

Assessing Nutrient Consumption and Fattening Performances of Simmental Crossbred Bulls Fed Concentrate Feed and Chopped Forage Under Different Times on Feed Offered

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Revised: 2023-06-30, Accepted: 2023-07-05, Publish: 2023-09-27

ABSTRACT

This study aimed to determine nutrient consumption, body weight gain, feed conversion, and feed efficiency of Simmental crossbred bulls through different feeding management specifically for levels of time on feed offered. Nine bulls were allocated on three different level treatments and three replicates. They were T0=feeding whole concentrate first in the morning then offering whole chopped forages after 6 hours later; T1=feeding half of the concentrate first then offering half of the chopped forages after 2 hours later in the morning and afternoon; T2=feeding half of the concentrate and chopped forages simultaneously in the morning and afternoon. Bulls were fed twice daily and had free access to drinking water *ad libitum*. Parameters observed were nutrient consumption, daily gain, feed conversion and efficiency. Data were analyzed using ANOVA and further analysis by DMRT for the significant parameter. The results showed that the treatment of different feeding management presented significantly different ($P<0.05$) on nutrient consumption; however, it had no effect ($P>0.05$) on daily gain, feed conversion, and feed efficiency. Feed-offered time differences affected nutrient consumption but did not alter the concentrate and forage ratio consumed or cattle performances.

Keywords: beef cattle, daily weight gain, fattening performances, feed offering method, feeding management.

INTRODUCTION

Good feeding management as part of good management practices will improve cattle performance. Feed plays an essential role in the livestock business, especially in the fattening industry, since about 85% of variable costs are allocated for feed expenses (Haloho et al., 2013). The common feeds for ruminants are forages and concentrates. However, when more fibre is used in the rations, it reduces the digestibility of feed ingredients, and the passage rate is slower than in normal conditions (Wawo et al., 2020). It caused a lack of livestock performance over time. A decreasing livestock performance would result in an extended maintenance period, inefficient use of feed, increased production costs, and can cause losses for farmers (Syahniar and Subagja, 2018). Therefore, concentrate can be a complementary feed covering nutrient deficiencies from forages. Concentrate administration accelerated the activity of the feed degradation process by rumen microbes and shortened the diet's passage rate (Ivat et al., 2020). Providing the required diet in quantity and quality and good feed management would improve livestock performances.

Generally, farmers in Indonesia are unaware of managing good feeding practices,

affecting their livestock performance (Iswoyo and Widianingrum, 2008). One of good feeding management is time on feeding. The application of the feeding method by adjusting the time interval between offering concentrate and forages can improve livestock performance (Astuti et al., 2015). However, feeding management was found at PT. X was applied six hours apart between concentrate and forages offered. The concentrate feed was offered earlier, followed by a forage diet after 6 hours. Offering concentrate first without being balanced with providing forages will accelerate fermentation and decrease rumen pH. The acidic condition in the rumen compartment causes damage to the epithelium, which has a domino effect on the low absorption of nutrients (Amalo et al., 2021). Therefore, this research aimed to determine beef bulls' nutrient consumption and fattening performances under the different times of feed offered.

MATERIALS AND METHODS

Research design, animal, and diet

This research was conducted at the individual pen in the PT. X, Indonesia. The cattle were 9 Simmental crossbred bulls between 2 and 3 years old.

The live weight was about (514±19.99) kg/head. They were randomly allocated to three groups designed by completely randomized design (CRD). The treatment was time on feeding with three levels and three replications each. Three levels of treatment were:

- T0: concentrate offered first in the morning, followed by forages six hours afterwards,
- T1: a half amount of concentrate offered earlier followed by a half amount of forage after 2 hours in the morning. The remaining feeds were offered in the afternoon with a similar method,
- T2: a half concentrate and a half forage were offered jointly in the morning, and the

remaining feeds were offered jointly in the afternoon.

