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Effect of Cassava Root Ensiled with Cassava Top or Legumes on Feed Intake and Digestibility of Dairy Cows

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***Abstract*—**The effect of cassava root ensiled with cassava top or legumes on voluntary feed intake and milk production were determined in 12 dairy cows using a 4×3 change-over design. Experimental period were 30 days long and consisted of 14 days of adaptation. Silage was prepared from cassava root mixed with cassava top or legumes at ratio 60:40. Cows were allotted at random to receive *ad libitum* one of four rations: T1) control, T2) cassava root +cassava top-silages, T3) cassava root +hamata - silages and T4) cassava root +Thapra stylo-silages.

The dry matter intake ($BW^{0.75}$) was higher ($P< 0.05$) in cow fed with silages diets compared with T1. However, the intake of T2 was higher among treatments. Milk production was lowest in cow fed with T1. Among silages based diets, milk production was not significantly different but 4%FCM was higher in cow fed T2. Milk compositions were not affected by feeding diets.

It is concluded that feeding cassava root ensiled with its leaves as a supplement increased dry matter intake and significantly improved 4%FCM. The combination of cassava root and legume silages did not improve the feed intake but did increase the milk production.

***Keywords*—** Cassava, dairy cow, hamata, Thapra stylo, silage.

I. Introduction

CASSAVA (*Manihot esculenta* Crantz) is widely cultivated in tropical and sub-tropical area. Reference [1] suggested that cassava root and leave have potential as energy source and protein source for ruminant ration, respectively. However, the roots and leaves are contained cyanogenic glucocides which need to reduce to acceptable levels for consumption. Generally, the reduction method is slicing or cutting the roots or leaves into pieces and drying them in the sun. Ensiling is also practical in the region where weather conditions do not favor for sun drying.

In addition, some research studied has indicated that ensiling is more effective than sun drying for reducing HCN concentrations [2]. Another one problems for feeding cassava root is a lack of protein content [2]. Cassava leaves contain more protein and fiber than roots.

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Reference [3] suggested that mixing of cassava leaves and roots in the silo will produce a feed that well balanced for energy and protein. However, at the time of root harvesting, cassava leaves yields are quite low.

Ensiling roots with other plant protein sources such as legume forages may be considered. The combinations between cassava root and legume have been reported to improve feed intake and nutrient digestion [4]. This study was aimed to study the effect of cassava root ensiled with cassava top and legumes silages on voluntary feed intake, nutrient digestibly and milk production in dairy cows.

II. Materials and Methods

A. Silage Preparation

FJLB was prepared from cassava leaves, hamata (*Stylosanthes hamata*) and Thapra stylo (*Stylosanthes guianensis CIAT 184*) before making silage [5]. Cassava root and cassava top were collected from the field immediately after root harvesting. Whole cassava root was sliced into approximately 0.5-cm thickness. The cassava top, 30 to 50 cm from the top including leaves, petioles and young stems, were collected, and mechanically chopped into 2-3 -cm pieces. Hamata and Thapra stylo were harvested at 60 d after planting and chopped into 2- to 3-cm lengths. Cassava root were mixed with cassava top or legumes at ratio 60:40. The mixed portion were treated with 1% FJLB (FJLB) which prepared from the same plant, then packed tightly in 100-kg plastic drums and stored at room temperature (27–30°C) until feeding experiment start.

B. Animals, Feeding

Twelve Holstein Friesian crossbred cows (mean body weight, 484 ±41 kg) were individually housed in metabolic cages. The cows were randomly allocated in a 4×3 change-over design to receive 1 of 4 *ad libitum* diets: T1) control, T2) cassava root+ cassava top- silage, T3) cassava root +hamata-silage, or T4) cassava root +Thapra stylo- silage. The 30-d experimental period consisted of a 30 d for feed intake. Feed was offered twice daily at 08:00 and 15:00 h, and the refused portions were weighed daily before the morning feeding. BW was measured before the morning feeding at the beginning and end of each experimental period. The daily dry matter (DM) intake per unit of metabolic BW was calculated with the mean

value of initial BW and final BW of each period. Milk yields were recorded daily throughout the experiment; milk composition was sampled in the end of each experimental period.

C. Chemical Analyses

The DM content of the silages and feces were determined by oven drying at 70°C for 48 h. The dried sample was milled to pass through a 1.0 mm sieve. The nitrogen was determined by the Kjeldahl procedure [6]. The NDF and ADF concentrations were determined by methods described by [7]. After milking for both a.m. and p.m., milk samples were analyzed for fat using the Gerber method. The Kjeldahl method for nitrogen analysis in milk protein (6.38×N), lactic acid and solids not fat were analyzed according to AOAC method (1995).

