Agricultural Journal 5 (3): 225-228, 2010
ISSN: 1816-9155

Quality and Chemical Composition of Cassava Wastes Ensiled with *Albizia saman* Pods

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Abstract: An investigation was carried out to assess the quality characteristics, proximate composition and cell wall fractions of 6 months ensiled cassava wastes and *Albizia saman* pods. Cassava Wastes (CSW) and *Albizia saman* Pods (ASP) were mixed for preparation of silage as 100% CSW, 75% CSW+25% ASP, 50%CSW + 50% ASP, 25% CSW + 75% ASP and 100% ASP. The pH of silage ranged from 3.38-4.61. Silage structure was visible while texture ranged from wet and firm to dry and very firm. Colour ranged from dark brown in CSW to reddish brown in ASP. Odour of silage was generally alcoholic. Values for crude protein (3.50-24.50 g/100 g) increased with increasing level of ASP. There was no trend observed in the values for NDF, ADF, ADL, Cellulose and Hemicellulose. An inclusion level of 50 and 75% of ASP in the diet showed good quality silage and enhanced nutrient composition.

Key words: Cassava wastes, *Albizia saman* pods, silage, chemical composition, cellulose, hemicellulose

INTRODUCTION

Meeting the nutritional needs of ruminants throughout the year is a major challenge facing livestock farmers in the tropics due to the seasonality of forages. The forages are unimproved and low in nutritive value during the wet season while in the dry season they are fibrous, lignified with low protein value and even in short supply (Babayemi *et al*., 2003; MacMillan, 1996).

Cassava waste is an industrial by product which is mainly carbohydrate and very low in crude protein. The wastes are usually found all year round in cassava processing centres and left as wastes (Ifut, 1988). *Albizia saman* is leguminous tree that is fast growing shrub which produces indehiscent pods filled with a sticky brownish pulp that is sweet and edible (Durr, 2001). Cassava wastes was utilized as an additive and energy substrate for microbes while ASP was to boost the protein content of the mixture since CSW is low in CP content. Silage making has been noted for allowing the long term storage of a variety of wastes, agro-industrial by products, excess forages over a shorter period with better feed quality over hay making.

It has also been noted to degrade antinutritional factors (Achinewhu *et al*., 1998) and enhances nutrient content of feedstuffs through the biosynthesis of vitamins, essential amino acids and proteins by improving protein quality and fibre digestibility. Cassava wastes though an energy source is highly acidic, possesses anti-nutritive factors and highly fibrous. Albizia on the other hand like all multi-purpose trees, possesses anti-nutritive factors and hard seed which can not be easily digested by ruminants.

The present study was thus designed to investigate the qualitative characteristics, proximate composition and chemical composition of cassava wastes ensiled with *Albizia saman* pods.

MATERIALS AND METHODS

Location/site: The experiment was carried out at the small ruminant unit of the Teaching and Research Farm, University of Ibadan, Nigeria between March and August 2008. The location is 7°27`N and 3°45`E at an altitude of 200-300 m above sea level. The average annual rainfall is about 1250 mm with a mean temperature of 25-29°C.

Silage materials: Cassava Wastes (CSW) (consisting of peel and skin of tuber) were collected from Mokola in Ibadan and the pods were hand picked from the *Albizia saman* (ASP) trees within the campus of the University of Ibadan between January and March.

Diet formulation and silage preparation: The feed stuffs were mixed for silage into five treatments: 100% CSW, 75% CSW + 25% ASP, 50% CSW + 50% ASP, 25% CSW + 75% ASP and 100% ASP. Salt was added at 0.25% per treatment. The cassava wastes and *Albizia saman* pods were mixed for silage in a 30 kg plastic capacity silo. Each silo was lined with polythene sheets.

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Determination of silage quality: Sub-samples from three different points of depth were taken and mixed together in airtight-containers. These were later used for quality assessment. The temperatures in the silos were taken by dipping a laboratory thermometer inside the silos at different points and depths. Colour assessment was done with visual observation and colour charts. The odour of the silage from each silo was assessed separately by four different people. The pH of each sub-sample was determined using a pH meter.

Chemical analysis: Dried and ground samples of the silage were used for chemical analysis. Nitrogen in the silage was analyzed using micro-kjedahl method and value was multiplied by 6.25 to determine the crude protein content. Crude fibre, ether extract and ash in silage were determined according to AOAC (1990). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined using the procedures of Van Soest *et al*. (1991).

