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Effect of Substitution of Corn (*Zea mays*) Fodder with Sorghum (*Sorghum bicolor* var. Numbu) Fodder on Nutrient Digestibility and Daily Weight Gain of Beef Cattle

L. Liman[1], S. Tantalo[1], M. Muhtarudin[1], W. Penta[1], K. Priscilla[1], R. Ramadhanu[1], A.K. Wijaya[1], and K. Adhianto[1*]

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ABSTRACT

Purpose: *Corn fodder is often used for fattening beef cattle, which compete for feeding other livestock. However, Sorghum fodder has a nutritional value equivalent to corn fodder. This study aims to determine the effect of substituting of corn fodder with sorghum fodder on the body weight gain of cattle and also the digestibility of nutrients.*

Research Method: *Nine local beef cattle with weights ranging from 139-239 kg were allocated in a completely randomized design with 3 treatments and 3 replications. The treatments given were: R0 = basal ration (30% corn fodder + 70% concentrate); R1 =15% corn fodder +15% sorghum fodder +70% concentrate; and R2 = 30% sorghum fodder + 70% concentrate. The data were analyzed using covariance analysis. Body weight gain; digestibility of dry matter, digestibility of organic matter, digestibility of crude protein, and digestibility of crude fibre were measured.*

Findings: *Based on the analysis of covariance, the study showed that there was no significant difference (P>0.05) between substituted sorghum fodder and ration consumption, body weight gain, ration conversion, and digestibility of feed substances (dry matter, organic matter, crude protein, and crude fibre) in beef cattle. The results showed that body weight gain ranged from 0.63-1.18 kg/head/day, feed conversion ratio ranged from 5.12-9.66, and digestibility of dry matter, organic matter, crude protein, and crude fibre, 76.29%-79.10%; 79.16%-82.16%; 72.47%-76.13%; and 45.46%-46.70% respectively. This study revealed that Tebon corn can be completely (100%) substituted by fodder sorghum in beef cattle rations.*

Research Limitations: *This research was conducted at the farmer level, which causes the diversity of cattle used as experimental material to be quite high. Therefore, in analyzing the data, we used covariance analysis.*

Originality/ Value: *This research informs that the use of forage sorghum can replace corn fodder up to a limit of 100%.*

Keywords: *Beef Cattle, Body Weight Gain, Corn Fodder, Nutrient Digestibility, Sorghum*

INTRODUCTION

Most of the cattle fattening business in Indonesia is located in Lampung Province. The population of cattle, goats, and buffalo in Lampung Province is respectively 653,537 heads, 1,297,872 heads, and 25,136 heads (Central Bureau of Statistics, 2016). With such a large population, most of it is met by forage crops in the form of field grass, cultivated grass, and corn. Most of the cattle

[1*]*Animal Husbandry Department Faculty of Agriculture University of Lampung Jl. Sumantri Brojonegoro No1 Bandar Lampung 35145, Indonesia.*
kusuma.adhianto@fp.unila.ac.id
https://orcid.org/0000-0001-8551-5377

fattening business relies on corn fodders as a source of forage. The large population resulted in the limited and expensive availability of corn fodder, thus requiring other alternative forage sources that could replace corn fodders at a relatively cheaper price and with nearly the same nutritional value as corn fodders.

Sorghum (*Sorghum sp*) is one of the grass species that belongs to the family Graminenae and has the potential to be managed and developed optimally as a fodder. Roughage is the main feed for ruminants and must be available on an ongoing basis every year for the improvement and development of animal husbandry businesses (Soeparno, 1992). *Sorghum sp* is one type of grass that has a large enough potential to be developed in Indonesia. This grass is capable of growing on very varied soils, is resistant to pests and diseases, and receives sufficient rainfall where other cereal plants often fail due to a lack of water (Yusmin, 1998). Sorghum plants are cereal plants that have high nutritional values, such as protein, carbohydrates, fat, calcium, and phosphorus. Besides, it can be used to replace it as a food source. Sorghum can be used as a raw material for the paper industry, as a raw material for mushroom media, and, of course, as animal feed. The potential of sorghum as animal feed is quite high. According to Liman *et al.* (2018), the protein content of forage sorghum can reach 11.13% in fertilization with cow dung at a dose of 25 tons/ha. In this study, it was also found that fresh production could reach 57.25 tons/ha. The amount of fresh production is based solely on the first cut, while sorghum can be harvested 3-4 times.

