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The Nutrient Quality of Cassava by Addition of Cow Rumen Fluid Enzyme

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Abstract: The research was conducted to study the effect of crude enzyme from cow rumen fluid on nutrient quality of cassava substrates through hydrolysis method. Completely randomized design (CRD) in this research consisted of 4 materials from cassava with its 11 combinations (the total was 15 treatments) with 3 replications. The fifteen treatments were tuber (T), leaves (L), peel (P), onggok (O), tuber + leaves (TL), peel + tuber (PT), tuber + onggok (TO), leaves + peel (LP), peel + onggok (PO), onggok + leaves (OL), leaves + tuber + peel (LTP), leaves + tuber + onggok (LTO), peel + leaves + onggok (PLO), peel + tuber + onggok (PTO), peel + leaves + tuber + onggok (PLTO). Rumen fluid was centrifuged at 10,000 rpm for 15 minutes in 4 °C. Supernatant was reacted with ammonium sulphate (60%) and incubated in the freezer at 4 °C for 24 hours. The ground cassava was added by rumen fluid crude enzyme at the dosage of 1% (b/v). The cassava substrates were kept for 24 hours in room temperature. The addition of rumen fluid enzyme on cassava did not significantly affect dry matter losses (0.96%-2.08%), but it significantly decreased crude fiber (8.61%-17.83%). And On the other hand, it increased total sugar (15.19%-29.52%). The conclusion of this research was that the addition of rumen fluid enzyme on cassava substrates was able to decrease crude fiber (17.83%) and the best total soluble sugar was in tuber (29.52%), but for dry matter, it was similar to control in the range of 0.96%-2.08%.

Key words: Cassava, cow rumen fluid enzyme, nutrient quality.

1. Introduction

Raw materials from cassava tubers, peel, leaves and cassava waste are potential alternative feedstuffs as poultry feed because of the availability in terms of quantity and quality and it is also relatively cheap in price. As far, the utilization of cassava as raw material for poultry feed is still not optimum, because of high fiber content, especially on leaves. Therefore, the addition of fiber-degrading enzymes such as cellulase derived from rumen fluid into the feed consisted of raw cassava materials is expected to solve the nutritional problems.

The addition of rumen fluid enzymes will break down the un-digested components into easily digested, such as cellulose is broken down into glucose component that can be utilized as a source of energy for poultry. Twomey et al. [1] reported that the addition of fiber-degrading enzymes could breakdown fiber into simple monomers components. The results from Iyayi and Davies [2] showed that the enzyme supplementation in diets on the basis of palm kernel cake and dried corn in starter phase broiler can improve digestibility and nutritional value of the rations. Based on this reason, the experiment was done to reveal the addition of rumen fluid enzyme on nutrient quality of raw cassava.

2. Materials and Methods

The materials used were raw materials from bitter

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cassava varieties (tubers, leaves, bark, cassava and their combinations) which were obtained from tapioca industry in Kedung Halang Bogor. Meanwhile cow rumen fluid obtained from the Slaughter House (RPH) in Tanah Sereal Bogor.

Rumen content from slaughtered cow was collected and compressed by using gauze screen to obtain the rumen fluid. A total of 500 mL rumen fluid was centrifuged at 10,000 rpm for 15 minutes at 4 °C. Supernatant obtained from the process was reacted with ammonium sulphate (60%) and incubated in a freezer at temperature of 4 °C for 24 hours. After that, the supernatant was re-centrifuged at 10,000 rpm for 15 minutes. The sediment formed was the crude enzymes. Crude enzymes were obtained about 8 g. Subsequently, the enzyme was dissolved in citrate phosphate buffer pH 6.8 and 0.05 M with a ratio of 1:10.

A total of 10 g of cassava tuber, cassava waste, peel, leaves and their combinations (1:1), which has been ground, was inserted into a plastic tray, and then added rumen fluid enzymes with a dosage of 1% (w/v). Due to the enzyme thickness, before the rumen fluid enzymes are mixed, distilled water was added (0.1 mL of rumen fluid enzymes + 0.4 mL of distilled water). Then each of these materials was stored for 24 hours at room temperature. Cassava raw materials were analyzed before and after hydrolysis.

