# The Effect of Using Different Levels of Cassava Flour and Cassava Wastes on Dry Matter and Organic Matter Degradation and Rumen Fermentation Products in Vitro of Cassava-Based Concentrates

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**Abstract.** This study was conducted to evaluate the effect of using different levels of cassava flour and cassava wastes on dry matter and organic matter degradation, efficiency of microbial protein synthesis (EMPS) and ammonia (NH3). The seven treatments from this study are 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 flour15% + 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 stover20% + cassava flour25% + cassava wastes 25% + palm kernel cake 0% + copra meal 30%, P6 = maize stover 20% + cassava flour30% + 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 arranged in a randomized block design (RBD). The results of this study showed that the use of cassava flour and cassava wastes markedly increased ($P < 0.01$) values of DM and OM degradation in the rumen, but decreased the EMPS value. Treatments had no significant effect ($P > 0.05$) on NH3 concentration. It can be concluded that the treatment P7 had the highest DM and OM degradation values (70.86% and 76.62% respectively). The highest efficiency rumen microbial protein value was recorded in treatment P1(20.94 g/kg DOMR).

**Keywords:** based concentrate · cassava flour · cassava wastes · in vitro · DM degradation · OM degradation · NH3 · EMPS

## 1 Introduction

According to Umiyasih and Utari [1] cassava can be used as animal feed both from tubers, leaves, stems, bark to industrial waste. Ruminants such as beef cattle can use all


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parts of cassava as feed, but the disadvantage of cassava-based feed is the low protein content, so there needs to be additional feed for protein sources to improve the nutritional quality of cassava products. The use of cassava in the form of cassava flour and cassava wastes are used as a concentrate material for ruminants.

According to Ishak *et al.* [2] the use of 1 kg of rice bran and 1.9 kg of rice bran and 0.1 gr of minerals produces the highest ADG (0.42 kg/day) in Balinese cows aged 1–2 years when compared to feed commonly given by farmers. In addition, such feeding is more efficient and profitable compared to other treatments. The high content of carbohydrates in cassava flour and cassava wastes results in a high level of degradation in the rumen and occurs quickly when balanced with high feed source Nitrogen [3].

According to Partama [4] feeding containing easily soluble carbohydrates will result in higher VFA production when compared to feed containing high fiber. The provision of cassava flour and cassava wastes which are higher in the ration of beef cattle will have a very noticeable influence on the decrease in the pH of the rumen because the cassava flour is very easy to digest in the rumen and is easily hydrolyzed into flying fatty acids (VFA). Therefore, to find out how effective the use of cassava flour and cassava wastes flour levels in feed, the parameters measured are dry matter degradation, organic matter degradation, efficiency of microbial protein synthesis (EMPS) and $NH_3$ concentration *in vitro*. This is done to predict how well the digestibility of nutrients is and how effective the process of fermentation of feed in the rumen is.

## 2 Materials and Methods

### 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 set of tools for DM degradation, OM degradation and efficiency of microbial protein synthesis (EMPS) analysis. Materials used were feeds tuffs consisting of maize stover, cassava flour, cassava wastes, palm kernel cake, and copra meal obtained from Blitar, East Java.

### 2.3 Method

This study used a Randomized Block Design (RBD) with five treatments and three replication. The treatments applied were 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

**Table 1.** Chemical composition of feed stuffs and treatments

| Feed stuffs | Chemical composition (%) | | | | |
|---|---|---|---|---|---|
| | DM | OM | CP | EE | CF |
| Maize stover | 85.75 | 87.02 | 10.58 | 1.27 | 31.30 |
| Palm kernel cake | 92.48 | 95.99 | 15.52 | 8.66 | 20.79 |
| Copra meal | 87.27 | 90.11 | 22.80 | 1.84 | 20.40 |
| Cassava flour | 87.77 | 95.99 | 2.38 | 0.68 | 3.57 |
| Cassava wastes | 88.97 | 81.58 | 1.48 | 0.66 | 14.90 |
| Urea | 99.89 | 99.85 | 287.5 | 0.00 | 0.00 |
| P1 | 89.40 | 93.18 | 16.18 | 1.45 | 17.18 |
| P2 | 87.50 | 91.02 | 15.81 | 1.69 | 16.22 |
| P3 | 86.97 | 89.95 | 14.43 | 0.85 | 16.32 |
| P4 | 86.31 | 89.44 | 12.34 | 0.46 | 15.68 |
| P5 | 84.82 | 89.75 | 11.96 | 0.64 | 16.05 |
| P6 | 86.86 | 91.42 | 10.46 | 1.90 | 10.49 |
| P7 | 86.14 | 90.69 | 9.57 | 0.82 | 9.16 |

*) Based on 100% of DM

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. The *in vitro* method used Makkar *et al.* [5] protocol for DM and OM digestible. For determining of EMPS value, the residues were refluxed using NDS solution and calculated with Bach *et al.* [6] equation. Meanwhile, to measure the concentration of NH3, the Conway method [7] was used. The nutritional content and treatment used in this study are found in Table 1.