Statistical analysis: Data were analysed using analysis of variance (SAS, 1999). Significant means were separated using the Duncan's multiple range F-test. Experimental model of the design is:

$$Yij = \mu + \alpha i + \varepsilon ij$$

Where:

Yij = Individual observation
μ = General mean of population
αi = Treatment effect
εij = Composite error effect

RESULTS AND DISCUSSION

Table 1 shows the colour, odour, texture, taste, smell and temperature of the silage made from cassava wastes and *Albizia saman* pods. The colour of the silages was observed to change with increasing inclusion of the pod and ranged from dark brown in silage with 100% CSW to reddish brown in 100% ASP. The odour was generally alcoholic with the 100% CSW silage being very strong than the others. The pH value ranged from 3.38-4.61. The values showed a trend increasing with increased inclusion of *Albizia* pods. The lowest pH was recorded for 100% CSW (3.38) while highest was observed in 25% CSW + 75% ASP (4.61). The taste was vinegar like indicating a well made silage. The temperature ranged from 25.13°C in 100% CSW to 27°C in 100% ASP. A trend for temperature was observed to be increasing as the inclusion of ASP in the silage mixtures increased except at 75% ASP. The texture of the silages showed wet and firm in 100% CSW while 100% ASP was dry and very firm. The chemical composition (g/100 g DM) of the unensiled feedstuffs is shown in Table 2 while the proximate composition and fibre fractions of the ensiled cassava wastes with *Albizia saman* pod mixtures are shown in Table 3 and 4, respectively. There was an increase in Crude Protein (CP) value (3.51% unensiled CSW to 4.81% in 100% CSW silage and 23.19% unensiled ASP to 24.50% in 100% ASP silage) after ensiling. In Table 3, the CP content ranged from 4.81 g/100 g for ensiled CSW to 24.50 g/100 g in silage with 100% ASP. There was a significant ($p<0.05$) difference in CP content as the ASP inclusion increased except for the 50 and 75% ASP inclusions. The Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) values of the silages in Table 4 ranged from 38-53% and 24-42%, respectively.

A decrease in NDF value was observed in sole CSW unensiled and ensiled (52% vs 40%) when comparing Table 2 and 4. There was significant ($p<0.05$) difference in the NDF and ADF values as seen in Table 4. There was an increase in NDF as ASP inclusion increased except for the 25% ASP. On comparing Table 2 and 4, hemicellulose decreased from 27-13% for sole CSW. Cellulose content ranged from 13-22%. The various silage colours obtained in the present study were close to the original colour of both feedstuffs and this is in agreement with the findings of Oduguwa *et al*. (2007). Adegbola and Asaolu (1986) reported a light brown colour for ensiled cassava peels at 21 days and dark brown at 35 days. In the present study, the reddish brown colour was probably as a result of increased inclusion of *Albizia saman* pods. *Albizia* pod is naturally red in colour and on hydrolysis with a high water containing cassava wastes might produce an intermediate the reddish brown colour. The odour observed in this study was comparable with that of Menenses *et al*. (2007). Therefore implying a well made

Table 1: Silage qualitative assessment of Cassava w. ensiled with *Albizia s.* pods

Parameters	100% C	75% C + 25% A	50% C + 50% A	25% C + 75% A	100% A
Colour	Dark brown	Dark brown	Dark brown	R. brown	R. brown
Odour	Alcohol(strong)	Alcohol	Alcohol	Alcohol	Alcohol
Texture	Wet and firm	Wet and firm	Semi dry firm	Dry and firm	Dry very firm
Temperature	25.13	25.83	25.83	25.67	27.00
pH	3.38	3.46	3.63	4.61	4.12
Structure	Visible	Visible	Visible	Visible	Visible
Taste	Vinegar	Vinegar	Vinegar	Vinegar	vinegar

A-*Albizia saman* pod; C-Cassava wastes; w-wastes; R-Reddish

Table 2: Chemical composition (%) of cassava wastes and *Albizia s.* pods

Parameters	Cassava wastes	*Albizia saman* pod
Dry matter	30.13	74.05
ASH	7.00	5.00
Crude protein	3.50	23.19
Crude fibre	10.00	9.00
Ether extract	12.00	13.00
Neutral detergent fibre	52.00	42.00
Acid detergent fibre	25.00	31.00
Acid detergent lignin	11.00	18.00
Cellulose	14.00	13.00
Hemicellulose	27.00	11.00

