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Cassava hay: A new strategic feed for ruminants during the dry season

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Abstract

Dry season feeding is critical in terms of both quantity and quality especially for productive ruminants such as dairy cattle. Cassava (*Manihot esculenta*, Crantz) a tuber crop can be grown as foliage in the dry season producing first cut yield after three months of 20,40 kg/ha (fresh) or 10,200 kg/ha (dried) and estimated combined yield of second and third cut of 40,820 kg/ha (fresh) or 20,400 kg/ha (dried) or 5,102 kg crude protein/ha. Cassava hay (CH) contained high level of crude protein (25%) and low levels of NDF and ADF. Voluntary intake of CH was 3.1% of live weight and the dry matter digestibility was 71%. Ruminal DM digestibility of CH was relatively high while protein ruminal degradability was low indicating it would be a good source of bypass protein.

Key words: Cassava, hay, feed, dry season, ruminant, dairy cattle.

Introduction

Cassava or tapioca (*Manihot esculenta*, Crantz) is an annual tuber crop grown widely in the tropics and sub-tropics. It can easily thrive in sandy-loam soil with low organic matter, receiving low rainfall and high temperature. It is therefore a cash crop cultivated by small-holder farmers within the existing farming systems in many countries. Cassava tuber contains high level of energy and minimal level of crude protein and has been used well as readily fermentable energy in ruminant rations. However, cassava leaves contain high level of crude protein (25%) some of which can apparently by-pass the rumen since it is in the form of a tannin-protein complex (Wanapat 1995).

The objectives of this study were to assess the feasibility of using cassava whole crop as hay when harvested in the dry season after 3 months of cultivation.

Materials and Methods

Cassava cultivation and hay making

Cassava was grown in rows using stems as plant material. Sowing date was September and harvest was in December (3 months) by picking the whole crop at 6 inches above the ground. Fresh yield was measured immediately and the biomass was left in the field to be dried for 3 days before being collected. The dried cassava biomass can either be stored in a stack or made into a bale for later storage and feeding. Cassava hay can easily be prepared in a simple square-wooden-box to obtain a 15-kg bale. A finished bale is recommended to be further sun-dried to secure dry matter of at least 85-90% and to reduce hydro-cyanic acid content.

Nutritional evaluation

Cassava hay was fed ad libitum to 4 rumen fistulated Holstein-Friesian steers, weighing approximately 350 kg, for two consecutive weeks before a metabolism trial was imposed for 5 days to measure voluntary intake, digestibility and pH, NH_3-N and VFA in rumen fluid. In addition, various parts of the cassava hay:

leaf, branch, stem and whole crop were studied for rumen degradation at 0, 24, 48 and 72 hours post feeding using the nylon-bag technique (Orskov and Shand 1997). Samples of feeds and faeces were analysed for DM, N and NDF by conventional methods (AOAC 19).

Results and discussion

Yield of cassava hay:

The whole cassava crop can be harvested in the dry season, three months after planting for the first cut and two times thereafter. The first cut at three months yielded 20,410 kg/ha (fresh) or 10,200 kg/ha (dried). The combined second and third cuts were estimated to be equal to the first cut. Therefore estimated total yield of cassava whole crop (fresh) and cassava hay were 40,820 kg/ha and 20,410 kg/ha, respectively. The practical use of cassava hay for ruminant feeding could be planned and fed in the dry season as shown in Figure 1. This feeding method would well follow recommendations previously given by Preston and Leng (1987).

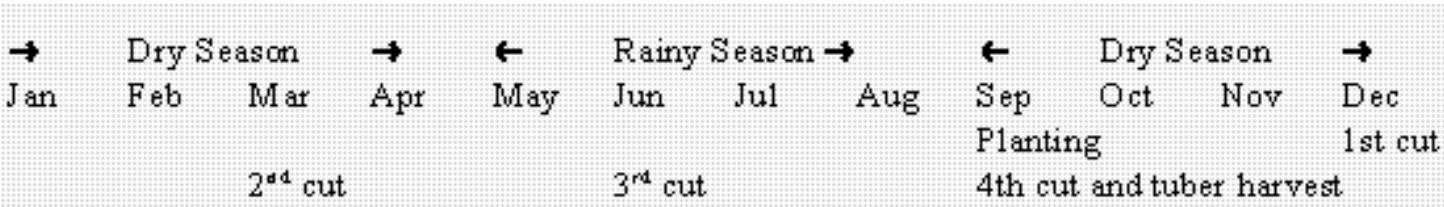

Figure 1: Practical planting and cutting of cassava foliage for dry season feeding

Cassava hay preparation:

Cassava crop can be harvested about 6 inches above the ground and sun-dried for 3-5 days before being collected in bundles or made into a square bale prior to feeding or storage for later dry season feeding. A short drying period (2-3 days) is essential to secure leaf attachment and higher quality. However, a longer period (4-6 days) is necessary for drying the stem and branches which contain higher content of moisture. The drying process is not only to reduce moisture but also to decrease hydrocyanic acid to a safe level for ruminants.

