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Improving Smallholder and Industrial Livestock Production for Enhancing Food Security, Environment and Human Welfare

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Effect of Age at Harvest on Whole Cassava (*Manihot esculenta*) Silage Qualities

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Improving local feed resource is a growing concern. Cassava is one of Indonesian local feed resource that can be grown in almost all of Indonesian region. However, because of its competitive use for human consumption and fuel production, and its high cyanic acid content, as well as its seasonal availability, therefore, utilization of the whole crop and conservation technique should be applied. So far, there is limited information available about the age at harvest of the plant to produce the best quality of its whole crop silage. The study was aimed to compare 7, 8 and 9 months of age at harvesting time of cassava plant on whole crop silage qualities produced. The qualities were compared based on their physical (color, odor, moisture, texture, and spoilage), ensiling (pH, DM, VFA, DM losses, CP, N-NH_3, CP degradation, WSC used, HCN and fleigh point) and utility (*in vitro* rumen fermentabilities and degradabilities) characteristics. Two kg of well mixed chopped sample of each the whole plants were ensiled for 5 weeks anaerobically in three fold 35 × 50 cm polyvinyl bags silo at room temperature. The experiment was designed completely random and each treatment was repeated thrice. Ensiling process reduced HCN content of the silage by more than 60%. Harvesting cassava plant at 8 months of age gave the best whole cassava plant silage quality (best physical characteristics, higher fleigh point as well as *in vitro* rumen digestibility). Because of its low CP content, solely diet in ruminant should be avoided.

Key Words: Cassava, Crop age, Local feed, Silage

INTRODUCTION

Comparing high feed import to the potential of Indonesian agriculture to support feed security in Indonesia shows that Indonesian local feed resources such as cassava have not been use optimally. In 2011, Indonesian cassava tuber production reached up to 22 million ton (Deptan, 2011). The problem with cyanic acid (HCN) content of cassava and its competitive use as food and fuel may be some of the reason for the situation. There is a need to reduce HCN content as well as improve its feed competitive advantage so that it is safe for use as animal feed commercially.

Ensiling technique has been used to conserve feed for years. The technique has been proven to lower HCN content of ensiled feed. Improvement of cassava feed competitive advantage might be done by increasing the proportion of the plant used in animal ration such as whole plant. Ensiling whole plant cassava is hoped lower the HCN content of ensiled cassava as well as improve its feed competitive advantage.

As proportion of cassava plant such as leave, stem, tuber change with the age, nutrient content of whole cassava plant will also be influenced. At age of 6 month, the leave proportion is optimum; the proportion will then steadily decrease after 7 month of age (Sudaryanto, 1990). So far only limited information is available on the optimum age at harvesting of the cassava plant to produce the best quality of whole cassava silage.

The study was aimed at finding the optimum age of cassava plant harvesting on the nutrient content and physical, fermentative and utilities characteristics of whole cassava plant silage produced.

MATERIALS AND METHODS

The research had been conducted in June 2011 to February 2012. Cassava plants of known age were collected periodically from a farmer plantation in Ciawi District of Bogor Regency. Total mix ration (TMR) as a control were formulated and mixed. The ration consisted of 50% nature grass, 15% cassava extract meal, 7.07% corn meal, 15.73% coconut oil meal, 10.49% soybean oil meal, 1.24% dicalcium phosphate (DCP), and 0.47% calcium carbonate ($CaCO_3$). Cassava plants used in this experiment were harvested from 7, 8 and 9 months of age. After harvesting, leaf, stem and tuber part of the plants were separated and weighted. All component of the plant were then manually chopped to about 1 cm length and then mixed homogeneously. Two kg of the mixed component plant were fed into three fold 35 cm x 50 cm polyvinyl plastic bag silos. The airs were removed by compacting and the silos were rapidly sealed with plastic tape. The Ensiling were let for 5 weeks at room temperature.