### 2.4 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.

## 3 Results and Discussion

The value of dry matter degradation, organic matter degradation, $NH_3$ concentration, and EMPS value is found in Table 2. The results of statistical analysis showed that the addition of different levels of cassava flour and cassava wastes had a very significant effect ($P < 0.01$) on the value of DM degradation, OM degradation, and EMPS values. The concentration of $NH_3$, has no significant effect. The P1 treatment had the lowest

**Table 2.** DM degradable, OM degradable, EMPS and $NH_3$ of treatments

| Treatments | DM degradation* (%) | OM degradation* (%) | NH3(mM) | EMPS* (g N / kg DOMR) |
|---|---|---|---|---|
| P1 | $51.39 \pm 2.71^{a}$ | $58.76 \pm 3.13^{a}$ | $5.63 \pm 0.51^{ns}$ | $27.94 \pm 1.08^{b}$ |
| P2 | $57.40 \pm 3.83^{ab}$ | $64.69 \pm 6.49^{ab}$ | $6.08 \pm 1.08^{ns}$ | $20.54 \pm 4.25^{ab}$ |
| P3 | $61.71 \pm 1.95^{abc}$ | $67.12 \pm 5.36^{bc}$ | $6.43 \pm 3.32^{ns}$ | $18.38 \pm 2.47^{ab}$ |
| P4 | $62.03 \pm 8.56^{abc}$ | $70.29 \pm 6.22^{bcd}$ | $6.23 \pm 2.23^{ns}$ | $22.60 \pm 8.62^{ab}$ |
| P5 | $65.12 \pm 5.48^{bc}$ | $71.59 \pm 8.78^{bcd}$ | $6.18 \pm 0.15^{ns}$ | $15.01 \pm 1.98^{a}$ |
| P6 | $68.22 \pm 2.023^{bc}$ | $73.54 \pm 4.14^{cd}$ | $4.82 \pm 1.05^{ns}$ | $14.61 \pm 2.19^{a}$ |
| P7 | $70.86 \pm 3.64^{c}$ | $76.62 \pm 3.78^{d}$ | $5.77 \pm 0.87^{ns}$ | $13.02 \pm 2.90^{a}$ |

Different superscript in the same showed the significant effect at $P < 0.01$. (*) Ns = not significant $P > 0{,}05$. EMPS = Efficiency of Microbial Protein Synthesis.

DM degradation and OM degradation values of 51.39% and 58.76% while the highest values at P7 were 70.86% and 76.62%. $NH_3$ concentrations increase from P1 to P3 then decrease P6 and increase back at P7. The trend seen in EMPS values is the increasing use of the level of flour cassava flour and cassava wastes tends to decrease the EMPS value where the highest value is at P1 (27.94 gN/kg DOMR) and the lowest at P7 (13.02 gN/kg DOMR).

The DM degradation and OM degradation values at P1 are the lowest because the high CP value is not balanced with the low CF value. According to Mizan *et al.* [8]. The high CF content in feed will make it difficult for rumen microbes to digest feed to produce a low digestibility value. Wajizah *et al.* (2015) [9] mentioned that the amount of digestibility of feed in the rumen is influenced by the chemical composition of the feed, especially the content of crude fiber and protein which supports the digestibility of feed during the fermentation process. Therefore, the P7 treatment with a higher level of cassava flour and cassava wastes, which is 35%, has the highest value of DM degradation and OM degradation because it has high digestible carbohydrates and sufficient protein.

Mc Donald *et al.* [10] explained that rumen microbes can grow optimally if the $NH_3$ concentration is 6.0–17.65 mM. Thus, the treatment of P2, P3, P4, and P5 has a fairly good concentration of $NH_3$ for microbial growth because it has a good protein content of 16.22%, 16.32%, 15.68%, and16.05% in addition to the proportion of cassava flour and cassava wastes as much as 10%, 15%, 20%, and 25% is well balanced using palm oil cake and copra. Syapura *et al.* [11] stated that the proportion of protein as an N source for rumen microbes, while carbohydrates as a carbon frame to support the synthesis of rumen microbial proteins and energy sources for ruminants. Therefore, the balance of proteins and carbohydrates in the feed is very important.

The higher the level of cassava flour and cassava wastes, the EMPS value tends to decrease. In this study, the increasingly high use of cassava flour and cassava wastest end storeduce the protein content of the feed and tends to produce low EMPS. According to Campbell and Reece [12] proteins, carbohydrates and NPN function as constituents of the body's rumen microbial body cells to be able to synthesize amino acids. In addition,

adequate protein and carbohydrate content can increase the growth of amylolytic and proteolytic bacteria or other bacteria in the rumen [13]. According to ARC [14] the average microbial protein for all ruminant feed ingredients that can be degraded in the rumen ranges from 15–45 gN/kg of DOMR.

## 4 Conclusions

Increased use of cassava flour and cassava wastes levels in cassava-based concentrate feed can increase DM and OM degradation values very significantly and NH3 concentrations also tend to increase although they do not produce significant values. Meanwhile, the value of EMPS decreased a long with the increasing level of use of cassava flour and cassava wastes.

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