Nutrient Adequacy Evaluation of Aceh Cattle Fed with Concentrate for Forage Substitution and Performance Improvement

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Abstract. This study aims to evaluate nutrient adequacy based on the nutrient requirement and intake of Aceh cattle fed by concentrate as a substitution for forage to improve their performance and productivity. The study was conducted from May to July 2018 at Livestock Breeding and Forage Center for Excellence (BPTU-HPT) of Indrapuri, Aceh. Twenty heads of selected male and healthy Aceh cattle aged 1.5-2.5 yo with a weight of ±160 kg were divided into four treatment groups based on different forage and commercial concentrate feed levels, i.e. T1 as a control (fed with 25 kg of forage without any additional concentrate feed), T2 (fed with 20 kg of forage plus 1 kg of concentrate feed), T3 (fed with 15 kg of forage plus 2 kg of concentrate feed), and T4 (fed with 10 kg of forage plus 3 kg of concentrate feed). The data observed were ADG, feed consumption, and nutrient intake, requirement, and balance. Data were analyzed using one-way ANOVA and continued by DMRT. The difference in the amount of forage consumption was very significant (P <0.05), directly proportional to the amount of forage provided. Dry matter intake significantly increased with provision of concentrate (P <0.05). Increases in DM, CP, and TDN intakes were 0.75, 0.16, 0.40 kg/d, respectively. A negative balance was found in almost all nutrients and treatment groups, and there was only one positive balance, i.e. protein in T4 group. T3 group had met the DM requirement, but did not meet protein and TDN requirements, and also had the highest ADG (P <0.05) compared to the other groups. This study concludes that the use of concentrate as a substitute for forage improves nutrient intake of male Aceh cattle. Feeding of 2 kg of concentrate and 15 kg of forage can meet nutrient requirements of dry matter and provide the highest ADG.

Keyword: Aceh cattle, average daily gain, dry matter intake, feed cost, feed efficiency

1. Introduction

The population of cattle in Aceh was dominated by the Aceh cattle breed (i.e. 84.93% of the total population of cattle) at smallholder farm level [1]. Aceh cattle is one of the Indonesian local cattle...
which has obtained stipulation under the decree of the Minister of Agriculture of the Republic of Indonesia Number: 2907/Kpts/OT.140/6/2011 [2]. According to data from [3], slaughtered cattle, beef production, and beef consumption in Aceh were on the increase from 2013 to 2017. Aceh people’s unique tradition known as meugang contributed to this condition. Meugang is a tradition of providing and cooking beef before the Islamic big day celebration and it is usually held three times a year, i.e. two days before Ramadan, Eid-al-Fitr, and Eid al-Adha. Ahead of meugang tradition, the market condition of Aceh cattle in Indonesia is unique [4]. The demand for beef and the price has increased from normal conditions. Based on [3], beef prices during normal conditions and during meugang tradition range from Rp100,000-120,000/kg and from Rp150,000-170,000/kg, respectively. The demand for live cattle is 18,000-20,000 heads/moment. Aceh cattle are very potential as meat producers as well as for fattening business.

Livestock businesses spend up to 70% of their total costs on feed because livestock needs good quality feed to have good productivity. Thus, improvement of feed quality is essential and farmers need to know how to do it, especially using feed ingredients available in the surrounding area. [5] reported that the feed cost could reach 69.10% of the total costs in the livestock business at smallholder farm level. Feed is an essential element in the production of beef cattle. Farmers in Aceh still rely on forage as a single source of feed regardless of the balance of required nutrients, and the forage used during the fattening process was mostly inadequate in terms of both quality and quantities [1]. Therefore, concentrate supplementation is needed to meet nutrient requirements.

