App. Trop. Agric. Vol 15, Nos 1 & 2, PP 120-125, 2010

Applied Tropical Agriculture

EFFECTS OF SUPPLEMENTATION OF GUINEA GRASS WITH CASSAVA LEAF SILAGE ON FEED INTAKE, DIGESTIBILITY AND NITROGEN BALANCE OF WEST AFRICAN DWARF GOATS

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Abstract
Silage prepared from wilted cassava leaves were fed to West African Dwarf (WAD) goats as supplement to Guinea grass (Panicum maximum) based diets to determine the effects on dry matter (DM) intake, digestibility of nutrients and nitrogen balance of the animals. Twenty four WAD goats were randomly assigned in group of 6 to four experimental diets. Diet I, which was the control contained 100% Panicum maximum (PM), diet II contained 80% PM + 20% cassava leaf silage (CLS) while diets 3 and 4 contained 60% PM + 40% CLS and 40% PM + 60% CLS, respectively. Treatment effect on DM intake was not significant ($p>0.05$). The digestibility of dry matter and most of the nutrients was significantly influenced ($p<0.05$) by the cassava leaf silage (CLS). Dry matter digestibility increased with increased level of cassava leaf silage to 40%. Diets 1 through 3 were not significantly different in crude protein digestibility (CPD), while diet 4 was significantly different ($p<0.05$) from the other diets in terms of CPD. Both the nitrogen balance and nitrogen retention were significantly influenced ($p<0.05$) by the treatments.

Keywords: Goats, cassava leaf silage, supplementation, N-balance, digestibility

Introduction

A major limitation to improve livestock production in the tropics is the non-availability of adequate supply of feed ingredients at affordable prices to producers. In Nigeria, the cost of feeding has been put at 60-80% of the total cost of intensive livestock production (Fajimi *et al.*, 1993; Tewe, 1997). This has constituted an un-ending challenge to the livestock industry especially the monogastric livestock subsector. Though, ruminants are less affected because of their ability to feed on grasses, forages and highly fibrous feeds, there is still the problem of dry season feeding of these animals as feed supplies are limited both in quality and quantity resulting in low animal performance in terms of growth and production.

The use of whole cassava and its products in livestock feeding has been on the increase. Evidence of its suitability in livestock feeding is accumulating (Iyayi and Tewe, 1994; Tewe, 1994; Aderemi *et al.*, 2000; Akinfala *et al.*, 2002). It is regularly fed to small ruminants in small scale subsistence farms in Africa. Several authors have shown that cassava foliage (leaves and stems) could efficiently serve as a protein and roughage supplement in ruminant feeding systems based on poor quality tropical forages, crop residues or agro-industrial by-products (Moore, 1976; Smith, 1992). Diets based on such feedstuff usually have protein as one of the first limiting factors and may thus require additional protein and roughage to maintain an efficient rumen ecosystem that will stimulate nutrient intake and improve animal performance. Ensiling cassava foliage can offer practical solution to the problem of feed for small ruminants during the dry season. A natural feed resource on which small ruminant feeding systems can be based in the tropics is the Guinea grass (*Panicum maximum* Jacq) (Bamikole *et al.*, 2004b; Abegunde, 2008). This grass is relatively in abundance in almost all the tropics, but it is still faced with the problem of rapid decline in crude protein and soluble carbohydrate with age. This is coupled with a progressive increase in crude fibre and lignin content (De-Leeuw, 1979; Agishi, 1985). Consequently, tropical grasses are low in voluntary intake and digestibility after maturity (Adu and Adamu, 1982). This study was therefore carried out with the aims of providing answers to the following questions: will West African Dwarf (WAD) goats readily accept silage made from cassava leaves, will graded levels of cassava leaf silage elicit any effect on voluntary feed intake, digestibility of nutrients and nitrogen balance of WAD goats fed Guinea grass (*Panicum maximum*) as basal feeds?

Materials and Methods

Animals, Experimental Diets and Treatment Arrangement

Twenty four West African Dwarf goats, aged about 6-9 months and weighing between 4.00 and 9.00 kg were used for the feeding trial. The animals were dewormed and treated with antibiotics as a precaution against bacterial infection before the commencement of the experiment. The animals were fed four diets in a split plot design. The four diets with the level of the test ingredients are shown in Table 1.