Table 1: Chemical composition of cassava foliage harvested at 3 months

	DM	Ash	CP	NDF	ADF	ADL	HCN
	%	----------%DM----------					mg%
Cassava hay							
Whole crop	93.4	6.6	24.9	34.4	27.0	3.8	0.348
Leaf	95.3	32.3					
Stem	82.7	14.6					
Branch	93.2	8.9					

Nutritive value study:

The chemical composition of cassava hay is presented in Table l. All parts of the cassava foliage contain high levels of crude protein; 32.3, 14.6, 8.9 and 24.9 % for leaf, stem, branch and whole crop hay, respectively. Moreover, NDF, ADF and ADL contents were relatively low. A comparison between cassava hay (CH) and alfalfa hay (AH) is presented in Table 2. CH has a higher level of CP and lower levels of NDF, ADF and ADL. These data are in agreement with previous reports by Maaruf et al (1995). With natural sun-drying, the hydro-cyanic acid was remarkably lowered to 0.38 mg% in CH which suggested a safe level for ruminants.

Table 2: A comparison between cassava hay (CH) (3 months) and alfalfa hay (AH, mid-bloom)

	CH	AH
DM, %	93.4	90.0
% in DM		
Ash	6.6	9.1
CP	24.9	17.0
NDF	34.4	46.0
ADF	27.0	35.0
ADL	3.8	9.0

Table 3 presents data on intake and digestibility. Cassava hay was fed to steers as a sole source of feed and it was well consumed at 11.2 kg/hd/d or 3.20 % of live weight.This intake was relatively higher than other sources of roughage as a sole feed. Ruminal pH measured before and post-feeding was relatively high (pH 6.95-7.11) which could possibly be due to high level of NH_3-N. DM digestibility by the total collection method measured on four steers was 71.0 1.23 %.

Table 3: Voluntary cassava hay intake and digestibility by Holstein Friesian steers

DM intake	
kg/d	11.2 ± 0.06
% of Lwt	3.2 ± 0.48
g/kg $W^{0.75}$	138 ± 3.09
Ruminal pH	
0 hr post feeding	7.1 ± 0.16
2 hr	7.05 ± 0.21
4 hr	6.95 ± 0.29
DM digestibility,%	71.0 ± 1.23

Table 4 and 5 present data on rumen degradation rates using the nylon-bag technique at 0, 24, 48, and 72 hr post feeding. Ruminal DM degradability of all parts showed linear increases as time progressed to 72 hr. Highest degradabilities were shown for leaf, whole crop and stem, while the branches resulted in the lowest value. These high ruminal degradabilites supported high intakes as shown in Table 3.

Table 4: Dry matter degradation of cassava hay suspended in rumen of steers by in sacco technique

	hr, post-feeding			
	0	24	48	72
Leaf	30.6	54.9	69.5	78.7
Branch	18.0	43.3	44.7	55.5
Stem	35.2	57.3	57.9	61.7
Whole crop	25.8	60.6	65.3	68.2

Rates of protein degradation of all parts were studied to relate to their by-pass protein characteristics since tannin was reported to be high especially in the leaf portion. As clearly shown, leaf protein exhibited highest "b" and "c" values, followed by whole crop hay.

Table 5: Protein degradation of cassava hay suspended in rumen of steers by in sacco technique

	Leaf	Branch	Stem	Whole crop
a, %	30.0	22.2	55.2	28.4
b, %	70.0	77.8	44.8	47.9
c, %/hr	1.6	0.4	0.2	3.7
ED, %	47.0	28.0	56.9	48.8

a= soluble fraction; b= potential degradation
c= degradation rate;
ED= effective degradation

Conclusions and recommendations

Based on this study, it can be concluded that cassava is highly recommended to be grown as foliage for dry season feeding since it can easily grow in low-organic matter soil, at high ambient temperature and with minimal management. Biomass production for first and subsequent harvests proved the potential of this crop since this timing coincides well with the harsh dry season period when natural feeds are limited.

The high quality in terms of protein and content of digestible nutrients, together with high consumption rate, prove that it is an excellent feed either for full feeding as cassava hay or as a supplement in crop-residue based diets (eg: urea-treated straw, or sugar-cane tops). This new approach of using whole crop cassava as hay needs to be implemented as a strategic feeding system during the dry season in a sustainable livestock production system particularly in small-holder dairy farming.

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