The diets provided in this study were concentrate and elephant grass (*Pennisetum purpureum*) as a forage. The elephant grass was purchased from the area around the farm. The concentrated was formulated and mixed by PT. X. It consisted of soybean meal, copra meal, milled husk bran, *kebi* bran, corn gluten feed (CGF), corn tumpi (epidermis), soybean skin, coffee husk, cocoa husk, molasses, and salt. The ratio of each feed ingredient was company-confidential and could not be disseminated. The nutrient composition of concentrate and elephant grass is presented in Table 1.

Table 1. Nutrient composition of concentrate and elephant grass as a fattening diet

| Nutrient Composition | Concentrate | Elephant grass |
|----------------------------------|-------------|----------------|
| Dry matter (%) | 84.67 | 19.5 |
| Crude protein (% DM) | 18.06 | 9.1 |
| Crude fat (% DM) | 5.74 | 1.95 |
| Crude fibre (% DM) | 17.56 | 29.45 |
| Total Digestible Nutrient (% DM) | 68.00 | 57.92 |

Calculation of rations based on the result of proximate analysis at Feed Technology Laboratory, Animal Science Department, Politeknik Negeri Jember, Jember (2021)

Animal management and parameters observed

Bulls were adapted to the diet and each pen for two weeks. They were treated with anthelmintic (Kalbazen-C with a dose of 3-4 ml/45 kg of body weight) after 24 hours of first-day adaptation. Bulls are fed more forages and less concentrated feed during the adaptation period; then, the diet ratio changes gradually to match the ratio observed in the diet. After a couple of weeks

of the adaptation period, bulls were weighed before feeding to determine their initial weight. The weighing was done every month using a digital Sonic-Ni7 scale. The weight of bulls is used to determine fattening performances such as average daily gain (ADG), feed conversion, and feed efficiency. ADG was determined through the difference in body weight divided by the length of the maintenance period based on the following formula:

$$ADG = \frac{\text{final body weight (kg)} - \text{initial body weight (kg)}}{\text{maintenance period (days)}}$$

The formula for calculating feed conversion and feed efficiency was determined by the feed consumption ratio to weight gain and the

percentage of its reverse, respectively. The following formula calculates them:

$$\text{Feed conversion} = \frac{\text{daily feed consumption (kg DM/head/day)}}{\text{daily weight gain (kg/head/day)}}$$

$$\text{Feed efficiency} = \frac{\text{daily weight gain (kg/head/day)}}{\text{daily feed consumption (kg DM/head/day)}} \times 100\%$$

Bulls fed 3% DM/kg BW/d with the ratio of concentrate and forages of 70:30 for an 11-

week observed period. The diet was assigned according to the treatment and offered restricted.

The concentrate was offered dry, forages were chopped before feeding, and drinking water was offered ad libitum. The feed was offered in the morning at 07.00 and in the afternoon at 13.00. The leftover diet was weighed daily in the morning to determine consumption on a *fed* basis. Chopped forages and concentrate were weighed by digital scales of DLE 300 and SF-400 scales, respectively. Nutrient consumption on a dry matter (DM) basis was adjusted as fed consumption to the nutrient composition of concentrate and forage diet, as shown in Table 1.

Statistical analysis

The data obtained were analyzed by analysis of variance (ANOVA) at a significant level of 5% using PASW version 18. Furthermore, when there was a significant parameter ($P < 0.05$), it would be further analyzed by using Duncan's Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Nutrient consumption (DM basis)

The average nutrient consumption of Simmental crossbred bulls during a fattening period with the treatment of different times on feed offered were presented in Table 2. The different times of feed offered showed a significant effect ($P < 0.05$) on nutrient consumption of forages and concentrated on dry matter basis, total dry matter, protein, TDN, fibre and lipid. Treatment of T0, followed by T2 and T1, presented as the lowest, moderate, and highest number of each nutrient consumption,

respectively. The range of total consumption on dry matter in this study tends to be higher compared with Astuti et al. (2015), which showed the average total consumption on Simmental crossbred bulls, which was 8.69 kg DM/head/day. On the contrary, the consumption ratio of forages and concentrate was not affected by the times of feed offered. It determined that the average ratio of forages to concentrate for a fattening diet consumed by Simmental crossbred bulls ranged between 29.18% and 70.76%, respectively.

