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# The effect of using different cassava flour and cassava wastes on cassava-based concentrate on nutrient content and *in vitro* gas production

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**ABSTRACT:** This study was conducted to evaluate the effect of using different cassava flour and cassava flour in cassava-based concentrates on nutrient content and *in vitro* gas production. P1 = CF 5% + CW 5%, P2 = CF 10% + CW 10%, P3 = CF 15% + CW 15%, P4 = CF 20% + CW 20%, P5 = CF 25% + CW 25%, P6 = CF 30% + CW 30%, P7 = CF 35% + CW 35% with 3 replications arranged in a randomized block design (RBD). The use of cassava flour and cassava west which is higher tends to reduce the content of dry matter, organic matter, crude fat, crude protein, and crude fiber. Meanwhile, the higher use of cassava flour and cassava pulp increased the total gas production and gas production rate ($P<0.01$) but did not have a significant effect ($P>0.05$) on the gas production potential. The conclusion of this study is the use of cassava flour and cassava waste of as much as 20% is most effective because it has the highest gas production rate (c value) 0.049 ml/hour with a gas production value (143.15 ml/500 mg DM) and ideal gas production potential (173.15 ml /500 mg DM).

**KEYWORDS:** based concentrate, cassava flour, cassava wastes, *in vitro*, gas production, gas production potential, gas production rate.

## I. INTRODUCTION

One of the cheap and easy sources of feed can be cassava products. Cassava can be grown widely by the people, easy to care for, and harvest. The tuber part is a very potential feed ingredient because it has a fairly high energy value at a relatively low price compared to other energy source feeds [1]. Cassava tubers that are dried and then ground are called cassava flour. Cassava flour is a safer feed product for livestock because of the low HCN content due to drying in the sun[2]. In addition to cassava flour, industrial waste from the manufacture of tapioca flour is cassava waste. cassava flour is a feed ingredient that contains nutrients including the energy of 3000 kcal per kg, crude protein 3.3%, crude fat 5.3%, phosphor 0.17%, and calcium 0.57% prasetyo [3]. Cassava contains 90.05% DM, 2.80% CP, 62.44% TDN, 8.68% CF and 0.51% EE [1].Rumen microbes require very complex nutrients for their body's protein synthesis activity and there must be sufficient sources of energy and other basic materials available. Cassava flour and cassava wastes can meet these energy sources [4]. According to Liu *et al.* [5] carbohydrates serve to predict the production of VFA in the fermentation process inside the rumen. In addition, the use of cassava flour and cassava wastes in concentrates can improve the performance of fattening cows. Crossbreed limousine given different levels of flour, are 60%, 50%, 40% and 30% in fattening concentrates produced PBBH of 0.77 kg / head / day, 0.96 kg / head / day, 1.43 kg / head / day and 1.26 kg / head / day. This study aims to evaluate the effect of the use of higher levels of cassava flour and cassava wastes on the nutritional content of feed and in vitro gas production.

## II MATERIALS AND METHOD

**2.1. Location and time :** This study was conducted in the Nutrition and Animal Feed Laboratory Faculty of Animal Science Brawijaya University and abattoir in Malang from September to December 2021.

**2.2. Materials :** Materials used were feedstuffs consisting of maize stover, cassava flour, cassava wastes, palm kernel cake,and copra meal from Blitar, East Java, Indonesia.

**2.3. Methods :** This study used an in vitro gas production technique arranged in a Randomized Block Design (RBD) with the following treatments: P1 = maize stover 20% + cassava flour 5% + cassava wastes 5% + palm kernel cake 44% + copra meal 26%, P2 = maize stover 20% + cassava flour 10% + cassava wastes 10% + palm kernel cake 33% + copra meal 27%, P3 = maize stover 20% + cassava flour 15% + cassava wastes 15% + palm kernel cake 22% + copra meal 28%, P4 = maize stover 20% + cassava flour 20% + cassava wastes 20% + palm kernel cake 11% + copra meal 29%, P5 = maize stover 20% + cassava flour 25% + cassava wastes 25% + palm kernel cake 0% + copra meal 30%, P6 = maize stover 20% + cassava flour 30% + cassava wastes 30% + 11% palm kernel cake + 9% copra meal, P7 = 20% maize stover + 35% cassava flour + 35% cassava wastes + 0% palm kernel cake + 10% copra meal with 3 replications.Rumen fluids used were collected from crossbred Limousine cattle slaughtered in an abattoir in Malang. Variables measured were chemical composition, in vitro gas production, gas production potential,and gas production rate. Table 1 presented the chemical composition and formulation of the treatments.

