Effect of Using Different Levels of Cassava Meal on Nutrient Intake, Fiber Digestibility and Body Condition Score in Crossbreed Limousin Bulls

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Abstract. An experiment was conducted in Malang, East Java-Indonesia to evaluate the effect of using cassava meal in the diet at levels of 30, 40, 50, 60 and 70 % on feed intake, fiber digestibility and body condition score (BCS). Treatment with 40% cassava meal had the highest nutrient intake, fiber digestibility and profit margin. The treatment with 70% cassava meal level had the lowest nutrient intake, fiber digestibility and BCS. It was concluded that a high level (>40%) of cassava meal in the diet reduced nutrient intake, fiber digestibility and causing low BCS.

1. Introduction
Cassava is one of the sources of feed energy and comes from the processing of cassava tubers. Fresh cassava tubers will go through of drying and grinding to become a feed ingredient called cassava meal. The function of processing cassava tubers into cassava meal is to remove cyanide content which can be harmful to livestock. [1] state that with the process of drying and processing cassava tubers to cassava meal be able to reduce the cyanide content by 91.5% after drying with the sun, the initial cyanide levels of 97 ppm to 8 ppm and this level is safe for consumption by cattle. [2] mention the nutrient content of cassava meal used as an energy source of feed ingredient that has an average dry matter (DM) 87.2%; organic matter (OM) 96.1%; crude protein 2.9%; crude fat 0.7%; NDF 8.0% and ADF 5.4%. [3] stated that as feed ingredients, cassava meal has a nutrient content with crude protein 2.8%; crude fiber 2.6%; crude fat 1.2%; OM 96.8%; metabolic energy (ME) 3.2 Mcal/kg and total starch 68%. The high ME value and starch content make cassava meal used as one of the energy sources.

Based on the results of research by [4], using cassava meal at the level of 80% with the addition of urea as much as 4% in concentrate for beef cattle shows that cassava meal will not interfere with rumen ecology but is effective in the rumen fermentation process and is able to increase synthesis protein microbes. The results of the study of [5] regarding the use of cassava meal in the diet by 40% and 50%, cattle fed with 50% cassava meal in the diet had average daily gain 0.80 kg/head/day and 12.20 for FCR compared to animals that were fed with 40% cassava meal only had 0.74 kg/head/day and FCR 15.24; it is known that the difference in this study with previous studies that in the difference level of cassava meal in feed formulations.

The energy content in the form of carbohydrates will be utilized by rumen microorganisms to be converted into volatile fatty acid (VFA) as the main energy source [6]. An energy balance above maintenance will be utilized and stored as new tissue and achieve a final body weight before slaughter. High performance in livestock is not only influenced by an adequate energy balance but is also influenced by other factors such as the breed of cattle and sex. Limousin crossbred are a cross between Limousin breeds and local cattle breeds in Indonesia. [7] showed that Limousin crossbred were able to produce a body weight gain of 0.84 to 1.25 kg/head/day. The high daily body weight gain is a factor considered by many breeders to keep Limousin crossbreed as feeder cattle for fattening.
The fattening process of Limousin crossbred, requires a high-energy feed. A high energy feed is cassava meal. However its use as an energy source and recommended level is not known. It is therefore necessary to determine the level of cassava meal in the diet on nutrient intake, fiber digestibility and body condition score in crossbred Limousin bulls.

2. Materials and Methods
2.1. Location
The experiment was conducted at Sumber Sekar Teaching Farm, Brawijaya University, Malang in East Java Province, Indonesia. The climate is entirely tropical with a wet season from November to April and a dry season from May to October. The average rainfall during 2018 was around 3,230 mm. The mean temperature and humidity during the experiments were 17.8 to 31.5°C and 69.2 to 87.0% respectively. The research was carried out from April to August 2018.

2.2. Experimental Animals
Thirty crossbred Limousin bulls used were 2.0-2.5 years of age with body weight ranging from 213 to 307 kg at commencement of the experiment. The animals were bought from a local cattle market and each individual was given an identity using neck collar tags. Before the adaptation period, all the experimental animals were treated against intestinal parasites using Nitroxinil (1.5 ml/50 kg live weight). The animals were weighed in the morning before feeding every week to determine body weight gain and as a basis for calculating feed offer. Animals were held in individual stalls. Each stall was 2.10 m x 1.25 m in size with separate feeding trough so the cattle could not access feed or water from their neighbor.

2.3. Feed Preparation
The feeds used in the experiment were maize stover and cassava mixture consisting of cassava meal, copra meal, palm kernel meal, urea, and mineral. The maize stover was harvested 70-80 days after planting. In the morning, maize stover was chopped into 3 to 5 cm lengths by a chopper. The maize stover was weighed according to the amount of feed offered on that day. The other feed ingredients of cassava meal, copra meal, palm kernel meal, urea, and mineral were mixed weekly according to the composition for each treatment. The cassava mixture was weighed each morning according to the amount of feed offered for that day.