Fattening performances

Fattening performances of body weight gain, daily gain, feed conversion and feed efficiency on Simmental crossbred bulls were shown in Table 3. They showed a similar effect ($P > 0.05$) between times of feed offered. However, T1 tended to show the highest weight gain and feed efficiency but the lowest feed conversion compared to others. It followed the result of Rico et al. (2020) but higher than that of Astuti et al. (2015), that the average daily gain of Simmental crossbred bulls was 0.95 kg/head/day and 0.40 kg/head/day, respectively. Furthermore, this study presented that the average feed conversion and feed efficiency between groups were 13.53 and 7.69%, respectively. This feed conversion was lower than the results of Carvalho et al. (2010) and Astuti et al. (2015) in 18.47 and 24.83, respectively. The average feed efficiency was slightly higher than Wati and Yusuf's (2020) study, which was 7.67%.

Table 2. The average nutrient consumption of Simmental crossbred bulls

| Parameters | Treatment | | | s.e.m. |
|---|---------------------|--------------------|---------------------|--------|
| | T0 | T1 | T2 | |
| Forages intake (kg DM/head/d) | 3.292 ^a | 3.829 ^c | 3.623 ^b | 0.15 |
| Concentrate intake (kg DM/head/d) | 8.131 ^a | 9.392 ^c | 8.771 ^b | 0.043 |
| Total intake (kg DM/head/d) | 11.424 ^a | 13.22 ^c | 12.291 ^b | 0.047 |
| The ratio of forage intake (%) ^{ns} | 28.995 | 29.127 | 29.415 | 0.142 |
| The ratio of concentrate intake (%) ^{ns} | 71.005 | 70.873 | 70.393 | 0.148 |
| Protein intake (kg DM/head/d) | 1.763 ^a | 2.038 ^c | 1.897 ^b | 0.008 |
| TDN intake (kg DM/head/d) | 7.436 ^a | 8.603 ^c | 8.007 ^b | 0.031 |
| Fibre intake (kg DM/head/d) | 2.397 ^a | 2.777 ^c | 2.592 ^b | 0.009 |
| Lipid intake (kg DM/head/d) | 0.531 ^a | 0.614 ^c | 0.570 ^b | 0.003 |

Superscript (^{a, b, c}) on the same line indicated a significant difference ($P < 0.05$);

ns: not significant ($P > 0.05$);

T0: concentrate offered first in the morning, followed by forages six hours afterwards;

T1: a half amount of concentrate offered earlier followed by a half amount of forage after 2 hours in the morning.

The remaining feeds were offered in the afternoon with a similar method;

T2: a half concentrate and a half forage were offered jointly in the morning, and the remaining feeds were offered jointly in the afternoon.

Table 3. Average of body weight gain, daily gain, feed conversion and feed efficiency on Simmental crossbred bulls

| Parameters | Treatment | | | s.e.m. |
|--|-----------|--------|--------|--------|
| | T0 | T1 | T2 | |
| Body weight gain (kg/head) ^{ns} | 71 | 105.3 | 87 | 7.802 |
| Daily gain (kg/head/d) ^{ns} | 0.772 | 1.145 | 0.946 | 0.085 |
| Feed conversion ^{ns} | 14.817 | 12.131 | 13.641 | 0.96 |
| Feed efficiency (%) ^{ns} | 6.82 | 8.557 | 7.703 | 0.589 |

ns: not significant ($P>0.05$);

T0: concentrate offered first in the morning, followed by forages six hours afterwards;

T1: a half amount of concentrate offered earlier followed by a half amount of forage after 2 hours in the morning. The remaining feeds were offered in the afternoon with a similar method;

T2: a half concentrate and a half forage were offered jointly in the morning, and the remaining feeds were offered jointly in the afternoon.

The significant results of nutrient consumption by different times on feed offered as the one of management on feeding bulls was as expected. The T1 bulls obtained the highest consumption due to the appropriate time interval of feed offered between concentrate and forages. It had a short time interval of 2 hours on each feeding term. Bulls could access concentrate and forage efficiently and concisely but relatively made un-bulky rumen. It was possible to point out a faster ruminal degradation process and a higher rate of feed metabolism than other groups.

