRBCM = EG, + supplement (RB 1.25% W DM/day and copra meal (CM) 1.25% W DM/day Means with different superscripts in same raw are significantly different (P< 0.05).

Table 2 displays the DMD of Bali bulls supplemented with various protein sources. Addition of protein sources to diet had a significant (P< 0.05) effect on DMD of Bali bulls received RB and EG. This result was consistent with previous research (Marsetyo et al., 2012; Marsetyo et al., 2021). These authors observed that DMD increased when protein supplements such as G, PKM, and CM were administered. In current study, however, CM-supplemented Bali bulls had the highest (P<0.05) DMD, whereas unsupplemented bulls had the lowest (P<0.05) DMD. The lower DMD of unsupplemented bulls compared to supplemented bulls may be a result of EG's high fiber and low CP content (Table 1). The greatest DMD in bulls supplemented with CM may be attributable to the high protein content of CM (Table 1). Bulls' rumen microbes degrade the nitrogen from ingested supplements to support their growth and activities (Meng et al., 1999). Da Silva-Marques et al. [2018] found that the supplement with the high CP concentration (601 g/kg of CP based on DM) improved intake, and digestibility of beef cattle during grazing in the rainy season by promoting a higher metabolism and nitrogen efficiency.

Table 2 displays the ADG of Bali bulls supplemented with various protein sources. The addition of rich protein and energy to the diet of Bali bulls substantially increased their ADG. The Bali bulls supplemented with CM had the highest (P<0.05) ADG, while those given with EG had the lowest. The minimal ADG of EG-treated Bali bulls is comparable to other studies. Nurhayu et al. (2021) noted that Bali bull fed EG had an ADG of 0.24 kg/per day. According to Anggraeny et al. (2010), the ADG for Bali bulls fed EG alone was 0.10 kg/day. Consistent with prior research (Marsetyo et al., 2012 and Marsetyo et al., 2021), the ADG of Bali bulls fed CM was greater than that of those fed PKM and G. The increased total DMI, DMD, and ME ingestion of CM-supplemented bulls is responsible for their superior ADG in the present experiment. Mastika (2003), Dahlanuddin et al (2014) and Panjaitan et al. (2014) reported that the ADG for Bali bulls to be 0.61–0.85 kg/day. This Bali bulls in this study may have achieved a greater ADG at a higher supplement level. It appears that farmers could use a much higher concentration of the supplement mixture to reach the higher ADG.

Data of IOFC as a direct result of the Bali bulls being supplemented with a variety of proteins is presented in Tables 2. IOFC increased significantly (P<0.05) in associated with addition of protein in the diet. The greatest IOFC was discovered in Bali bulls that were given gliricida supplements at a level of (1.25% W/day) with a value of IDR 8185/day. The value of this IOFC was significantly higher for Bali bulls supplemented with G than supplemented with PKM and CM, which came in at IDR 5128/day and IDR 6453/day, respectively. This is due to the fact that G is more readily available and inexpensive in the village compared to PKM and CM. This finding suggests that the utilization of a combination of high protein and ME of supplement derived from tree legume would be very profitable for smallholder fattening of Bali cattle across Indonesia.

## 4. Conclusion

It During the fattening of Bali bulls, high levels of protein and energy supplementation led to increased ADG and IOFC. Protein sources derived from copra meal and rice bran exhibited a greater increase in ADG than protein sources derived from gliricidia and palm kernel meal with a comparable energy source. According to the IOFC value, gliricidia supplementation resulted in the maximum increase compared to palm kernel meal and copra meal. This suggests that gliricidia is a more profitable supplement for farmers.

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