Table 1. The four diets used in this study

Test ingredients	Treatments (%)			
	I	II	III	IV
Panicum maximum (PM)	100.00	80.00	60.00	40.00
Cassava leave silage (CLS)	0.00	20.00	40.00	60.00

Feeding and Management of Animals

The animals were randomly divided into four groups of six animals per group. Prior to the experiment, the animals were allowed one week to get acclimatized to the environment and two weeks to get accustomed to the experimental rations. During the experimental period, the animals were assigned into individual feeding unit at the Teaching and Research Farm, University of Ibadan, Oyo State, Nigeria. The animals in experimental groups of six per group had sufficient quantities of the experimental diets and fresh water *ad libitum* on daily basis throughout the period of the experiment. Voluntary intakes were estimated as the difference in feed offered and the remnants collected daily. The animals were weighed weekly both for the four weeks of feed intake measurement and the one week of digestibility study.

Digestibility and Nitrogen Balance

Digestibility study was carried out by the total faecal and urine collection method. Six animals in each group were used. Each animal was kept in an individual metabolic cage designed for separate collection of faeces and urine for one week after a period of 5 days of adaptation to the cage environment. The refusals and faeces of each animal were collected daily and weighed using the method described by Onwuka (1983). Daily urine excreted by each animal was also collected; urine was kept and made acidic by addition of concentrated tetraoxosulphate (VI) acid (H_2SO_4) and little distilled water added, all in an attempt to inhibit microbial growth and guide against volatilization loss of nitrogen. Daily collections of faeces and urine were thoroughly mixed separately and a 10% sub-sample of each was taken. Samples of urine required for analysis were stored in a deep freezer and faecal samples oven dried at 70^0C for 2 days and stored.

Analytical Procedure

At the end of all collections, samples were bulked, mixed thoroughly and sub-samples of urine analyzed for nitrogen, while the faeces were analyzed for dry matter, nitrogen, ash, crude fibre, ether extract, nitrogen free extract, acid detergent fibre and neutral detergent fibre, respectively. Feed and faeces were analyzed for dry matter by oven drying at 105^0C for 24 hours. Dried samples of feed offered and faeces were milled with Christy Norris Hammer mill using a 2 mm sieve and then analyzed for nitrogen by the micro-Kjeldhal method. Dry matter, crude fibre, ether extract and ash were determined according to standard method (AOAC, 1995). Nitrogen free extract was obtained by simple deduction, while acid detergent fibre and neutral detergent fibre were determined by the methods of Van Soest and Robertson (1985) and Van Soest *et al.* (1991), respectively. Hemicellulose was obtained as the difference between nitrogen detergent fibre and acid detergent fibre. Nitrogen balance refers to the difference between nitrogen intake and faecal nitrogen added to urine nitrogen. Total nitrogen concentration of feed, ingredient used and faeces was determined with the aid of complete combustion nitrogen analyzer (CCNA). Sub-samples of urine collected were freeze, dried and later digested in a block digester with freshly prepared tetraoxosulphate (VI) acid and nitrogen concentration was then colorimetrically determined.

Statistical Analysis

Data collected so as to ascertain the effects of rations supplied were tested for statistical significance using the one-way analysis of variance (ANOVA) of SAS (2003) package. The treatment means were compared using the Duncan's Multiple Range Test (Duncan, 1985).

Results and Discussion

The proximate composition of both the cassava leaf silage and *Panicum maximum* used in feeding WAD goats and the chemical composition of the experimental diets are presented in Tables 2 and 3, while the effects of cassava leaf silage on feed intake, digestibility and nitrogen balance of the WAD goats are shown in Table 4.

Feed Intake, Apparent Digestibility and Nitrogen Balance

The average daily dry matter intake values by the animals on the various treatments during the voluntary feed intake measurement were 227.90 g/d, 227.50 g/d, 232.00 g/d and 214.00 g/d for animals in groups I to IV and details of these are presented in Table 4. Animals on diet III consumed the highest amount of dry matter while those on diet IV consumed the lowest dry matter. The differences among the four treatments were not significant ($p>0.05$). On metabolic weight ($kgBW^{0.75}$) basis, the mean dry matter intake (g/d) consumed by the animals were 57.10, 56.20, 57.50 and 52.80 for the animals on treatments I to IV, respectively. The treatment means were not significantly different ($p<0.0.5$).

