The effects of energy and protein supplementation on liveweight change, body dimension and condition score of Donggala bulls fed corn stover

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Abstract. This study was aimed to evaluate the effect of rice bran (energy source) and palm kernel meal (protein source) or their combination supplementation on liveweight change, body dimension and condition score of Donggala bulls given corn stover. The experiment used a completely randomised block design with 4 treatment and 7 replicates. Twenty eight of Donggala bulls were randomly allocated to 4 treatments. The treatments were (1) corn stover (CS), (2) CS added 1% body weight (W) dry matter (DM)/day of rice bran (RB), (3) CS added 1% W DM/d palm kernel meal (PKM) and (4) CS added 1% W DM/d RBPKM (1:1). Observed parameters were average daily gain (ADG), body dimensions, and body condition score (BCS). Analysis of variance showed supplementation of energy and protein sources significantly (P<0.05) increased ADG, chest girth and BCS of Donggala bulls. Height at withers and body length of the bull was not affected (P>0.05) by treatment. Addition of RB or PKM significantly increased ADG, chest girth and BCS. The highest increases in ADG, chest girth and BCS were resulted in RBPKM supplementation. It is concluded that supplementation of energy in combination with protein increased growth performance of Donggala bulls fed low quality forage.

1. Introduction
Donggala (Bos indicus) cattle is one Indonesian native breed raised by smallholder farmers in Central Sulawesi and surrounding. In fattening practice, farmers in this region usually fed Donggala bulls with low quality roughages such as corn stover as a single fed. Under this condition, bull liveweight gain are usually low. [1] reported that liveweight gain of Donggala bull given native grass is 0.18 kg/d, while [2] showed that liveweight gain of Ongole, Limousin-Ongole and Brahman bulls given elephant grass was 0.18, 0.26 and 0.11 kg/d, respectively. Generally, feeding low quality forages will constrain feed intake and digestibility that resulting low metabolisable energy intake. Furthermore, with crude protein content less than 7%, low quality forage provide inadequate nutrient to support the growth and activity of microbes in the rumen. Therefore, the growth of bulls given low quality forages usually below their genetic potential. One of strategies to increase the growth of bulls given low quality forage is by supplementation of concentrates containing high energy and protein sources.
Supplementation of RB and PKM in low quality diet is expected will increase feed intake, digestibility and liveweight gain of bulls through optimisation of microbes growth and activities in the rumen.

The objective of this experiment was to examine the influence of RB, PKM or its combination as feed supplements on the liveweight gain, body dimension and BCS of Donggala bulls fed low quality roughage. Liveweight, body dimension and body condition score of animals are an important parameters that associated with animal growth. At village level cattle scale is oftenly not available, therefore an alternative method for estimating live weight is the use of body dimension measurements.

2. Material and methods

2.1. Material

This experiment was carried out at experimental farm located at Potoya village, Dolo subdistrict, Sigi district, Central Sulawesi from March to May 2019. Twenty eight Donggala bulls, 1.5-2.5 years old and with a mean initial unfasted live weight of 181 ± 4.35 kg, mean BCS 2.58 ±0.04 (scale 1-5) were used. The bulls were purchased from animal market around Sigi district, Central Sulawesi province. At the beginning of the trial each bull was injected with Ivomec (1 mL/50 kg live weight) to prevent the animal against internal and external parasites.

2.2. Methods

2.2.1. Experimental design and diets. A completely randomised block design was used in this experiment. The bulls were blocked based on unfasted weight and allotted to four treatments, according to completely randomised block design. The treatments were corn stover offered ad libitum (CS), CS + rice bran (CSRB), CS + palm kernel meal (CSPKM), and CS + mixture of RB and PKM (1:1, CSRBPKM). All supplements were offered at rate 1% W DM/d. As replications, there were 7 Donggala bulls per treatment. The amount of corn stover offered ad libitum that was 115% as the previous day intake/bull. The amount of supplement offered each week was adjusted according to the latest liveweight. Corn stover was chopped into length of 5-10 cm and given two times every day at 10.00 h and 15:00 h with half of ration for each feeding offer, while the supplements were offered once every day at 07.00 h. Each feed was placed in a similar feeding troughs. The feeds were weighed each day for individual animal intake and adjusted to actual DM content of the feeds. The bulls were housed in an individual pen (1.5×2 m) during the trial. Feeding trial was conducted for 12 weeks consisted of 2 weeks for adaptation and 10 weeks for measurement periods. Drinking water was provided continuously ad libitum during the trial.

2.2.2. Parameter measured. Some parameters such as feed intake, liveweight gain, chest girth, height at wither, body length and body condition score were measured in this experiment. Feed intake was calculated by reducing the amount of feed offered with the amount of feed refusal each day and measured for 10 weeks. The liveweight gain of each bull was determined by calculating the difference between the initial weight and the final weight of the bull each week for 10 weeks. Chest girth and body length were measured using a tape. Height at wither was measured using measuring stick when bull was standing as described by [3]. Body condition score of bull was assessed by standing behind, right and left side of the bull and palpated the tailbone and waist using hand. The BCS was determined using a single BCS unit 1-5 based on the rules of [4].

2.2.3. Feed and statistical analysis. Feed samples were analysed for DM, nitrogen content (Kjeldal method), and ether extract content [5] and neutral detergent fibre (NDF) content by method of [6]. Data collected were statistically tested by analysis of variance and differences between the means were tested using a least significant differences.
3. Results and discussion
Corn stover, RB and PKM contained 282, 924 and 894 g/kg DM, 74, 127 and 172 g/kg DM CP and 674, 452 and 634 g/kg DM of NDF, respectively. The EE content of CS, RB and PKM was 132, 714 and 103 g/kg DM, respectively. Palm kernel meal had a highest CP and EE contents, while CS contained the lowest CP, EE and highest NDF components.