Unfortunately, the price of concentrate is so high that smallholder farmers barely can afford it. To overcome these problems, smallholder farmers may reduce the provision of forage and provide a sufficient quantity of concentrate, making the use of feed efficient. One way to increase beef cattle production is by reducing feed costs and enhancing the efficient use of feed ingredients. As the nutrient content of feed, especially protein and energy, increases, its digestibility will increase as well, allowing fulfillment of livestock production needs. By improving feed utilization efficiency, farmers will have more chances to get higher profits. However, currently only a few smallholder farmers use reinforcing feed for Aceh cattle. It is due to the tradition of smallholder farmers in Aceh who still pass down traditional farming activities. This study aims to evaluate the adequacy of nutrients based on the nutrient requirement and intake of Aceh cattle by providing concentrate feed as a substitute for forage. This information will be useful as a basis and preliminary data for raising Aceh cattle through concentrate feed to improve their performance and productivity.

### 2. Materials and Methods

The study was conducted for three months, i.e. from May to July 2018, using twenty (20) heads of male and healthy Aceh cattle at Livestock Breeding and Forage Center for Excellence (BPTU-HPT) of Indrapuri located in Aceh Besar Regency. Selected Aceh cattle aged 1.5 to 2.5 years with similar initial weight (±160 kg) were used in the study. Aceh cattle were kept intensively in individual housing. Aceh cattle were divided randomly into four treatment groups based on different forage and commercial concentrate feed level, i.e. T1 as a control fed with 25 kg of forage without any additional commercial concentrate feed, T2 fed with 20 kg (-5 kg) of forage plus 1 kg of commercial concentrate feed, T3 fed with 15 kg (-10 kg) of forage plus 2 kg of commercial concentrate feed, and T4 fed with 10 kg (-15 kg) of forage plus 3 kg of commercial concentrate feed. Water was available at all times (ad libitum). Concentrate feed was given in the morning at 07.00 am while forage feed was given at noon at 01.00 pm and in the afternoon at 04.00 pm. The nutrient content of feed used in the study is presented in Table 1.

| Variable/Nutrient* | Forage | Concentrate |
|--------------------|--------|-------------|
| Dry matter (%)     | 22.50  | 92.26       |
| Ash (%)            | 8.72   | 7.19        |
| Crude protein (%)  | 4.88   | 18.67       |
| Crude fat (%)      | 1.62   | 3.87        |

Table 1. Nutrient content of feed used in the research
Crude fiber (%) 39.81 11.5
Organic matter without N (%) 44.97 58.78
Organic matter (%) 91.28 92.81
Total digestible nutrient (%)** 47.08 73.70

*Based on analysis at Laboratory of Animal Nutrition, Faculty of Animal Science, UGM, 2018
**Calculated using formulas proposed by Hartadi, 2005

Aceh cattle were kept for three months and weighed monthly to determine average daily gain (ADG). Feed intake (FI) was observed daily by weighing the feed offered minus the leftover feed. The amount of each nutrient intake was calculated based on the nutrient content multiplied by the total dry matter (DM) intake. Daily dry matter, protein (CP), and total digestible nutrient (TDN) requirements are 3% of body weight, 12% of dry matter, and 60% of dry matter, respectively [6]. Dry matter intake was calculated by multiplying asfeed consumption by dry matter content of the feed, while protein intake was calculated by multiplying the dry matter intake by crude protein content of the feed. Fulfillment of nutrients was calculated by subtracting nutrient requirements from the amount of nutrient intake. Data were analyzed using a one-way analysis of completely randomized design (one-way ANOVA), followed by Duncan's New Multiple Range Test (DMRT) to examine mean significant differences.

3. Results and Discussion

Table 2 shows the daily asfeed consumption for forage and concentrate. The difference in the amount of forage consumption was very significant (P <0.05), proportional to the amount of forage provided. However, all groups did not consume up the forage feed. Table 2 also presents daily feed nutrient intake. Dry matter intake significantly increases with the provision of concentrate (P <0.05). The results accord with [7] that DM consumption rises substantially. In this study, feeding with 15 kg of forage and 2 kg of concentrate (T3) generated similar results to those of feeding with 10 kg of forage and 3 kg of concentrate (T4). According to [8], increasing the level of concentrate above the needs of livestock will not increase livestock body weight gain, rather it will increase dry matter intake and affect animal weight gain.