Table 1. Feedstuffs chemical composition

| Feedstuffs | Chemical composition (%) | | | | | composition (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DM | | CP | EE | | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
| Maize stover | 85,75 | 87,02 | 10,58 | 1,27 | 31,30 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Palm kernel cake | 92,48 | 95,99 | 15,52 | 8,66 | 20,79 | 44 | 33 | 22 | 11 | 0 | 11 | 0 |
| Copra meal | 87,27 | 90,11 | 22,80 | 1,84 | 20,40 | 26 | 27 | 28 | 29 | 30 | 9 | 10 |
| Cassava flour | 87,77 | 95,99 | 2,38 | 0,68 | 3,57 | 5 | 10 | 15 | 20 | 25 | 30 | 35 |
| Cassava wastes | 88,97 | 81,58 | 1,48 | 0,66 | 14,90 | 5 | 10 | 15 | 20 | 25 | 30 | 35 |
| Urea | 99,89 | 99,85 | 287,5 | 0 | 0 | 0 | 0 | 0 | 0 | 0,50 | 1,20 | 1,40 |

% Percentage based on dry matter.
* Based on 100% of DM.

**2.4. *Chemical* analysis :** Proximate analysis was carried out according to the procedure of AOAC [6] to determine DM, OM, CP, EE, and CF. Measurement of the total in vitro gas production was carried out by the method of Makkar [7]. The value of gas production potential (b value) and gas production rate (c value) is determined by the equation by Makkar method to facilitate this calculation, so the NEWAY Excel program [8] is used. The equations used are:

$$\boxed{Y = b\,(1\text{-}e\text{-}^{ct})}$$

Y= Gas production at the time of t (ml / 500 mg DM);
b = Gas production potential (ml/500 mg DM) at "t";
c = Gas production rate (ml/hour);
t = Incubation time (hours);
e = Exponential

***2.5. Statistical analysis***

Data obtained were analyzed by analysis of variance (ANOVA) and followed by Duncan's Multiple Range Test if the treatments gave a significant effect on the variables measured.

## III RESULTS

**3.1. Chemical composition of different levels of cassava meal in the ration :** The nutrient content of the treatment feed used in this study is found in Table 2. In the P1 treatment with a percentage of cassava flour and cassava wastes of 5% each, the highest DM was 89.40% while the lowest DM in P4 with cassava flour was 25% and 50% produced DM of 84.82%. The highest OM content in the P1 treatment was 93.18% and the lowest in P4 was 89.44%. The CP content of the ration ranging from 9,57% (P7) – 16.18% (P1), EE from 0.46% (P4) – 1.90% (P6), CF from 9.16 % (P7) – 17.18 % (P1).

Table 2. Chemical composition of treatments.

| Treatments | Chemical Composition (%) | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | 89,40 | 93,18 | 16,18 | 1,45 | 17,18 |
| | 87,50 | 91,02 | 15,81 | 1,69 | 16,22 |
| | 86,97 | 89,95 | 14,43 | 0,85 | 16,32 |
| | 86,31 | 89,44 | 12,34 | 0,46 | 15,68 |
| | 84,82 | 89,75 | 11,96 | 0,64 | 16,05 |
| | 86,86 | 91,42 | 10,46 | 1,90 | 10,49 |
| | 86,14 | 90,69 | 9,57 | 0,82 | 9,16 |

*) Based on 100% of DM.