According to Somanjaya *et al*. (2016), fermentation of forage sorghum waste can replace up to 50% of the forage needs of Garut sheep; this can be seen from the performance and digestibility of food substances. Seeing the potential of sorghum fodder, it may be possible to replace corn fodder as the main feed ingredient for cattle. The purpose of this study was to determine the effect of substituting of corn fodder with sorghum fodders on local cattle's nutrient digestibility and body weight gain.

MATERIALS AND METHODS

Each treatment in this study were:

R0 = 30% corn fodders + 70% concentrate

R1 = 15% corn fodders + 15% sorghum fodders + 70% concentrate

R2 = 30% sorghum fodders + 70% concentrate

Table 01: Composition of diets research (concentrate) (in dry matter basis)

Feeds	%
Cassava by product	32.5
Rice brand	26
Coconut cake	23
Soy bean meal	12
Molasses	4.5
Mineral	1
Urea	1

Research Implementation

The composition of diets that used in this research showed in table 01.

The second forage silage was made at the age of 65 days. After harvesting, the forage is chopped, and then silage is made. Silage was made for 21 days.

In vivo assay

The ration is given by a limited method. The amount of ration given is based on dry matter, which is 3% of the cow's body weight. The rations were given twice a day, in the morning and evening.

The research was divided into two stages, namely the preliminary stage and the data collection stage. The preliminary stage aims to familiarize the cows with the research ration and also eliminate the effects of the previous ration. This stage lasts 14 days. The next stage is data collection, which lasts for 30 days. The data collected consists of:

1. The feed intake is calculated based on the dry matter of the ration, determined by calculating the difference between the amount of ration given and the rest of the ration.

2. Body weight gain is measured by weighing the cow before the start of the research and weighing it again after the research is complete, which takes 30 days. The body weight gain per day is obtained by reducing the cow's weight after 30 days from the initial weight; the results are divided by 30.

3. Feed conversion, by dividing the amount of feed intake with the resulting body weight gain.

Digestibility assay

The provision of rations was carried out in a limited manner based on the dry matter of the ration. The amount of ration given is based on 3% of the cow's body weight. Feeding is given twice a day.

Measuring the nutritional digestibility of the ration using the total feces collection method. Stool collection was carried out for 7 days. The feces obtained were weighed, and 10% was taken for analysis of the nutritional digestibility of the ration.

Nutrient digestibility is calculated according to the following equation:

$$\text{Nutrient digestibility} = \frac{\text{Nutrient intake - Nutrient excretion}}{\text{Nutrient intake}} \times 100\%$$

Analysis of the nutritional content of rations and feces using the proximate analysis method.

Statistical analysis

This study was arranged using a completely randomized design with 3 treatments and 3 replications. The data obtained were analyzed using covariance analysis by the R program.

RESULTS AND DISCUSSION

Effect of treatment on feed intake, ration conversion, body weight gain

The results of the covariance analysis showed that the provision of treatment rations had no significant effect ($P > 0.05$) on ration consumption. This shows that the substitution of corn fodder with sorghum fodder can reach 100%. Based on Table 2, the highest average dry matter consumption in the treatment ranges from 5.47-5.77 kg/head/day. According to the National Research Council (1996), dry matter consumption for bulls weighing 181.6 kg with a body weight

gain of 0.681 kg is 4.77 kg. Beef cattle used in this study had an average weight of 176.5 kg, meaning that the dry matter consumption of the ration was sufficient according to their needs.

According to Hume (1982), the consumption of dry feed ingredients is influenced by the ability of the rumen to accommodate dry matter; besides, the faster the feed ingredients leave the rumen, the more feed is entered or consumed. Several factors influence the level of ration consumption, namely internal and external factors. Internal factors such as age, sex, breed, and body weight. External factors consist of feed nutrition, palatability, and environment (Mwangi *et al*., 2019). Palatability is a performance characteristic of feed ingredients as a result of the physical and chemical conditions of feed ingredients, which are reflected in their organoleptic characteristics such as, taste, texture, and temperature.