2.4. Experimental Design and Treatments
Thirty were randomly allocated to the five treatments, and were arranged in a Randomized Block Design (RBD) using initial live weight as a block. Five treatment diets were applied and 6 bulls were used in each treatment. The five diets had a different level of cassava mixture (consisting of cassava meal, copra meal and palm kernel meal) as shown in Table 1. Urea was added to the cassava meal at level of 2% and mineral was added at 2% of the total cassava mixture.

| Ingredients                   | Treatments (%) |
|-------------------------------|----------------|
|                               | 30C  | 40C  | 50C  | 60C  | 70C  |
| Maize Stover                  | 20.00| 20.00| 20.00| 20.00| 20.00|
| Cassava meal                  | 30.00| 40.00| 50.00| 60.00| 70.00|
| Copra meal (CM)               | 25.00| 20.00| 15.00| 10.00| 5.00 |
| Palm Kernel Cake (PKC)        | 25.00| 20.00| 15.00| 10.00| 5.00 |
| Urea (add in Cassava meal)    | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Mineral (add in Cassava mixture) | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |

2.5. Feeding and Management
The feeds were offered five times per day, at 07.30 am with half of maize stover followed by one-third of cassava mixture one hour later at 08.30 am. In the afternoon, feed was offered at 01.00 pm with remaining maize stover, 02.00 pm with one-third of cassava mixture and at 04.00 pm with the last third of cassava mixture. Drinking water was provided _ad libitum_ throughout the experimental period. The experimental period continued for 84 days excluding 21 day adaptation period.
2.6. Data Collection and Sampling Procedures

Individual intake of maize stover and cassava mixture was measured daily, based on the amount of feed offered and refused each morning every week after weighing the animals, adjustment was made for maize stover offered so that it was 0.5% live weight. For adaptation, the cassava mixture for each treatment was offered 2% live weight but then, cassava mixtures was offered ad-libitum with a 10% refusal of what offered used to adjust the amount offered each day. The total feed intake was calculated as the sum of the intake of the ration component by weighing cattle individually in the morning before feeding.

2.7. Chemical Analysis

During the trial, the feeds offered and individual feed refusals were sampled daily and collected to one sample for one week. During the digestibility period, the feeds offered and refused and faeces were sampled daily and then collected the seven days collection period. Sample of feeds, refusals and faeces were analysed for DM, crude protein (CP), and crude fiber (CF). The DM, CP and CF were analysed according to the standard methods of[8].

2.8. Statistical Analysis

The data were analyzed statistically by ANOVA using the general linear model procedure of Minitab software version 17.0 (Minitab, 2014). The treatment least-square means showing significant differences at the probability level of P<0.05 were compared using Tukey’s pairwise comparison procedure. The statistical model used was Yij = µ + βj + δi + εij where: Yij is the dependent variable, µ is the overall mean, βj is the effect of the block, δi is the effect of treatment and εij random error. Initial live weight as covariates in the statistical model, but since the covariates were not significant (P>0.05) it was omitted from the final model.

3. Results and Discussion

3.1. Chemical Composition of The Ration

The concentrate is formulated based on the level of use of cassava meal in the diet Table 2. shows the chemical composition of feed ingredients and concentrate mixtures. The crude protein content of concentrate mixture was highest for treatment 30C (13.50%), protein was reduced as the proportion of dried cassava meal increased is also an . There is also an increase of crude fiber contents in the concentrate from treatment with 70C cassava meal sequentially to treatment 30C due to the lower level of use of cassava meal.

Cassava meal in this study has different nutritional values with the results of the study of [2], where the nutrient content of cassava meal used as an energy source feed ingredients is an average dry matter value of 87.2% and crude protein 2.9%. The difference can be determined by various factors. [9] states that the quality of cassava meal was determined by several factors, namely the type or cultivar of the plant, the process of planting and fertilizing, the age of the plant, handling at harvest and after harvest, processing and storage processes and technology.

| Composition | Maize Stover | Cassava Meal | Copra Meal | Palm Kernel Cake | Cassava Mixture |
|-------------|--------------|--------------|------------|-----------------|----------------|
| Dry Matter (%) | 26.22 | 87.3 | 88.14 | 91.67 | 92.77 | 91.02 | 90.32 | 89.97 | 91.38 |
| Crude Protein* (%) | 9.51 | 2.13 | 24.6 | 17.66 | 13.50 | 12.13 | 10.67 | 9.86 | 9.98 |
| Crude Fiber* (%) | 24.09 | 3.2 | 20.8 | 21.9 | 10.88 | 11.14 | 10.71 | 11.16 | 11.50 |

*DM Basis

3.2. Feed Intake

Data of feed intake is presented in Table 3. Statistical analysis showed that feed treatments significantly affected nutrient intake (P<0.05).
The digestibility crude fiber in this study was closely related to carbohydrate content as a source of energy in feed as explained by [13] that in ruminants, the total number of crude fiber that can be digested is very important because it affects the total NDF that can be digested which is a source of energy that can be digested. There are four important factors that affect digestion and crude fiber performance in ruminants, namely: 1) proportion of the amount of fiber that is potentially digestible; 2) crude diber digestibility level; 3) digestion rate of fiber in the rumen and 4) digestive potential of digestible fiber in the rumen and other digestive devices.