***3.2 Gas production, gas production potential, and gas production rate:*** Based on statistical analysis, it shows that the application of concentrates with increasing levels of cassava flour and cassava wates (5%, 10%, 15%, 20%, 25%, 30%, and 35%) is very significantly ($P<0.01$) on total gas production and gas production rate (value c) but has no significant effect ($P>0.05$) on the value of b (gas production potential).

Table 3. Gas production, gas production potential and gas production rate

| :s | Gas production (ml / 500 mg DM) | b value (Gas production potential) (ml / 500 mg DM) | C value (Gas production rate) (ml/hour) |
|---|---|---|---|
| | 119,25 ± 7,99$^{a}$ | 13,36$^{ns}$ | 0010$^{a}$ |
| | 125,81 ± 1,10$^{ab}$ | 1,17$^{ns}$ | 0028$^{ab}$ |
| | 134,22 ± 7,73$^{bc}$ | 7,85$^{ns}$ | 0047$^{ab}$ |
| | 143,15 ± 16,64$^{cd}$ | 22,21$^{ns}$ | 0049$^{b}$ |
| | 135,43 ± 10,25$^{bc}$ | 5,90$^{ns}$ | 0077$^{ab}$ |
| | 150,52 ± 5,25$^{d}$ | 17,42$^{ns}$ | 0149$^{ab}$ |
| | 151,62 ± 4,43$^{d}$ | 12,81$^{ns}$ | 0129$^{ab}$ |

Description:) Different superscripts on the same column show a very significant difference (P<0.01

Ns = not significant

## IV DISCUSSION

**4.1 Chemical composition of different levels :** The concentrate is a nutrient-dense feed with low crude fiber and is easy to digest. The purpose of giving concentrate is because concentrate is a source of protein and energy source [9]. The function of the concentrate is to increase the nutritional value of forage feed ingredients. The feed ingredients for making concentrates in this study include concentrates of energy sources in the form of cassava flour and cassava wastes as well as concentrates of protein sources in the form of palm kernel cake, copra meal, and urea. Based on the proximate analysis in Table 2, it can be seen that the highest CP value in P1 is 16.18% and in P7 the lowest is 9.57%. encouraged because the proportion of cassava flour and cassava flour is increasing. The proportions of cassava flour and cassava wastes were 5%, 10%, 15%, 20%, 25%, 30% and 35%, respectively. The higher the proportion of cassava flour and cassava wastes, the CP value decreases. According to [1], cassava flour and cassava wastes are a source of energy but have a low protein content.Based on the Table 2, the use of high cassava flour and cassava wastes decreases the value of DM and OM from P1 to P5 then tends to increase at P6 and fall back at P7. Meanwhile, the use of cassava flour and higher cassava wastes tends to reduce CP and CF values [1]. Cassava flour and cassava wastes are energy sources with low protein content, therefore, the protein content decreases along with the increasing proportion of cassava flour and cassava wastes used. The use of feed with a fairly high energy content in livestock can provide easily soluble carbohydrates (low CF) so that ready-to-use energy is available [10]. Therefore, treatments that use cassava flour and more cassava wastes have a low crude fiber.

Based on Table 2, the highest CF value in P1 is 17.18% and the lowest is P7 9.16%. This happened because the proportion of oil palm cake in P1 was 44% of the total concentrate, while in P7 it was 0%. The disadvantage of using too much palm kernel cake in concentrate is that it is easy to go rancid if stored for a long time. This is because the oil contained in the cake is still high. Coconut cake is still used because the oil content is still high, rations containing a high proportion of coconut cake will easily go rancid [10]. Therefore, the proportion of palm oil meal in concentrate also needs to be considered for the optimum limit.NRC [11] states that fattening bulls weighing 250-363 kg and ADG 1.23 kg/day require protein as much as 0.93-1 kg/head/day or 9.8% – 12.4% in DM. . The average feed protein in this study was 9.57% - 16.18%. The higher the use of cassava flour and cassava flour, the lower the protein content. The lowest CF value was found in P7, which was 9.57% with cassava flour and cassava wastes each as much as 35%. When compared with the nutritional requirements of CP based on the NRC [1], the CP content in P7 is still too low. The CP content in P4, P5 and P6 (12.34%, 11.56% and 10.48%) was sufficient for fattening cattle. While in treatments P1, P2 and P3 using cassava flour and cassava wastes 5%, 10% and 15% contained CP of 16.18%, 15.81% and 14.43%, respectively. According to NRC [11], cattle with a body weight of 250-363 kg need a CP of 13.2% - 17% to obtain a ADG of 1.73 kg/day. Therefore, high protein at P1, P2 and P3 is expected to result in higher average day gain.