Completely randomized design (CRD) in this research consisted of 4 materials from cassava with its 11 combinations (the total was 15 treatments) with 3 replications. The fifteen treatments were tuber (T), leaves (L), peel (P), onggok (O), tuber + leaves (TL), peel + tuber (PT), tuber + onggok (TO), leaves + peel (LP), peel + onggok (PO), onggok + leaves (OL), leaves + tuber + peel (LTP), leaves + tuber + onggok (LTO), peel + leaves + onggok (PLO), peel + tuber + onggok (PTO), peel + leaves + tube + onggok (PLTO).

The variables measured in this experiment were the content of dry matter and crude fiber [3] and total soluble sugars [4]. Data were analyzed by ANOVA using SAS 6:12, when ANOVA showed significant differences then followed by Duncan's Multiple Range Test.

3. Results and Discussion

3.1 Changes of Dry Matter Content of Cassava Raw Materials (CRM)

The decrease in dry matter CRM in this study varied from 0.96% to 2.08% (Table 1). This reduction was closely related to the presence of water in the materials. The higher water content, dry matter yield was low, due to the increase of hydrolysis materials. Suroso et al. [5] stated that the hydrolysis reaction increases with the increasing concentration of hydrogen ions. Effect of water on the reaction kinetics is very important because water can cause hydrolysis process and will affect the quality of the product [6]. Also, reduction of CRM dry matter content is influenced by the enzymes, in which the filtrate of rumen fluid enzymes in this study is crude enzymes, which might be mixed with another substrate so that when added to the CRM will affect dry matter content of the materials.

3.2 Changes of Crude Fiber Content of Cassava Raw Materials (CRM)

CRM treated with rumen fluid enzymes significantly ($P < 0.05$) reduced the content of crude fiber (Table 2). The highest decline in crude fiber content was in single treatment of tubers material (T), which was 17.83%, while the lowest was in leaves treatment (L), which was 8.61%. Hydrolysis in the two materials causes the highest decreased in tuber cassava + onggok treatment (TO) at 17.42% and the lowest in leaves + peel treatment (LP) at 9.45%, meanwhile, hydrolysis at three and four materials combination relatively the same.

The difference of crude fiber content is closely related to the lignocellulose-material composition, especially lignin content. Kamara et al. [7] found that

Table 1 Changes of dry matter of cassava raw materials during the experiment.

Types of raw materials	Enzyme treatment		Changes (%)
	Without enzyme	With enzyme	
One material			
Tuber (T)	90.90	89.01	-2.08 ± 0.32
Onggok (O)	90.87	89.04	-2.02 ± 0.18
Peel (P)	89.60	87.86	-1.94 ± 0.48
Leaf (L)	88.69	87.53	-1.31 ± 0.83
Two materials			
PT	89.05	87.63	-1.59 ± 0.49
TO	90.46	89.10	-1.51 ± 0.17
OL	87.56	86.71	-0.96 ± 0.55
TL	87.62	86.68	-1.06 ± 0.19
LP	87.18	85.59	-1.83 ± 0.71
PO	87.56	85.93	-1.86 ± 0.63
Three materials			
LTP	87.66	86.45	-1.38 ± 0.52
PTO	87.57	86.59	-1.12 ± 0.14
LTO	87.99	86.49	-1.72 ± 0.33
PLO	87.79	86.18	-2.03 ± 0.57
Four materials			
PLTO	88.02	86.31	-1.94 ± 0.41

Table 2 Changes of crude fiber content of cassava raw materials during the experiment.