The formerly offered concentrate would lead to a digestive process by ruminal microbes to produce amino acids, which would be used for microbial protein synthesis (Purbowati et al., 2014). Also, it would accelerate the growth of ruminal microbes, so it was better prepared to degrade high-fibre feed (Bata and Sodik, 2014). The large population of microbes, mainly lignocellulolytic, would produce lignocellulose enzymes to degrade fibre in forages (Turangan et al., 2018). The rapid degradation process increased the feed metabolism rate in the digestive tract and caused the rumen to empty faster (Ransa et al., 2020). It resulted in a higher appetite for bulls to increase their consumption automatically. Moreover, the high rate of feed metabolism showed the activity and growth of digestive microorganisms to digest feed quickly, thus accelerating the feed leaving the digestive tract and impacting feed consumption (Kaleka et al., 2021). High consumption of total dry matter promoted increased consumption of other nutrient fractions such as protein, TDN, fibre and lipids.

The treatment levels of T0 and T2 showed lower consumption than T1. It was caused by the time interval on feeding during 6 hours at T0, which was longer than T1. Bulls administrated about 71% concentrate ratio of the whole diet in

the morning feeding, which was quickly finished. Finished concentrate with a higher rate of metabolism caused vacant rumen faster, as explained before. However, bulls with T0 could not consume any rest of the forages due to being unavailable before afternoon feeding even though the concentrate feed had run out early. Thus, the bulls were fasting. It reduced the opportunity for bulls to eat any feed before afternoon feeding, which could lower the consumption. In dissimilar conditions, the treatment levels of T2 presented moderate nutrient consumption. It was lower than T1 but higher than T0, averaging 12.3 kg DM/head/day of total dry matter consumption. The feeding technique of a half concentrate and a half forage simultaneously fed indicated that bulls ate a bulky diet at once than T0 and T1. This bulky diet induced a slower feed metabolism rate in the rumen, thus affecting consumption. Nevertheless, the consumption ratio between concentrate and forages was similar at all treatment levels.

The significantly increasing nutrient consumption based on the treatment levels had not been able to improve the fattening performance of Simmental crossbred bulls. However, this tended to show a similar trend in daily gain and feed efficiency but vice versa in feed conversion. The daily gain of bulls on T1 showed the quantitatively highest number due to the highest nutrient consumption achieved from the feeding management with an interval of 2 hours between the offered of concentrate and forages. It was similar to the result of Iswoyo and Widiyaningrum (2008) in weaned Peranakan Etawah (PE) goats. Feeding with good nutrient content and given the required amount of feed will increase livestock productivity (Nurhayu and Sariubang, 2016). Additionally, the principle of feeding highly nutritious feed will result in the highest average daily gain rather than reducing feed cost

was used to maximize the profits of feedlot industries in Western countries (Cowley et al., 2020).

Feed efficiency and conversion were equally influenced by the amount of DM feed intake and average daily gain (Yakin et al., 2012; Riyanto et al., 2017). The good digestibility of feed influenced the high feed efficiency value (Nanda et al., 2014). A high feed efficiency value indicates that decreasing consumption produces more body weight gain (Wati and Yusuf, 2020). Contrarily, the smaller feed conversion value means more efficient bulls utilizing the feed. The higher value of feed efficiency and lower value of feed conversion produced would benefit the company. This was due to fewer production costs spent for feed (Green *et al.*, 2013), and it was also shown that livestock could utilize the feed efficiently for production activities (Safwan et al., 2020).

CONCLUSION

The results can be concluded that feed-offered time differences affected nutrient consumption. Specifically, T1 was able to increase nutrient consumption. However, the treatment of different times on feed offered did not alter concentrate and forage ration consumed as well as cattle performances such as daily weight gain, feed conversion and feed efficiency—feeding management at PT. X should be replaced by following the treatment level at T1 to obtain the optimal fattening performances of Simmental crossbred bulls.

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