**4.2 Gas production, gas production potential, and gas production rate :** The value of gas production obtained in this treatment is higher when compared to the study by Nikmatullah [12] using 50% elephant grass forage and 50% concentrate consisting of coconut cake, soybean meal, rice bran and pollard producing an average gas production of 101.04 ml/500 mg DM at 48 hours of incubation. Meanwhile, according to Afifah [13] the average total gas production with the provision of 25% rice straw and 75% concentrate consisting of bran, polar, copra meal and soybean meal was 51.55 ± 4.53 ml/500 mg DM. The high and low value of gas production is thought to be influenced by the carbohydrate content of cassava flour and cassava wastes with low crude fiber. According to McDonald et al. [14] carbohydrates in the rumen are hydrolyzed into disaccharides and non-saccharides. The results of this fermentation are reprocessed into VFA products, especially acetate, propionate and butyrate as well as $CH_4$, $H_2$ and $CO_2$ gases. That the low content of CF makes the feed easier to digest in the digestive tract, making it easier for bacteria to penetrate into the feed material for the digestive process.

The value of b (potential for gas production) in this study was not influenced by the use of cassava flour and onggok flour levels (P>0.05). However, there is a tendency for the highest gas production potential value at P7 207.04 ml/500 mg DM and the lowest at P2 154.56 ml/500 mg BK. Based on research conducted by Nikmatullah [12] using 50% elephant grass forage and 50% concentrate consisting of kapok cake, coconut cake, soybean meal, rice bran, and pollard b values of 107.183 – 117.631 ml/500 mg BK while the research conducted by Afifah [13] by giving 25% rice straw and 75% concentrate consisting of bran, polar, copra meal and soybean meal at 56.18 – 59.97 ml/500 mg DM. This value is smaller than this study, it is suspected that the high value of b is due to the type of feed used. In this study, the forage feed used was unfermented corn meal, protein source feed in the form of palm oil cake and coconut meal and energy source feed in the form of cassava flour and cassava wastes.The gas production rate parameter value c is the speed of rumen microbes to digest the feed consumed per hour from the feed consumed [15]. Based on Table 8, it is known that the use of different levels of cassava flour and cassava flour has a very significant effect on the value of c (gas production rate) (P<0.01). The highest c value was found in treatment P4 which was 0.049 ml/hour and the lowest was in treatment P1 0.029 ml/hour but the c value between P2 to P7 was not statistically different, this was indicated by the same notation in the treatment. Based on research conducted by Nikmatullah [12] using 50% elephant grass forage and 50% concentrate consisting of kapok cake, coconut cake, soybean meal, rice bran and pollard produced a c value of 0.046 - 0.056 ml/hour while the research conducted by Afifah [13] by giving 25% rice straw and 75% concentrate consisting of bran, polar, copra meal and soybean meal at 0.09 – 0.11 ml/hour. The value of c in this study is smaller than that of Nikmatullah [12] and Afifah [13]. The high and low value of c (gas production rate) is influenced by the crude fiber contained in the treatment feed, which is 9.16% - 17.18%. The higher the cell wall content of a feed ingredient, the lower the rate of degradation. Therefore, low CF will decrease the value of the number of cell walls and increase the rate of degradation and finally produce a high value of c. The high value of c indicates that the feed can be rapidly degraded in a certain time unit [16].

## IV CONCLUSIONS

The conclusion of this study is the use of cassava flour and cassava waste of as much as 20% is most effective because it has the highest gas production rate (c value) 0.049 ml/hour with a gas production value (143.15 ml/500 mg DM) and ideal gas production potential (173.15 ml /500 mg DM).

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