The Use of Cassava Peel as a Source of Energy for Substituting Rice Bran in Ration Containing *Gliricidia maculata* Leaves in Dairy Cows

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Abstract. The objectives of this research are (1) to obtain an alternative feed; (2) to determine the best level of using cassava peel in ruminant ration to substitute rice bran in term of nutrients intake, digestibility of nutrients, and milk yield; (3) to obtain ration formulation for lactating dairy cows using cassava peel. The cattle used in this study were 4 Frisian Holstein dairy cows aged 5 years with a body weight of 400 kg. This research was conducted using the Latin Square Design 4x4 consisted of 4 treatments (rations). The ration was prepared with a ratio of forage and concentrate 55:45. The treatments were the use of cassava peel as follows: T1= 0% Cassava peel; T2=3% Cassava peel; T3=6%Cassava peel; T4=9% Cassava peel. The result showed that there is no significantly different (P>0.05) on nutrient intake, nutrient digestibility, and milk yield. It can be concluded that the cassava peel can be used in dairy cattle ration up to 9% with the value of dry matter intake 13.29 kg day⁻¹, organic matter intake 12.59 kg day⁻¹, crude protein intake 1.97 kg day⁻¹, digestibility of dry matter, organic matter and crude protein were 71.75%, 73.62%, and 73.67%, respectively. Milk yield was 8.64 kg.

1. Introduction

The availability of feed for ruminants, including dairy cattle, is sufficient to support the production of meat and milk to meet the needs of these livestock products. For this reason, efforts are needed to find alternative feeds that can be utilized during the dry season or when there is a lack of animal feed, especially those with abundant availability, concentrated in one place, and have a good nutritional value. Rice bran has a high lignin content of 10.55% [1], so it affects the nutritional content, such as a decrease in crude protein to 7.83%. Therefore, we need alternative feed ingredients to replace rice bran in rations. One alternative feed source that meets the above criteria is cassava peel, and *Gliricidia maculata* leaves. It is necessary to study and evaluate the level of using cassava peels in the dairy rations, which is carried out in vivo.

Cassava peel is a waste of cassava obtained from the processing of cassava tubers industries. Indonesia is among the fourth largest cassava producing countries in the world after Brazil, Nigeria, and Thailand. In 2015 cassava production in Indonesia reached 21,801,415 tons/year [2]. One of the cassava producing provinces in Indonesia is West Sumatra. In 2018 the contribution of West Sumatra to cassava production in Indonesia amounted to 208,386 tons/year [3]. The amount of cassava peel produced is 15% of the weight of the cassava [4]. Cassava peels should not be fed alone, as their protein and mineral content cannot support optimum rumen function and productivity [5].
The low milk yield is one of them caused by the management of feeding that is not following the nutritional needs of dairy cows. Energy is the main requirement needed by dairy cows, so to meet the energy needs of dairy cows can be done by providing feed that acts as an energy source. Feedstuff that can be used as an energy source is cassava peel because cassava peel has a high nutritional content, namely nitrogen-free extract (56.06%) and total digestible nutrient (TDN) (56.91%). Therefore the use of cassava peels in dairy cattle rations combined with protein source feed ingredients, *Gliricidia maculata* leaves, and tofu dregs with protein content of 24.28% and 22.34%, respectively. *Gliricidia maculata* can be used as a protein source in sheep ration [6]. *Gliricidia maculata* also can be used 30% in combination with 30% sweet corn straw + 40% concentrate[1]. It is expected to support the activity of rumen microbes and increase nutrient digestion, which in turn will increase the amount of milk production and the quality of milk.

Anti-nutrient compounds found in the cassava peel, namely hydrocyanic acid (HCN) [7] and on the leaves of *Gliricidia*, namely tannin, and coumarin, will have a negative effect if the levels are high in the ration. Therefore, the level of use of cassava peel and *Gliricidia maculata* leaves is attempted in the ration with HCN and coumarin levels that can be tolerated so that it does not give adverse effects or interfere with the work of microbes in the rumen in digesting nutrients. Conditions to get the best level of cassava peel used in rations containing *Gliricidia maculata* leaves can be done by making several levels of use in dairy cattle rations, where the use of cassava peel will reduce the use of rice bran that is commonly used.