Table 2. Daily asfeed and nutrient consumption of Aceh cattle with a different amount of forage and commercial concentrate feed (mean ± standard deviation).

| Variable                        | Treatment |
|---------------------------------|-----------|
|                                 | T1        | T2        | T3        | T4        |
| Asfeed consumption              |           |           |           |           |
| Forage intake (kg/d)            | 15.58±0.46| 14.80±0.105| 13.4±0.100| 8.18±0.87 |
| Concentrate intake (kg/d)      | 0         | 0.99±0.00 | 1.98±0.00 | 2.98±0.01 |
| Total nutrient consumption      |           |           |           |           |
| Dry Matter intake (kg/d)        | 3.50±0.33 | 4.25±0.24 | 4.85±0.23 | 4.59±0.19 |
| Ash intake (kg/d)               | 0.30±0.03 | 0.36±0.02 | 0.39±0.02 | 0.36±0.02 |
| Crude Protein intake (kg/d)     | 0.17±0.02 | 0.33±0.01 | 0.49±0.01 | 0.60±0.01 |
| Crude Fat intake (kg/d)         | 0.05±0.00 | 0.09±0.00 | 0.12±0.00 | 0.14±0.00 |
| Crude Fiber intake (kg/d)       | 1.40±0.13 | 1.43±0.09 | 1.41±0.09 | 1.05±0.08 |
| OM without N intake (kg/d)      | 1.58±0.15 | 2.03±0.11 | 2.43±0.10 | 2.44±0.08 |
| Organic Matter intake (kg/d)    | 3.20±0.30 | 3.89±0.22 | 4.46±0.20 | 4.23±0.17 |
| Total Digestible Nutrient (kg/d)| 1.65±0.15 | 2.24±0.11 | 2.78±0.10 | 2.90±0.08 |

Different superscripts denote significant differences between rows (P<0.05).
Non-significant

Nutrient intake in Table 2 shows a significant difference (p <0.05) between T1 group and T2, T3, and T4 groups. The pattern of increasing nutrient intake was strongly influenced by dry matter intake. This pattern indicates that the provision of concentrate feed with better nutrient content such as crude protein, crude fat, and total digestible nutrient tends to produce significantly higher intake (P
<0.05). Meanwhile, high forage consumption results in high fiber intake, with the lowest intake found in T4 group (P <0.05). This is because forage has higher crude fiber content. The highest nutrient intake (P <0.05) was dominated by T4 group with 10 kg of forage feed and 3 kg of concentrate, especially in terms of crude protein, crude fat, organic matter without N, and Total digestible nutrient, while T3 group had the highest dry matter intake and organic matter intake (P <0.05) compared to the other groups. [9] states that the amount of feed consumed by livestock is determined by dry matter intake. The quality of feed is related to the amount of feed given and is determined by the content of dry matter feed or dry matter intake and nutrient content. Furthermore, [10] reported that the administration of concentrate with a 12% CP level increased dry matter, CP, CF, and TDN intake by 3.16, 0.15, 0.20, and 4.35 kg/d, respectively, among male Bali cattle in Timor compared to those fed with 100% forage. In this study an increase in DM, CP, and TDN intake with the provision of concentrate as a substitute for forage amounted to 0.75, 0.16, and 0.40 kg/d, respectively.

Table 3 presents data on body weight, nutrient requirements, nutrient intake, nutrient balance, and the average daily gain of Aceh cattle with different forage and commercial concentrate feed levels. Aceh cattle had similar weight, making it easier to calculate nutrient requirements. Dry matter requirements are 3% of the body weight, while CP and TDN requirements are 12% and 60% of DM, respectively [6]. Nutrient requirements were not significantly different because Aceh cattle had a similar body weight. A significant difference (P <0.05) was found in nutrient intake as explained in the paragraphs above and Table 2. The nutrient balance was calculated based on nutrient requirements and the intake level. The results obtained suggest a negative balance in almost all nutrients and treatment groups, except for protein in T4 group which shows a positive balance. Nutrient balance has an opposite pattern to nutrient intake. T1 group with the lowest intake level (P <0.05) had the highest negative nutrient balance (P <0.05).