Characteristics of cassava plant used in the experiment were observed including weight of each plant component, dry matter (DM), crude protein (CP), HCN and water soluble carbohydrate (WSC) contents of the whole plant. Physical (color, odor, texture, moisture and spoilage), fermentative (pH, DM, VFA, DM degradation, CP, NH_3, HCN, WSC and fleigh point) and utilities (in vitro organic matter and protein ruminal fermentabilities, and DM and OM digestibilities) characteristics of silage produced were also determined.

Proportion of cassava plant component was calculated after separating and weighting leaves, stem, tuber and comparing to the total weight of the plant. Dry matter and CP contents of cassava plant were analyzed according to Neumann and Bassler (1997) procedures. Water soluble carbohydrates were determined using Phenol method (Singleton and Rossi, 1965). While HCN content of cassava plant were measured using APHA (1985) method.

Physical characteristic of silage was described for its color, odor, texture, moisture and existing spoilage. The value of 1 to 4 was given for the worse to the best color, odor, texture and moisture of the silage produced as compare to the plant material. The amount of contaminated silage was weighted to calculate the proportion of spoilage silage.

The pH value of silage was measured using calibrated Hanna pocket pH meter. Silage DM were measured using oven heat method, while, crude protein content were analyzed using micro kjeldahl method according to Neumann and Bassler (1997) procedure. Concentration of silage VFA's were measured using steam distillation method of the same supernatant sample that have been used for pH measurement. Silage dry matter degradation (DMD) was calculated as proportion of DM loss to the material DM. Ammonia concentration in silage was observed from the same supernatant sample as used for pH and VFA. The concentration was determined using micro diffusion Conway (General Laboratory Procedure, 1966). The proportion of protein degraded was calculated from the proportion of CP material that has been converted into ammonia. WSC and HCN contents left in the silage were determined using the same procedure with determination of WSC in plant material. Fleigh point (FP) grades silage based on DM content and pH value of the silage (Öztürk et al., 2009). The point was calculated according to formula: FP = 220 + [(2 x DM (%)) – 15] – [40 x pH], where FP denotes values between 85 and 100, very good quality; 60 and 80, good quality; 55 and 60, moderate quality; 25 and 40, satisfying quality; <20, worthless.

Ruminal fermentabilities of organic matter to produce VFA and protein to produce NH_3 were determined from supernatant after in vitro incubation of silage sample in buffer-rumen liquor for 6 h. While DM and OM in vitro digestibilities were determined according to two stage methods by Tilley and Terry (1963).

The experiment was completely random designed with 4 treatments (TMR, 7, 8 and 9 months age at harvesting) and 3 replications. Data were analyzed using ANOVA and significant different between treatments were subjected to contras orthogonal test.

RESULTS AND DISCUSSIONS

Cassava plant properties

Proportion and DM, CP, WSC and HCN contents of the plant were shown in Table 1. Ensiling might change properties of the plant, however, the silage properties pretty much depend on the properties of the plant material. The table showed that the older the plant, the lower leave and the higher tuber proportions of the plant have. DM content increased with the age, while CP, WSC and HCN contents decreased.

Table 1. Cassava plant properties

Treatments	Plant proportion (%)			DM (%)	CP (%)	WSC (%)	HCN (ppm)
	Stem	Leaves	Tuber				
TMR	-	-	-	45.29	20.83	13.88	13.56
7 months	35.82	19.94	44.24	28.14	7.87	18.82	3496.76
8 months	35.66	12.99	51.35	34.50	6.98	16.37	1933.40
9 months	34.96	12.09	52.95	35.18	5.71	11.56	858.64

Started from 7 month age of harvesting, the cassava plant has shown a good material characteristic to be ensiled (Parakassi, 1999). However, HCN content of the plant material were above normal level that can be tolerate (500 ppm) by ruminant (Sandi *et al.*, 2010), therefore pretreatment are needed. Crude protein content of the plant material less than 7.9% which shows value below ruminant requirement. Water soluble carbohydrate content in the plant material more than enough (> 10%) to provide material for lactic acid bacterial (LAB) to produce acid and lower the pH value of during ensiling (Parakassi, 1999).