Research on the use of a combination of mixed silage of corn fodder and sorghum fodder was reported by Dann *et al*. (2008). The results show that the consumption of dry matter is greater when cows are fed 35% and 45% corn fodder silage compared to cows fed 45% sorghum fodder.

The results of covariance analysis showed that different types of feed have no significant effect on the body weight gain of local beef cattle (P>0.05). This shows that the substitution of corn fodder with sorghum fodder can reach 100%. The body weight gain ranged from 0.63 to 1.18 kg/head/day. The average R2 ration treatment produced numerically the highest body weight gain, which reached an average of 1.18±1.193 kg/head/day. This is presumably because the high amount of dry matter consumed in R2 will increase the amount of nutritional intake received by beef cattle. The higher the nutritional intake received by beef cattle, the greater the nutrients that enter the body, the better the nutrient content of the ration, and the better the absorption of the ration. This figure is higher than the research results summarized by Siregar (2002), which show a body weight gain of 0.90 kg/head/day for Onggole Pedigree cattle and 1.00 kg/head/day for Frisien Holstain cattle. Meanwhile, research conducted by Kurniawan (2014) shows that cattle breeds have a very significant effect on body weight gain. At the initial weight of 254 kg, the body weight gain for PO cattle is 0.797±0.059 kg/head/day higher than Bali cattle 0.478±0.057 kg/head/day, also at the initial weight of 291 kg of PO cattle, the body weight gain is 0.903±0.088 kg/head/day higher than Bali cattle's 0.418±0.052 kg/head/day. The ideal condition for local beef cattle's general body weight gain is 0.8-0.9 kg/head/day (Soedjana *et al*., 2012). This means that the body weight gain that reached the ideal conditions in this study was only in Onggole cattle. Based on a study of Bali cattle fattening businesses conducted by Qomariyah and Bahar (2010), the optimal body weight gain for Bali cattle is 0.6 kg/head/day. This shows that the difference in body weight gain of different cattle breeds is inseparable from their genetic potential, especially from the influence of frame size (Firdausi *et al*., 2012), which determines the rate of growth. Onggole cattle have a larger frame than Bali cattle, and PO cattle. According to Purpranoto (2013), cattle are in the medium frame size category, and Bali cattle are in the small frame size category. According to Jelantik *et al*. (2007), cattle with large frame sizes showed a body weight gain rate up to 100% higher than cattle with smaller frame sizes.

The results of the covariance analysis showed that the treatment had no significant effect (P> 0.05) on the feed conversion ratio (FCR). The FCR of the research results ranged from 5.12 to 9.66. The lowest ration conversion was obtained in the R2 ration; this shows that a good use of sorghum is 50% of the total forage. The use of 100% forage sorghum (R3) increased the conversion of the ration, this was in line with the decrease in the digestibility of dry matter in R3 compared to R2. According to Siregar (2002), the good FCR for cattle is 8.56–13.29. Muhtadi (2001) reported the results of his research: the FCR in PO cattle was 10.01.

Table 02: Effect of treatment on feed intake, body weight gain, and feed conversion ratio (FCR)

	Treatments		
Parameters	R1	R2	R3
Feed Intake (kg/head/day)	5.47±1.25	5.77±1.32	5.70±1.83
Body weight gain (kg / head /day)	0.75±0.11	1.18±1.19	0.63±0.62
Feed conversion ratio (FCR)	7.44±2.19	5.12±2.11	9.66±4.90

Information: R0 = 30% corn fodders + 70% concentrate.; R1 = 15% corn fodders + 15% sorghum fodders + 70% concentrate.; R2 = 30% sorghum fodders + 70% concentrate.