D. Statistical Analyses

Statistical analyses were performed using the general linear models (GLM) procedure of SAS (SAS Institute Inc., Cary, NC). For the means were compared by Duncan's multiple range test (DMRT), all data were analyzed using the procedures of SAS for a 4×3 change-over design.

III. Results and Discussion

The chemical composition of silage materials prior to ensiling and the ingredient of the rations were shown in Table I and Table II. The dry matter intake ($BW^{0.75}$) was the highest ($P< 0.05$) in cow fed with T2. Cows fed control diet was higher in dry matter intake compared with cows fed cassava+legumes-silages (Table III). Milk production in cow fed silages based diets were higher than cow fed with control diets but was not significantly different among silage diets. However, 4%FCM was highest in cow fed with cassava root +cassava top-silages. It is concluded that feeding cassava root ensiled with its leaves as a supplement increased dry matter intake and significantly improved 4%FCM.

TABLE I
CHEMICAL COMPOSITION OF SILAGE MATERIAL PRIOR TO ENSILING

	Cassava root	Cassava top	Hamata	Thapra Stylo
DM (g/kg)	329.9	236.5	362.2	325.3
(g/kg DM)				
OM	886.7	911.4	814.3	926.4
CP	33.0	167.7	101.2	121.9
NDF	361.2	496.2	659.3	618.8
ADF	55.6	315.0	437.3	457.2
ADL	12.2	106.9	111.3	90.3

TABLE II
INGREDIENTS AND CHEMICAL COMPOSITIONS OF THE RATIONS

Ingredient (%)	T1	T2	T3	T4
cassava chip	20.00	0.00	0.00	0.00
soybean meal	17.61	17.61	17.61	17.61
Rice bran	5.50	5.50	5.50	5.50
Whole cotton seed	21.89	21.89	21.89	21.89
urea	1.50	0.85	1.00	1.20
molasses	7.00	7.00	7.00	7.00
sulfer	0.30	0.30	0.30	0.30
premix	0.50	0.50	0.50	0.50
Calcium carbonate	0.60	0.60	0.60	0.60
Dicalcium phosphate	0.60	0.60	0.60	0.60
Bicarbonate	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Tallow	3.00	3.00	3.00	3.00
Rice straw	20.00	20.00	20.00	20.00
Cassava root + cassava top silage	-	20.65	-	-
Cassava root + hamata silage	-	-	20.50	-

Cassava root + Thapra stylo silage	-	-	-	20.30
Total	100.00	100.00	100.00	100.00
Chemical composition				
DM, g/kg	76.63	61.42	57.60	56.48
OM, g/kg DM	91.68	90.77	90.81	90.46
CP, g/kg DM	16.83	16.69	16.88	16.92
EE, g/kg DM	7.44	8.21	7.67	7.25
NDF, g/kg DM	62.94	70.60	76.06	76.92
ADF, g/kg DM	29.21	32.04	35.49	36.92

T1 = control, T2 = cassava root +cassava top-silages, T3 = cassava root +hamata - silages and T4 = cassava root +Thapra stylo-silages.

TABLE III
FEED INTAKES AND DIGESTIBILITY IN COWS FED WITH DIFFERENT SILAGE- BASED DIET

Item	T1		T2		T3		T4		SEM	P-value
Total intake										
kg DM/d	12.98	b	13.85	a	11.3	d	11.48	c	0.01	0.0001
%BW	2.67	b	2.9	a	2.35	c	2.43	c	0.037	0.0001
g/kg $BW^{0.75}$	125.48	b	135.3	a	110.75	c	113.43	c	1.268	0.0001
Milk production										
kg/d	11.68	b	13.75	a	13.4	a	12.25	ab	0.466	0.0483
4% FCM, kg/d	9.77	d	11.82	a	11.3	b	10.48	c	0.117	0.0001
Milk fat, %	2.92		3.05		2.97		3.02		0.133	0.8993
Milk protein, %	3.37		3.18		3.48		3.42		0.126	0.3550
Total solids, %	12.52		12.8		13		12.83		0.305	0.7251
Solids not fat, %	9.77		9.75		10.2		9.82		0.322	0.7181

Values in the same row followed by different letters are significantly different ($p<0.05$). SEM = standard error of the mean. T1 = control, T2 = cassava root +cassava top-silages, T3 = cassava root +hamata - silages and T4 = cassava root +Thapra stylo-silages.

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