2. Materials and methods

2.1. Data collection and animal management

Cassava peels were collected in fresh form from the business of making cassava chips in Padang city. The fresh cassava peels were soaked in water first to reduce its HCN levels, and then the cassava peels were drained and were dried and ready to be used as feed ingredients for lactating dairy cattle. This research was conducted using the Latin square design 4 x 4, which consisted of 4 kinds of treatments and 4 periods and 4 lactating dairy cows.

The cows used in this study are 4 Friesian Holstein dairy cows aged 5 years with a bodyweight of 400kg. The data were analyzed statistically according to two-way Analysis of Variance (ANOVA). The ration was prepared with a ratio of forages and concentrate 55:45. The ration was prepared with a crude protein content of 15% and TDN 66-67% [8]. The treatment is the use of cassava peel in ration as follows: T1= 0% Cassava peel; T2=. 3% Cassava peel; T3= 6% Cassava peel; T4= 9% Cassava peel. The feed composition of treatments are presented in Table 1 and the nutrient compositions of the experimental rations are presented in Table 2.

| Feed stuffs (%) | Treatment | T1 | T2 | T3 | T4 |
|-----------------|-----------|----|----|----|----|
| Elephant grass  | 50        | 50 | 50 | 50 | 50 |
| *Gliricidia maculata* | 5 | 5 | 5 | 5 | 5 |
| Cassava peel    | 0         | 3  | 6  | 9  | 9  |
| Rice bran       | 9         | 6  | 3  | 0  | 0  |
| Tofu dregs      | 28,5      | 28,5 | 28,5 | 28,5 | 28,5 |
| Sago            | 6         | 6  | 6  | 6  | 6  |
| Mineral         | 1         | 1  | 1  | 1  | 1  |
| Natrium chloride| 0.5       | 0.5 | 0.5 | 0.5 | 0.5 |
| Total           | 100       | 100 | 100 | 100 | 100 |
Table 2. Nutrient composition of the experimental ration

| Nutrient composition (% dry matter) | T1   | T2   | T3   | T4   |
|-----------------------------------|------|------|------|------|
| Organic matter                    | 92.78| 93.02| 93.26| 93.51|
| Crude protein                     | 14.87| 14.84| 14.81| 14.78|
| Crude fiber                       | 25.99| 25.72| 25.46| 25.19|
| Ether extract                     | 5.06 | 4.97 | 4.88 | 4.87 |
| Nitrogen free extract             | 46.86| 47.48| 48.11| 28.5 |
| Ash                               | 7.22 | 6.98 | 6.74 | 6.49 |
| Total Digestible Nutrient         | 65.74| 66.19| 66.63| 67.08|
| Lignin                            | 5.01 | 4.91 | 4.81 | 4.71 |
| Silica                            | 1.26 | 0.91 | 0.55 | 0.20 |
| Calcium                           | 0.72 | 0.73 | 0.75 | 0.76 |
| Phosphor                          | 0.30 | 0.31 | 0.31 | 0.32 |
| HCN (ppm)                         | 0    | 1.77 | 3.54 | 5.31 |

2.2. Implementation of the experiment on dairy cows

The study was conducted in 2 periods, namely the preliminary period and the collecting period. The preliminary period was carried out for 2 weeks, and the collecting period was carried out at the 3rd week. Research cows are kept in standard conditions. The amount of feed given is calculated based on body weight and milk production. Drinking water was given ad libitum. During the collecting period, samples of feed, feces, and milk were collected.

2.3. Sampling analysis

During the one week total collecting period, the remaining feed and feces were collected and weighed every day. Sub-samples were taken as much as 10% and sundried. All feed residues and daily feces samples for each individual cow were mixed at the end of the collection period then milled for analysis. Calculation of the amount of intake and the amount of milk production was done every day during the study. Milk samples for analysis were taken at the beginning before the study and every week during the study, starting at week 4. Analysis of dry matter content, organic matter and protein content, and other animal feed substances from feed and feces samples used the official methods of analysis [9]. Hydrocyanic acid was determined through the procedures described by [10]. Milk samples were obtained twice a day at 8.00 and 17.00 in the collecting period, and daily samples were mixed and analyzed its milk quality.