Characteristics of whole plant silage

Physical, fermentative and utilities characteristic of whole plant silage compare to TMR are shown in Table 2. Physically whole plant cassava silages (WPCS) were better than TMR silage. No spoilages were found in the WPCS but in TMR. High DM content of TMR (>40%) might caused difficulty of compacting which lead to the present of oxygen during ensiling (Sandi *et al.*, 2010). However, the percentage of spoilage silage in this experiment was lower than that was found by Lendrawati (2008) on corn silage based TMR (7.64%).

According to Wilkins (1988), treatment 7 and 8 months produced better silage pH in compare to 9 months and TMR treatment. The lower pH value of treatment 7 and 8 months might be caused by ideal DM content and high WSC content which provided better material and environment for BAL to grow and produce lactic acid (Despal *et al.*, 2011). Although TMR had high WSC content, only very small proportion of it have been used by BAL. High protein content of the TMR might also caused higher buffering capacity in the medium which lead to higher pH value. Dry matter degradation was not significantly different between the treatments (< 11%) but lower than 16% that was found by Sumarsih and Waluyo (2002).

Concentration of ammonia in TMR (4.30 mM) and 8 months (4.23 mM) treatments were significantly higher than 7 (2.2 mM) and 9 months (2.08 mM) treatments. Ammonia concentration of less than 50 g/kg total N (~2.94 mM) were categorized by Zamudio et al. (2008) as good quality silage. Because of higher CP content in TMR material in compare to whole plant cassava material then percentage of CP degraded from TRM (3.94%) was lower than whole plant cassava (> 7.31%).

Although ensiling could reduce more than 60% of cyanic acid content of WPCS (Man and Hans, 2002), however, HCN concentration found in treatment 7 and 8 months were still above safety level for ruminant consumption. There is a need to let the silage open for a while before fed them to ruminant. Although FP of the silage statistically different, but the point (> 85) showed that all silage produced were in very good quality (Öztürk et al., 2009).

Table 2. Characteristics of whole plant cassava silage

Parameters	TMR	7 months	8 months	9 months
Physical characteristic				
Color	++++	+++	++	+++
Odor	++++	++++	++++	++++
Texture	+++	+++	+++	+++
Moisture	+++	+++	++++	+++
Spoilage	1.158%	-	-	-
Fermentative characteristic				
pH	4.53 ± 0.08	4.21 ± 0.08	4.29 ± 0.22	4.54 ± 0.04
DM (%)	43.30 ± 2.34^{a}	26.31 ± 0.46^{c}	32.56 ± 0.31^{b}	32.70 ± 1.07^{b}
Silage VFA (mM)	5.36 ± 5.12^{b}	58.02 ± 11.82^{a}	17.06 ± 5.91^{b}	51.19 ± 10.24^{a}
DM degradation (%)	10.88 ± 3.45	9.75 ± 2.01	10.96 ± 1.18	9.32 ± 2.68
CP (%)	20.53 ± 5.24^{a}	7.36 ± 0.42^{b}	6.91 ± 0.80^{b}	5.99 ± 0.77^{c}
Silage NH_3 (mM)	4.30 ± 0.21^{a}	2.22 ± 0.39^{b}	4.23 ± 0.30^{a}	2.08 ± 0.45^{b}
CP degradation (%)	3.94 ± 1.05^{a}	8.54 ± 1.93^{c}	14.21 ± 2.44^{d}	7.31 ± 0.89^{b}
WSC (%)	13.27 ± 0.80^{a}	6.30 ± 2.64^{b}	12.29 ± 2.54^{a}	5.44 ± 0.72^{b}
HCN (ppm)	13.56 ± 0.63^{a}	829.86 ± 13.66^{c}	680.50 ± 34.62^{b}	326.94 ± 46.48^{b}
FP	120.72 ± 4.69^{a}	89.34 ± 0.92^{c}	101.83 ± 0.63^{b}	102.13 ± 2.14^{b}
Utilities characteristics				
Ruminal NH_3 (mM)	9.96 ± 0.86	8.96 ± 1.21	9.44 ± 0.83	8.30 ± 1.83
RuminalVFA (mM)	106.55 ± 9.64^{b}	111.88 ± 1.11^{b}	123.21 ± 6.65^{a}	93.21 ± 10.86^{b}
DMD(%)	67.54 ± 2.87^{b}	70.25 ± 1.31^{b}	77.10 ± 4.32^{a}	77.43 ± 0.35^{a}
OMD(%)	62.91 ± 10.25^{b}	70.47 ± 2.14^{b}	77.79 ± 4.77^{a}	77.96 ± 0.25^{a}

Note: Different superscript at the same row showed statistically different ($p < 0.05$); + = less desired and ++++ = most desired physical quality of silage; DMD and OMD = dry matter and organic matter digestibilities.