According to Sutardi (1990), FCR is greatly influenced by the condition of the livestock, the digestibility of the livestock, sex, breed, quality, and quantity of feed, as well as environmental factors. The FCR value is influenced by the frame size type. The frame size is the area of the livestock frame where meat is grown (Firdausi *et al*. 2012) and determines the ability of the body weight gain and the final weight of the cattle to reach the optimum growth limit (Tatum *et al*. 2006). Feed conversion ratio refers to the cow's ability to change the amount of feed consumption based on dry matter into body weight gain. The results of research conducted by Kurniawan (2014) showed that cattle breed had a very significant effect on FCR value; at an initial weight of 254 kg of Balinese cattle FCR was 14.586 ± 0.779 higher than that of PO cattle, 9.063 ± 0.804. With an initial weight of 291 kg Bali cattle's FCR was 18.565 ± 0.711 higher than that of PO cattle (9.135 ± 1.199). The FCR shows that Bali cows require more BK consumption than PO cows to obtain the same Body weight gain: the lower the FCR, the higher the level of feed efficiency.

Effect of Treatment on Digestibility

The results of the covariance analysis showed that the treatment had no significant effect (P> 0.05) on the digestibility of feed ingredients (dry matter, organic matter, crude protein, and crude fibre). Table 3 shows the digestibility of the material dry, organic matter, crude protein, and crude fibre, respectively, as 68.73-71.67%, 72.33-75.10%; 72.47-76.13%; and 45.46-46, 70%.

Table 03: Effect of dietary treatment on feed digestibility

	Treatments		
Parameters	R1	R2	R3
Dry matter digestibility (%)	69.40	71.67	68.73
Organic matter digestibility (%)	72.33	75.10	73.28
Crude protein digestibility (%)	72.47	76.13	76.07
Crude fiber digestibility (%)	46.55	45.46	46.70

Information: R0 = 30% corn fodders + 70% concentrate; R1 = 15% corn fodders + 15% sorghum fodders + 70% concentrate; R2 = 30% sorghum fodders + 70% concentrate.

In the study of Suryani *et al* (2015), the highest digestibility of dry matter and crude protein in Bali cows given various forages were 67.78 and 71.42% respectively. According to Valdes *et al*. (1988), the dry matter digestibility ranged from 69.6, 68.2, and 57.4% in Frisian Hosltain cattle feed with silage of corn fodder with sunflower fodders. According to Bakshi *et al*. (2017), the digestibility of dry matter, organic matter, and crude protein was 56.61, 57.97, and 70.67% in bulls fed corn fodder. In another study, Abdelhadi *et al*. (2006) reported that the use of sorghum fodder silage had lower *in vitro* digestibility (52%) when compared to corn fodder silage (62%).

CONCLUSION

The substitution treatment of corn with sorghum had no significant effect on the dry matter consumption of the applied ration (P>0.05), where the highest consumption was in the R2 treatment ration, namely 5.77+ 1.32 kg/head/day. The substitution treatment of corn with sorghum had no significant effect on Body weight gain (P>0.05), and the highest body weight gain was in treatment R2, namely 1.18+ 1.19 kg/head/day. The treatment of substitution of corn with sorghum had no significant effect on ration conversion (P>0.05); however, the best conversion was in treatment R2, namely 5.12+ 2.11. The substitution treatment of corn with sorghum had no significant effect on the digestibility of nutrients, however, the best results were in treatment R2, where dry matter digestibility was 71.67%, organic matter digestibility was 75.10%, and crude protein digestibility was 76 .13%, while the digestibility of crude fiber in the R3 treatment was 46.70%. Based on the measurement of these various parameters, corn substitution in rations with sorghum can reach 100%, but better results can be obtained with 50% substitution (R2).

Conflict Of Interest

All authors state that there is no conflict of interest.

Authors Contribution

Liman Liman, Syahrio Tantalo, and Muhtarudin Muhtarudin designed and conducted research. Wayan Penta, Khairani Priscilla, and Rizki Ramadhanu conducted research and analyzed in laboratorium, Agung Kusuma Wijaya analyzed data and wrote the manuscript. Kusuma Adhianto criticized and revised the manuscript. Liman Liman, Agung Kusuma Wijaya, and Kusuma Adhianto completed the manuscript.

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