3. Result and discussion

3.1. Feed Intake

This research is on-farm research, which means it was designed without interfering the feeding management of dairy cows to obtain the real condition. The feed provided consists of 55% forage and 45% concentrate with nutritional value that meets the standard requirements for lactating cattle for protein (15%), crude fibre (25%), and fat (5%) and Total Digestible Nutrients (66-67%) (Table 2). The dry matter intake is fundamentally essential in nutrition because it establishes the amount of nutrients available to animals for health and production. Measurements of dry matter intake (DMI), organic matter intake (OMI), and other nutrients intake to see how much the contribution of cassava peel to feed intake were taken (Table 3).

The results showed that the treatment gave no significant difference (P>0.05) in the feed intake: dry matter intake, organic matter intake, and intake of other nutrients, namely crude protein intake, fat intake, and intake of nitrogen-free extract. Dry matter intake of dairy cows fed 3%-9% cassava peel in the ration as a substitute for rice bran were not different from those in cows fed 9% rice bran. Factors that cause no significant difference in the value of dry matter intake is a balance between protein and
energy, with a protein content of 15% and a total digestible nutrient (TDN) of 66-67%. Another factor that also determines the results of the dry matter intake that are not different is the composition of feed ingredients in the ration. We can see in Table 1 that in all of the treatments, the use of feedstuffs in the diet formula was the same level except the use of rice bran and cassava peel, so there was a balance of nutrients provided from the ration.

Table 3. Feed intake of dairy cows fed cassava peel

| Feed intake (kg/d)        | Treatment |
|---------------------------|-----------|
|                           | T1        | T2        | T3        | T4        |
| Dry matter intake         | 13.20±0.68| 13.06±0.91| 13.54±0.38| 13.29±0.32|
| Organic matter intake     | 12.51±0.65| 12.37±0.86| 12.83±0.35| 12.59±0.31|
| Protein intake            | 1.79±0.11 | 1.94±0.13 | 2.00±0.06 | 1.97±0.05 |
| Crude fiber intake        | 3.41±0.01 | 3.33±0.02 | 3.43±0.01 | 3.32±0.01 |
| Fat intake                | 0.67±0.04 | 0.65±0.04 | 0.67±0.02 | 0.64±0.02 |
| Nitrogen free extract intake | 6.10±0.01 | 6.12±0.02 | 6.32±0.01 | 6.29±0.01 |

Values with the same superscript in the same row are not significantly different (P>0.05)

The value of dry matter intake in this study has met the standard requirements of lactating dairy cows for producing milk, where dry matter intake of 13.06-13.54 kg/ head/day, equal to 2.95%-2.97% of the weight of dairy cows. Body weight and 4 percent fat-corrected milk were factors used to estimate DMI, which ranged from 2 to 4 percent of body weight [8]. Many factors influenced dry matter intake. The low digestibility values inhibit the consumption of dry matter. In this research, the digestibility value of dry matter showed no significant difference. The dairy cows appear to consume feed to meet energy needs, so intake is driven by milk production [8]. In this study, the amount of milk produced in each treatment showed slightly different results but not statistically significantly different. The availability of sufficient dry matter causes the availability of sufficient organic material which functions as a source of energy, building agents and plays a role in the metabolic processes in the body of dairy cattle, so that it can produce milk as expected. Diets with higher levels of dry matter (DM), crude protein (CP) and ether extract (EE) also tend to result in reduced consumption due to an adjustment of energy intake; but in this research, the level of DM, CP, and EE in the diet was nearly the same, so that it produces the same consumption value of DM, CP, and EE.

