In Vitro Digestibility of Fermented Rice (*Oryza sativa*) Straw and Cassava (*Manihot utilissima*) Leaves Basal Feed Supplemented with Cassava Tuber

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ABSTRACT

This study was done to determine the *in vitro* digestibility of basal feed consisted of fermented rice (*Oryza sativa*) straw and cassava (*Manihot utilissima*) leaves supplemented with various levels of cassava tuber. Fermented rice straw was made by mixing 4 kg urea and 1 kg Starbio® into 2000 kg freshly harvested rice straw. As dietary treatments, fermented rice straw was mixed with 15% cassava leaves and added with cassava tuber in various levels (0, 5, 10, or 15%). All the dietary treatment samples then incubated for 48 h according to 2-stage *in vitro* technique. Results showed that the *in vitro* digestibility of dry matter, organic matter, and crude protein were increased by the increasing level of cassava tuber added ($P<0.05$), with the greatest digestibilities on the 15% cassava tuber supplementation (41.2, 57.1, and 47.4%, respectively; $P<0.05$). No significant effects were detected on pH of rumen culture due to cassava tuber supplementation. It can be concluded that supplementing feed consists of fermented rice straw and 15% cassava leaves with cassava tuber can improve its nutrient quality without giving negative effects on the rumen pH.

Keywords: Fermented rice straw, Cassava leaves, Cassava tuber, *In vitro* digestibility, Supplementation

INTRODUCTION

In Indonesia, cattle are commonly fed with high fiber feed, including agricultural by-products such as rice (*Oryza sativa*) straw that are low in nutrient as well as its digestibility. Digestibility of high fiber feed depends on cellulolytic microbes. In order to maximize the degradation of fibrous feed, the growth of cellulolytic microbes in the rumen is needed to be spurred. One of the efforts to increase the ruminal microbe population is by balancing the nutrients needed for their growth, especially the energy and protein.

Microbes in the rumen require energy and protein for their growth and development. A synchronized protein-to-energy ratio indicates optimal fermentation efficiency. Cattle fed only fermented rice straw may be able to provide energy from structural carbohydrates of the rice straw. However, since fermented rice straw also contains rapidly degraded N derived from urea that used in fermentation process, feedstuffs that contain rapidly degraded carbohydrates (non-structural carbohydrates) such as cassava (*Manihot utilissima*) tuber may fulfill the need of soluble carbohydrate. Cassava tuber is known as a good carbohydrate source that is degraded rapidly, while the leaves contain quite high crude protein (CP) which is ranged 20 – 36% (Askar, 1996). Slow degraded protein contained in cassava leaves can be a good source to synchronize the slowly degraded carbohydrate of rice straw. By balancing energy and protein availability in the rumen, an increase of microbial population as well as increasing volatile fatty acids (VFA) production in the rumen can be expected. Based on these, a research that focused on improving the *in vitro* digestibility of fermented rice straw and cassava leaves basal feed supplemented with cassava tubers was established.

MATERIALS AND METHODS

This research was conducted at the Laboratory of Feed Technology, Department of Nutrition and Feed Science, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia. A one-way experimental design was used in this study with the level of cassava tuber (0, 5, 10, or 15%) as the treatments. Fresh cassava tuber and leaves were collected from Gunungkidul area, while fresh rice straw was gathered from Sleman area, Yogyakarta. Fresh cassava tuber and leaves were dried under direct sunlight, and then ground using hammer mill with 1 mm screen. Fermented rice straw was made by mixing freshly harvested rice straws with urea and probiotic (Starbio®) in ratio of 1: 2 (1 g probiotic + 2 g urea/kg DM rice straw). After were mixed with urea and probiotic, rice straw were stored in the room temperature for 21 days. In the end of fermentation period, fermented rice straw was dried in 55°C oven (Memmert GmbH + Co. KG, Germany) and then ground using Wiley mill (Thomas Scientific, USA) with 1 mm screen. As the basal diet in this *in vitro* study, fermented rice straw was mixed with 15% cassava leaves and added with cassava tuber in according to the dietary treatments (0, 5, 10, or 15%).