The high digestibility (DM, CF and CP digestibility) in treatments 40C influenced by the high protein while in treatment 70C with a low digestibility due to the high level of cassava meal, the higher content of starch in the feed as in the study conducted by [14], explaining the comparison of digestibility between energy-fed and high-protein feeds, the results obtained indicate that high-protein feeds have higher digestibility, high-protein ration cause: 1). can overcome the deficiency of degraded protein in the rumen; 2). increase intrinsic speed and digestive potential of fiber; 3). rumen conditions get better at digesting coarse fibers because of the reduced concentration of starch in the feed and; 4). stimulation of cellulolytic bacteria by amino acids and peptides derived from proteins.

The digestibility data in this study showed that there were associative effects of the level of cassava meal with the nutrient intake and digestibility. Associative effect that occurs at the level of

Table 3. Feed and Nutrient Intake of Crossbred Limousin Bulls

| Nutrient Intake | Treatment | 30C | 40C | 50C | 60C | 70C |
|-----------------|-----------|-----|-----|-----|-----|-----|
| Dry matter (DM) | 77.2±6.36a | 78.3±6.97b | 70.7±5.36a | 70.1±8.18ab | 62.9±7.91a |
| Crude fiber (CF) | 51.4±8.19ab | 50.3±14.22b | 34.7±5.17ab | 36.3±11.19ab | 31.8±10.84ab |
| Crude protein (CP) | 80.3±3.63b | 83.3±6.21b | 72.8±4.68ab | 75.8±5.80ab | 69.8±10.03ab |

a,b,c Mean within rows with different superscripts are significantly different (P<0.05).

Table 4. Nutrient Digestibility of Crossbred Limousin Bulls

| Item | Treatment | 30C | 40C | 50C | 60C | 70C |
|------|-----------|-----|-----|-----|-----|-----|
| Dry matter (DM) | 77.2±6.36a | 78.3±6.97b | 70.7±5.36a | 70.1±8.18ab | 62.9±7.91a |
| Crude fiber (CF) | 51.4±8.19ab | 50.3±14.22b | 34.7±5.17ab | 36.3±11.19ab | 31.8±10.84ab |
| Crude protein (CP) | 80.3±3.63b | 83.3±6.21b | 72.8±4.68ab | 75.8±5.80ab | 69.8±10.03ab |

a,b,c Mean within rows with different superscripts are significantly different (P<0.05).
cassava meal was negative because along with the increasing level of cassava meal causes a decrease in the nutrient intake and digestibility. [15] explain that interactions or associative effects of feed can be seen in changes in feed intake and/or digestibility.

3.4. Body Condition Score

Data of nutrient digestibility presented in Table 5. Statistical analysis showed that BCS change significantly affected (P<0.05) by feed treatments.

| Parameters          | Perlakuan |
|---------------------|-----------|
|                     | 30C | 40C | 50C | 60C | 70C |
| Initial BCS (unit)  | 3.33| 3.25| 3.42| 3.17| 3.42|
| Final BCS (unit)    | 4.33| 4.58| 4.58| 3.75| 3.58|
| BCS Change (unit)   | 1.00<sup>ab</sup>| 1.33<sup>b</sup>| 1.16<sup>b</sup>| 0.62<sup>ab</sup>| 0.16<sup>a</sup>|

a,b,c  Mean within rows with different superscripts are significantly different (P<0.05).

Table 5 shows the initial BCS, final BCS and BCS change in crossbred limousin bulls during the experiment. The BCS unit used in this study uses a range of scores with values 1-5. The average score with the highest increase in treatment 40C of 1.33 unit. Measurement of BCS scores in this study was used to assess physical conditions as described by [16] that BCS is an indicator for evaluating nutritional status in cattle. BCS indicates the existence of energy reserves in cattle in the form of fat and muscle tissue that affect growth performance. Numerous studies show that BCS values are more accurate in ensuring the nutritional status of livestock compared to bodyweight because most cattle have an age range, frame size, and muscularity that have an impact on livestock weight. Therefore if the determination of nutritional status is only based on body weight, the results are less precise for example, two cattle that have the same body weight can have different BCS scores.

Conclusions

The highest DM intake was obtained by cattle received treatment 40C (7.60 kg/head/day) followed by treatment 30C, 50C, 60C and, 70C, as well as the value of BCS changes that indicate that feed with 40C has the highest BCS change value compared to other treatments. The lowest feed cost of gain was achieved by cattle fed on treatment 30C (30% dried cassava tuber in the diets). It was concluded that using 40% cassava meal in the diet give the highest DM intake, BCS change and give the low feed cost of gain.

Conclusions

Based on the data obtained in this experiment, it can be concluded that the increased use of dried cassava meal in concentrate mixture reduced nutrient intake, fiber digestibility and BCS change. The highest value of nutrient intake was obtained by cattle received treatment with 40% level of cassava meal followed by treatment 30%, 50%, 60% and, 70% of cassava meal in the diet.

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