3.2. Nutrients digestibility and milk yield

There were no significant differences in nutrients digestibility value between dairy cows fed cassava peel and dairy cows fed rice bran (P>0.05). The dry matter digestibility value of dairy cows fed 9% cassava peel was 71.75% and this value was not significant different with the dry matter digestibility value of dairy cows fed 9% rice bran (Table 4). The same value was also found in the digestibility of dry matter of cattle fed 3% and 6% cassava peel. The digestibility value of dry matter in this study was not different may be due to the nutritional content of the ration nearly the same, especially the energy content of the ration in the form of total digestible nutrients (TDN) which was 66-67% and crude protein content of the ration was 15%, and the value of the dry matter intake was also not significantly different. Another factor that causes the digestibility value of dry matter showed no difference is the HCN level of 5.31 ppm in rations containing cassava peel 9% in the ration can still be tolerated by cattle so that it does not interfere with the digestibility of dry matter. The HCN in the cassava was reported to be transformed into the non-toxic thiocianate by the enzyme rhodanese that in turn activates the cyanide ion, which combines with thiosulfate (S2O32-) yielding -non-toxic thiocianateand is partly eliminated via the milk [11]. Fresh cassava peel supplementation in the dairy cow diet may be possible to be used as an alternative measure to prevent mastitis in lactating dairy cows [12].

The digestibility value of dry matter obtained is also influenced by the level of lignin from the ration. In the control treatment (T1), the ration used 9% rice bran, the lignin content was 5.01% whereas in the T4 treatment, 9% cassava peel had a lower lignin content of 4.71%. The difference in lignin content in the ration gave different digestibility values. Lignin, together with cellulose and hemicellulose form lignocellulosic make complex bonds which are difficult to be digested [13]. The digestibility of plant cell-wall is affected by lignin content [14]. A reduction in the indigestible cell-wall fraction will be
beneficial because it will increase the digestibility value. However, in this research, the differences in lignin levels of 0.3% in the ration showed that the digestibility value of dry matter was not significantly different.

| Table 4. Nutrients digestibility and milk yield of dairy cows fed cassava peel |
|-----------------------------------------------|---------------|---------------|---------------|---------------|
| Nutrients digestibility (%)                  | Treatment     |               |               |               |
| Dry matter digestibility                     | T1            | T2            | T3            | T4            |
| Organic matter digestibility                 | 69.97±2.35    | 70.10±3.74    | 70.69±4.05    | 71.75±2.50    |
| Protein digestibility                        | 72.32±2.33    | 72.45±3.43    | 72.76±3.81    | 73.62±2.47    |
| Crude fiber digestibility                    | 71.65±1.40    | 71.96±3.60    | 72.88±3.86    | 73.67±1.90    |
| Fat digestibility                            | 63.14±2.87    | 62.58±4.95    | 62.71±4.40    | 64.50±3.09    |
| Nitrogen free extract digestibility          | 81.27±0.04    | 80.68±0.04    | 81.05±0.02    | 81.13±0.02    |
| Milk yield 4% FCM (kg/day)                   | 7.05±0.78     | 8.02±1.19     | 8.47±2.17     | 8.64±1.95     |

Values with the same superscript in the same row are not significantly different (P>0.05)

The digestibility value of organic matter from rations using cassava peel from 3% to 9% also showed results that were not significantly different (P>0.05) with values ranging from 72.32% to 73.62%. The nutrient digestibility is influenced by the characteristics of the fiber fraction, especially the levels of lignin and silica. Digestible organic matter will be used by dairy cows to produce energy for milk production and to support metabolic processes in the body and the results of which can be seen in milk production. In this research, cows fed 9% cassava peel in their rations produced milk 4% FCM (Fat Corrected Milk) of 8.64 kg per day, while dairy cows fed 9% rice bran in their rations produced only 7.05 kg per day. This difference in the amount of milk produced may be due to the amount of digestible nutrients, which includes higher protein digestibility and nitrogen-free extracts in cows fed cassava peels, with a protein digestibility value of 73.67% versus 71.65% and a nitrogen-free extract value of 76.06% versus 74.49%. Although the amount of milk produced in the T4 treatment is higher, it is statistically not significantly different.

4. Conclusion

Based on the results of the study, it can be concluded that the cassava peel, as an energy source, can be used up to 9% in the dairy cows ration or can be used to substitute rice bran 100%. The value of dry matter intake 13.29 kg/day, organic matter intake 12.59 kg/day, crude protein intake 1.97 kg/day, while the digestibility of dry matter, organic matter, and crude protein were 71.75%, 73.62%, and 73.67% respectively and milk yield 4% FCM was 8.64 kg.

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