The chemical compositions of samples were analyzed by proximate analysis according to (AOAC, 2005). The chemical compositions of fermented rice straw, cassava leaves and tuber are presented in Table 1. The *in vitro* digestibility analysis was carried out using the first stage of two-stage *in vitro* method (Tilley and Terry, 1963). The data were analyzed by one-way analysis of variance (ANOVA) using SPSS ver. 22 (IBM, USA). Comparisons of means for treatments were done by contrast test with Duncan's new multiple range tests when the effects of treatments ($P \leq 0.05$) were detected.

Table 1. Chemical compositions of fermented rice straw, cassava leaves and tuber (%)

Feedstuffs	Dry matter	Organic matter	Crude protein	Crude fiber	Ether extract	TDN*
Fermented rice straw	92.9	79.7	8.20	32.4	1.70	43.0
Cassava leaves	87.0	93.4	30.6	24.2	4.87	66.0
Cassava tuber	86.1	97.0	3.11	2.24	0.63	81.8

*Calculated based on Hartadi *et al*. (2005).

RESULTS AND DISCUSSION

In general, *in vitro* digestibility of DM, OM, and CP of fermented rice straw were increased ($P < 0.05$) simultaneously with increasing level of cassava tubers supplementation, while no significant effect was detected on pH among treatments (Table 2).

Table 2. pH and *in vitro* digestibility of fermented rice straw and cassava leaves basal diet supplemented with various level of cassava tuber

Item[1]	Tuber (% as fed)[2]			
	T0	T5	T10	T15
pH	7.10±0.115	7.03±0.050	7.00±0.082	6.98±0.050
IVDMD, %	34.6^{a}±0.76	38.8^{bc}±1.13	36.7^{b}±1.27	41.2^{c}±1.77
IVOMD, %	47.2^{a}±0.90	50.3^{b}±0.67	51.7^{b}±2.71	57.1^{c}±2.30
IVCPD, %	39.6^{a}±1.00	42.1^{b}±1.15	43.9^{bc}±2.30	47.4^{c}±2.00

^{a,b,c} Means in the same row with different superscripts differ at $P<0.05$.

[1] IVDMD = *in vitro* dry matter digestibility; IVOMD = *in vitro* organic matter digestibility; IVCPD = *in vitro* crude protein digestibility.

[2] T0 = fermented rice straw without cassava tuber; T5 = fermented rice straw with 5% cassava tuber; T10 = fermented rice straw with 10% cassava tuber; T15 = fermented rice straw with 15% cassava tuber.

Results showed that supplementing fermented rice straw with cassava tuber up to 15% did not significantly affect the pH of rumen fluid (Table 2). The unaffected pH of rumen fluid is due to the amount of soluble carbohydrates available in cassava tuber is still in balance with the protein availability in the feed, in this case, from urea added in the fermentation process of rice straw. Although cassava tuber is high in soluble carbohydrate (5.00%) and low in protein (3.34%; Despal *et al*., 2008), the increasing level of cassava tuber used in this study did not beyond the limit that may cause imbalance of energy and protein availability in the rumen, or worst may cause ruminal acidosis. Deacon (2004) reported that the optimal rumen pH ranges from 6.3 to 7.5.

Compared with controls (T0), the digestibility of DM, OM, and CP of fermented rice straw were increased ($P<0.05$) due to cassava tuber supplementation with the greatest digestibilities at 15% supplementation (Table 2). The digestibility improvement of fermented rice straw due to cassava tuber supplementation was caused by increasing amount of non-structural available in the feed. Cassava contains non-structural (62.5%) and structural carbohydrates, which includes 2.69% cellulose, 0.36% hemicellulose, and 0.02% lignin (Arnata, 2009); thus, adding cassava tuber in the diet would increase the soluble carbohydrates availability in feed. Since non-structural carbohydrates is rapidly fermented in rumen, the volatile fatty acids (VFA) and adenosine triphosphate (ATP) production from this fermentation may increase, thus more energy is available for microbial growth which lead to greater microbes population in the rumen. Furthermore, the increasing non-structural carbohydrates from cassava tuber matched with rapidly degraded N of urea contained in the fermented rice straw, thus the rumen microbes population might be increased significantly. With greater microbe population in the rumen, feed can be degraded more efficient which ended with greater *in vitro* digestibility of DM, OM, and CP (Table 2).

CONCLUSIONS

Supplementing cassava tubers up to 15% on fermented rice straw improve the *in vitro* DM, OM, and CP digestibilities without giving any negative effects on rumen condition.

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