Type of raw materials	Enzyme treatment		Changes (%)
	Without enzyme	With enzyme	
One materials			
Tuber (T)	1.12	0.89	$-17.83^{a} \pm 5.08$
Onggok (O)	6.95	5.94	$-14.02^{abc} \pm 2.03$
Peel (P)	7.26	6.23	$-13.54^{abc} \pm 1.43$
Leaf (L)	13.8	12.42	$-8.61^{c} \pm 1.94$
Two materials			
PT	3.33	2.73	$-17.35^{ab} \pm 3.61$
TO	3.70	2.99	$-17.42^{ab} \pm 1.84$
OL	9.82	8.77	$-9.64^{c} \pm 0.91$
TL	6.13	5.28	$-11.25^{c} \pm 2.78$
LP	10.83	9.68	$-9.45^{c} \pm 2.01$
PO	6.37	5.62	$-10.05^{c} \pm 2.01$
Three materials			
LTP	6.64	5.72	$-13.47^{abc} \pm 1.58$
PTO	3.74	3.18	$-12.09^{bc} \pm 3.42$
LTO	6.61	5.75	$-10.14^{c} \pm 2.18$
PLO	7.66	6.65	$-11.62^{c} \pm 1.99$
Four materials			
PLTO	6.10	5.34	$-12.22^{bc} \pm 0.33$

relatively high lignin content would affect enzymatic hydrolysis process and can slow down the penetration by the enzymes. High lignin content resulted in the difficulty of substrate hydrolysis, so that reduction of crude fiber content will be low, as seen in the leaves treatment, the decrease of crude fiber was lower than in tuber treatment.

3.3 Changes of Total Soluble Sugar Content of Cassava Raw Materials (CRM)

CRM treated with the addition of rumen fluid enzymes significantly ($P < 0.05$) increased the total soluble sugar (Table 3). The highest increase of total soluble sugar was`in tuber treatment (T) equal to 29.91%, meanwhile the lowest was in leaves treatment (L), that was of 18.78%. In two materials combination, the highest increase of total soluble sugars present in the peel + tuber treatment (PT) of 26.31% and the lowest was in onggok + leaves (OL) treatment at 18.26%. Total sugar of three and four materials

Table 3 Changes of total soluble sugar content of cassava raw materials during the experiment.

Types of raw materials	Enzyme treatment		Changes (%)
	Without enzyme	With enzyme	
One materilas			
Tuber (T)	9,087.50	11,805.40	$29.91^{a} \pm 0.91$
Onggok (O)	5,365.97	6,384.67	$19.01^{d} \pm 0.63$
Peel (P)	6,383.31	8,018.18	$25.61^{b} \pm 0.22$
Leaf (L)	4,935.92	5,862.34	$18.78^{d} \pm 0.76$
Two materials			
OL	4,928.02	5,828.13	$18.26^{d} \pm 1.95$
PT	6,581.28	8,311.96	$26.31^{b} \pm 1.63$
TO	6,303.35	7,876.44	$24.94^{b} \pm 0.28$
UD	6,054.13	7,386.02	$21.99^{c} \pm 0.78$
LP	5,173.76	6,149.03	$18.89^{d} \pm 2.06$
PO	5,016.48	5,957.73	$18.74^{d} \pm 1.64$
Three materials			
LTP	4,284.44	4,955.88	$15.67^{e} \pm 1.15$
PTO	4,356.96	5,037.79	$15.65^{e} \pm 1.90$
LTO	4,174.19	4,807.84	$15.19^{e} \pm 1.88$
PLO	4,097.16	4,724.61	$15.30^{e} \pm 1.35$
Four materials			
PLTO	4,064.55	4,708.11	$15.83^{e} \pm 0.74$

combinations was relatively similar. The difference of total soluble sugar of treated CRM was influenced by carbohydrate content in raw materials, particularly starch content of cassava. High starch content of cassava resulted in higher production of total soluble sugar. In tuber treatment, soluble starch content is higher so the opportunity for starch to contact with the enzyme is also larger, compared to cassava peel, leaves and their combinations. Kamra [8] stated that there is amylase enzyme in the rumen fluid that is able to degrade starch.

4. Conclusion

Addition of rumen fluid enzymes are able to reduce the crude fiber content (17.83%) and increase total soluble sugars (29.91%) and the best treatment is obtained on tuber. However, the dry matter content is relatively similar to control in the range of 0.96%-2.08%.

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