Table 3: Proximate analysis (%) of ensiled cassava wastes with *Albizia saman* pods

Parameters	100% CSW	75C + 25A	50C + 50A	25C + 75A	100 ASP	SEM
DM	31.79^{c}	46.36^{b}	46.36^{b}	53.44^{ab}	60.53^{a}	1.65
ASH	6.00^{ab}	7.00^{a}	5.00^{b}	5.00^{b}	5.00^{b}	0.30
CP	4.81^{d}	10.06^{c}	16.19^{b}	16.63^{b}	24.50^{a}	0.10
CF	10.00^{c}	12.00^{a}	8.00^{d}	10.00^{c}	11.00^{b}	0.13
EE	14.00^{b}	14.00^{b}	12.00^{d}	13.00^{c}	15.00^{a}	0.16

$^{a, b, c, d}$means on the same row with different superscripts differ significantly ($p<0.05$)

Table 4: Fibre fractions (%) of Cassava w. ensiled with *Albizia saman* pod

Parameters	100% CSW	75C + 25A	50C + 50A	25C + 75A	100 ASP	SEM
NDF	40.00^{d}	38.00^{d}	46.00^{c}	49.00^{b}	53.00^{a}	0.50
ADF	27.00^{c}	30.00^{b}	24.00^{d}	27.00^{c}	42.00^{a}	0.34
ADL	11.00^{c}	11.00^{c}	8.00^{d}	14.00^{b}	20.00^{a}	0.26
CELL	16.00^{c}	19.00^{b}	16.00^{c}	13.00^{d}	22.00^{a}	0.40
HEMC	13.00^{b}	8.00^{c}	22.00^{a}	22.00^{a}	11.00^{bc}	0.62

$^{a, b, c, d}$means on the same row with different superscripts differ significantly ($p<0.05$) C/CSW-Cassava wastes; A/ASP-*Albizia saman* pods

silage and possible proliferation of lactic acid bacteria. The pH values observed here were higher than that obtained by Oduguwa *et al.* (2007) but lower than the range classified to be good for silage (4.5-5.5) in some treatments (Menenses *et al.*, 2007). The result obtained for temperature in the present study was below the range of 30-60°C (Mannetje, 1999) presumed to tamper with the colour of silage and tending to spoilage by caramelization. The current temperature (25-27°C) of the silage therefore indicates a well made silage. The texture tended towards being dry due to the increasing inclusion of ASP. The CSW contained high moisture while ASP was relatively dry, thereby affecting the final silage texture. Adegbola and Asaolu (1986) reported a very soft texture for cassava peels when it was ensiled for 35 days while at 4-5 weeks silage, rotten masses were observed. The increase in CP value is in agreement with Oboh and Akindahunsi (2003) that increase in protein content of fermented cassava wastes could be as a result of secretion of some extracellular enzymes (proteins) such asamylases, linamarase and cellulase into the mash by the fermenting organisms in an attempt to make use of the cassava starch as a source of carbon (Raimbault, 1998). Values obtained for CP in the silages were higher than the critical value of 70 g kg^{-1} recommended for small ruminants (NRC, 1981), except for cassava wastes only. A trend was noticed here with increasing pods inclusion. The Crude Fibre (CF) for unensiled ASP (Table 2) in this study was lower than that (10.10%) reported by Hosamani *et al.* (2005).

Oboh and Akindahunsi (2003) reported 6.5% as CF for CSW naturally fermented and later Oboh reported 11.7% for naturally fermented CSW. The Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) values of the silages in the current study were >20.79 and 4.87% reported for CSW (Aderemi and Nworgu, 2007) fermented for 10 days. Otukoya (2007) reported NDF of 47.46% for ASP stored in polyethylene bag and was lower than that obtained for 100% ASP in the present study. A trend was observed in NDF values as ASP percentage inclusion increased. A high NDF connotes low intake due to slow degradability while high ADF is low digestibility (Wood and Badve, 2001).

CONCLUSION

In view of the good keeping quality and increase in protein content which was significant ($p<0.05$) throughout the treatments of the cassava wastes fermented with *Albizia saman* pod, it thus prove shows that this technology could assist in preserving agroindustrial by products hence making them a veritable source of feed during the off season for ruminants.

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