| Variable                          | Treatment                   | T1               | T2               | T3               | T4               |
|----------------------------------|-----------------------------|------------------|------------------|------------------|------------------|
| Body weight (kg)a,b                |                             | 164.80±54.15     | 166.60±40.41     | 163.60±39.90     | 164.97±38.18     |
| Nutrient requirement (kg/d)       |                             |                  |                  |                  |                  |
| Dry Mattera,b                      |                             | 4.91±1.62        | 4.97±1.21        | 4.90±1.20        | 4.94±1.14        |
| Protein a,b                        |                             | 0.59±0.19        | 0.60±0.14        | 0.59±0.41        | 0.59±0.14        |
| Total Digestible Nutrient a,b      |                             | 2.95±0.30        | 2.95±0.22        | 2.94±0.21        | 2.96±0.21        |
| Nutrient intake (kg/d)             |                             |                  |                  |                  |                  |
| Dry Mattera,b                      |                             | 3.50±0.33        | 4.25±0.24        | 4.85±0.23        | 4.59±0.19        |
| Protein a,b                        |                             | 0.17±0.02        | 0.33±0.01        | 0.49±0.01        | 0.60±0.01        |
| Total Digestible Nutrient a,b      |                             | 1.65±0.15        | 2.24±0.11        | 2.78±0.10        | 2.90±0.08        |
| Nutrient balance (kg/d)            |                             |                  |                  |                  |                  |
| Dry Mattera,b                      |                             | -1.41±1.03       | -0.72±1.13       | -0.05±1.03       | -0.34±0.99       |
| Protein a,b                        |                             | -0.42±0.18       | -0.26±0.14       | -0.10±0.13       | 0.01±0.13        |
| Total Digestible Nutrient a,b      |                             | -1.30±0.82       | -0.74±0.69       | -0.17±0.64       | -0.07±0.62       |
| Nutrient intake (%)                |                             |                  |                  |                  |                  |
| Dry Mattera,b                      |                             | 2.27             | 2.68             | 3.09             | 2.90             |
| Crude Protein ab                    |                             | 3.69a            | 7.02b            | 10.44c           | 12.76e           |
| Total Digestible Nutrient a,b      |                             | 35.61a           | 47.22ab          | 59.00b           | 61.04b           |
| Average daily gain (kg/d)          |                             | 0.17±0.05        | 0.46±0.10        | 0.72±0.08        | 0.67±0.24        |

a,b,c,d Different superscripts denote significant differences between rows (P<0.05).

Non-significant

[10] reported that male Bali cattle fattened with 100% forage feed and feed concentrated with a 12% CP level at smallholder farm level had an intake of 1.72% and 2.71% of their body weight, protein by 17.17% and 12.11% of dry matter, and TDN by 61.03% and 81.30% of dry matter,
respectively. Meanwhile, [9] reported that DM and protein intake of female Bali cows with 100% forage feed were 2.70% of their body weight and 10.38% of dry matter, respectively. When compared with the previous study on another local cattle, Aceh cattle have lower protein and TDN intake. In terms of requirement, T3 group did have met DM requirements but did not meet protein and TDN requirements, contrary to T4 group that did not meet DM requirements but met protein and TDN requirements. This confirms the statement of [11] that protein intake was not only influenced by the DM intake but also by digestibility, fermentation in the rumen, digestive enzymes, metabolism by microbes, and feed quality. Aceh cattle fed with 100% forage (T1) as a single source of feed did not necessarily have adequate DM and nutrient intake. Forage has bulky properties in the rumen, which help reduce feed intake in the event of slow degradation. An increase in ADG occurred significantly with the provision of concentrate, with the highest ADG found in T3 group (P <0.05) compared to the other groups.

4. Conclusion
This study concludes that the use of concentrate as a substitute for forage improves nutrient intake of male Aceh cattle. Feeding of 2 kg of concentrate and 15 kg of forage can meet nutrient requirements of dry matter and provide the highest ADG.

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