In vitro utilities test of the WPCS showed that the silage produced were fermentable and highly digestible for ruminant. Digestibility of 8 and 9 months treatments silage were higher than others. Increasing proportion of tuber and reducing proportion of leaves might cause this condition.

REFERENCES

APHA. 1985. American Public Health Association. Standard Methods for the examination of water and waste water 15th edition. Pp 476. America

Deptan. 2011. Statistik Pertanian. Pusat Data dan Informasi Pertanian Departemen Pertanian. Jakarta.

Despal, I. G. Permana, S. N. Safarina, and A. J. Tatra. 2011. Penggunaan Berbagai Sumber Karbohidrat Terlarut Air untuk Meningkatkan Kualitas Silase Daun Rami. Media Peternakan Vol. 34 (1) : 69-76.

General Laboratory Procedure. 1966. Department of Dairy Science. University of Wisconsin. Madison.

Lendrawati, Ridla and Ramli. 2008. Kualitas Fermentasi dan Nutrisi Silase Ransum Komplit Berbasis Jagung, Sawit dan Ubi Kayu In Vitro. Institut Pertanian Bogor. Bogor.

Man, N.V. & W. Hans. 2002. Effect of molasses on nutrition quality of cassava and *gliricidia* top silage. Asian-australas. J. Anim. Sci.. 15: 1294-1299.

Neumann, C. and R. Bassler (1997). VDLUFA-Methodenbuch Band III, Die chemische Untersuchung von Futtermitteln. 3rd ed. VDLUFA-Verlag, Darmstadt, Germany.

Öztürk, D., M. Kizilsimsek, A. Kamalak, O. Canbolat,& C. O. Ozkan. 2005. Effects of ensiling alfalfa with whole-crop maize on the chemical composition and

Parrakasi, A. 1999. Ilmu Nutrisi dan Makanan Ternak Ruminansia. Universitas Indonesia. Press. Jakarta.

Sandi, S. E. B. Laconi, A. Sudarman, K. G. Wiryawan and Mangundjaja. 2010. Kualitas silase berbahan baku singkong yang diberi enzim cairan rumen sapi dan *Leuconostoc mesenteroides*. Media Peternakan Vol. 33 (1): 25-30.

Singleton, V. L. and J. A. Rossi. 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am. J. Enol. Vitic. 16: 144-158.

Sudaryanto, B. 1990. Biomassa ubi kayu sebagai pakan ternak. Pengkajian pengembangan teknologi pra dan pasca panen ubi kayu. Prosiding seminar nasional UPT-EPG, Lampung.

Sumarsih, S. and B. Waluyo. 2002. Pengaruh aras pemberian tetes dan lama pemeraman yang berbeda terhadap protein kasar dan serat kasar silase hijauan sorgum. Laporan Penelitian. Fakultas Peternakan, Universitas Dipenogoro, Semarang.

Tilley, J. M. A. and R. A. Terry. 1963. Two-stage technique for the in vitro digestion of forage crops. J. Brit. Grassland Soc. 18:104-11

Wilkins, R. J. 1988. The Preservation of Forage In: E. R. Orskov (Ed.). Feed science. Elsevier Science Publisher BV, Amsterdam.

Zamudio, D. M., J. M Pinos-Rodriguez, S. S Gonzalez, P. H Robinson, J. C Garcia, and O. Montanez. 2009. Effects of *agave salmania* otto ex salm-dyck silage as forage on ruminal fermentation and growth in goats. Anim Feed Sci and Tech. 148:1-11