Rice bran, PKM and RBPKM DM intake was 0.92, 0.74 and 0.84 % W/d, respectively. Bulls received PKM showed lower feed intake than bull received RB and RBPKM (Table 1). This may attributed to low palatability of PKM. PKM contained kernel oil residue, which might cause rancidity then affect the palatability [7]. Total DM intake increased significantly (P<0.05) by the inclusion of supplements with CSRPKMK, which had the highest value (Table 1).

| Parameter                        | Dietary treatments |
|----------------------------------|--------------------|
| Corn stover DM intake (% W/d)    | CS, CSRB, CSPKM, CSRPKMK |
| Supplement DM intake (% W/d)     | 2.62±0.00, 2.14±0.01, 2.04±0.01, 2.30±0.01 |
| Total DM intake (%W/d)           | 3.06±0.07c, 2.78±0.08b, 3.14±0.08c |
| Total CP intake (kg/d)           | 0.37±0.01, 0.54±0.02, 0.96±0.02, 0.60±0.02 |

Means with different superscripts in the same row are significantly different (P<0.05)

Data of ADG, body dimensions and BCS of Donggala bulls received treatment diet are presented in Table 2. Inclusions of RB, PKM and RBPKM in the diet up to 1% W/d, was associated with the significant increased (P<0.05) in ADG, chest girth and BCS of bulls fed CS. The lowest ADG of Donggala bull was found in CS diet (0.34 kg/day). Donggala bulls fed CSRPKMK had the highest ADG (P<0.05). There was no difference in ADGs of bulls fed CSRB and CSPKM (Table 2). Similarly, chest girth was changing as the pattern of ADG namely the lowest chest girth increase was found in CS diet (1.60 cm) and the highest increase was in CSRPKMK diet (3.30 cm).

| Parameter                        | Dietary treatments |
|----------------------------------|--------------------|
| Liveweight (kg, week 1)          | CS, CSRB, CSPKM, CSRPKMK |
| Liveweight (kg, week 10)         | 204.2±5.44, 219.3±4.31, 213.6±4.87, 224.5±4.77 |
| Daily liveweight gain (kg/d)     | 0.34±0.18a, 0.52±0.21b, 0.47±0.16b, 0.63±0.14c |
| Height at wither (cm, week 1)    | 112.8±1.23, 115.6±2.14, 117.3±1.73, 114.9±2.05 |
| Height at wither (cm, week 10)   | 114.3±1.62, 117.4±1.78, 118.9±1.90, 116.6±1.84 |
| Change in Height at wither (cm)  | 1.50±0.13, 1.70±0.14, 1.60±0.14, 1.70±0.12 |
| Chest girth (cm, week 1)         | 131.7±0.72, 132.4±0.53, 133.5±0.62, 130.3±0.60 |
| Chest girth (cm, week 10)        | 133.2±2.42, 135.5±3.15, 136.4±3.23, 133.6±3.07 |
| Change in chest girth (cm)       | 1.60±0.15a, 3.10±0.23b, 2.92±0.19b, 3.30±0.17c |
| Body length (cm, week 1)         | 114.5±2.14, 116.2±2.28, 118.3±2.32, 112.8±2.44 |
| Body length (cm, week 10)        | 114.9±2.18, 116.7±2.17, 118.7±2.36, 113.3±2.26 |
| Change in body length (cm)       | 0.43±0.09, 0.50±0.13, 0.40±0.17, 0.50±0.18 |
| Body condition score (week 1)    | 2.62±0.21, 2.58±0.17, 2.64±0.20, 2.47±0.24 |
| Body condition score (week 10)   | 3.21±0.18, 3.49±0.24, 3.45±0.18, 3.56±0.30 |
| Change in body condition score   | 0.59±0.09a, 0.91±0.07b, 0.81±0.08b, 1.09±0.09c |

CS = corn stover ad libitum, CSRB = CS + rice bran (1% W DM/d), CSPKM = CS + palm kernel meal (1% W DM/d) CSRPKMK = CS + mixture of rice bran and palm kernel meal (1:1; 1% W DM/d)
Means with different superscripts in the same row are significantly different (P<0.05).
This study revealed that there is a strong relationship between body heart girth and liveweight of the bull. Previously, [8] found that chest girth was the best parameter in predicting liveweight of Brown Swiss and crossbreed cattle. The change in chest girth could be as a result of the growth of chest bone and muscle around the chest. In contrast, supplementation had no significant effect on height at wither and body length of Donggala bull. The change in BCS of bull fed CS alone was the lowest (0.59). Supplementation significantly increased ($P<0.05$) BCS and CSRBPKM treatment resulted in the highest BCS increase (1.09). The significant increase in DM and CP intakes of supplemented bulls (Table 1) is the main reason in increasing ADG, body dimension and BCS of the bull. The increase of protein intake in PKM diet was not followed by ADG increase. [7] reported that PKM contains anti-nutritional factor such as saponins, copper and phytic acid, which may affect animal metabolism. Additionally, high lipid content of PKM (103 g/kg DM) may inhibit rumen fermentation and thus fibre digestion, which in turn, may have effect on animal performance.

4. Conclusion
Growth performance and body condition score of Donggala bull fed low quality forage can be increased by the inclusion of rice bran and palm kernel meal as energy and protein supplement in the diet.

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