The dry matter digestibility coefficients varied from 50.30% obtained for treatment IV to 67.20% obtained for treatment III. The level of cassava leaf silage significantly ($p<0.05$) influenced dry matter digestibility. The highest organic matter digestibility was recorded by animals on treatment III and the least was obtained on treatment IV with corresponding values of 67.90% and 52.10%, respectively. No significant difference ($p>0.05$) among treatments I, II and III, but organic matter digestibility for each of treatments I, II and III was significantly different ($p<0.05$) from treatment IV. The crude protein digestibility (CPD) of the various treatments was influenced significantly by the inclusion of cassava leaf silage, but CPD value for animals fed diets I, II and III were statistically similar. The highest crude protein digestibility was recorded for treatment II and the least for treatment IV despite the fact that it had the highest crude protein (nitrogen) content as a result of cassava leaf silage. The variations in the chemical composition of *Panicum maximum* as observed in this study differed slightly from what Abegunde (2008) recently reported for *Panicum maximum* used with WAD goats in Southwestern Nigeria.

There was significant difference ($p<0.05$) in the digestibility of nitrogen free extract and ether extract among the diets. The least nitrogen free extract digestibility was recorded for treatment IV while the ether extract of diet II was the least digested. The acid detergent fibre and neutral detergent fibre of treatment IV had the lowest digestibility of all the four treatments despite the fact that all the diets were close in acid detergent fibre and neutral detergent fibre composition. The digestibility of both acid detergent fibre and neutral detergent fibre was significantly ($p<0.05$) influenced by the treatments. Apart from animals on treatment III that showed disparity, the acid detergent and neutral detergent fibre digestibility can be said to decrease from treatments I-III. The least nitrogen free extract digestibility was recorded for treatment IV while the ether extract of diet II was the least digested. The acid detergent fibre and neutral detergent fibre of treatment IV had the lowest digestibility of all the four treatments despite the fact that all the diets were close in acid detergent fibre and neutral detergent fibre composition. The digestibility of both acid detergent fibre and neutral detergent fibre was significantly ($p<0.05$) influenced by the treatments.

Apart from animals on treatment III that showed disparity, the acid detergent and neutral detergent fibre digestibility can be said to decrease from treatments I-III. This implies that the fibre in cassava leaf silage is not readily degraded in the rumen of goats (Akinsoyinu, 1974). The age of the cassava foliage (leaves) used in preparing the CLS in this study was about a year old and may be responsible for this observation. The digestibility coefficient of hemicellulose increased significantly ($p<0.05$) with inclusion level of cassava leaf silage in the diets up to 40%. However, the range of value for this parameter was from 49.50 to 80.80% (Table 4).

The nutritional benefits of cassava leaf silage as a supplement to *Panicum* in the diets of goats was very evident in its influence on the digestibility of hemicellulose. Animals on the various treatments in this study showed positive nitrogen balance, a phenomenon of this nature for goats fed with Panicum had been reported by Abegunde (2008).

Table 2. Proximate composition of the cassava leaf silage and *Panicum maximum* used in feeding West African Dwarf goats in this study

Components	Cassava leaf silage	*Panicum maximum*
Dry matter	30.75	42.70
Organic matter	91.40	89.30
Crude protein	31.90	10.16
Crude fibre	31.30	35.90
Ash	8.60	10.70
Ether extract	8.40	1.80
Nitrogen free extract	19.80	41.00
Neutral detergent fibre	58.70	61.80
Acid detergent fibre	51.00	45.00
Hemicellulose	7.70	16.80

Table 3. The chemical composition of the experimental diets (g/100 gDM)

Parameter	Diets			
	I	II	III	IV
Dry matter	42.70	40.40	37.90	35.60
Organic matter	89.30	89.70	90.20	90.60
Crude protein	10.16	14.51	18.86	23.20
Nitrogen free extract	1.70	2.40	3.10	3.80
Ash	10.70	10.30	9.90	9.50
Ether extract	1.80	3.12	4.44	5.96
Crude fibre	35.90	34.98	34.06	33.14
Neutral detergent fibre	61.80	61.20	60.60	60.00
Acid detergent fibre	45.00	46.20	47.40	48.60
Hemicellulose	16.80	15.00	13.20	11.40

Table 4. Effects of cassava leaf silage on feed intake, digestibility and nitrogen balance of WAD goats

	Diets				
Parameter	I	II	III	IV	S.E.
Feed intake g/kg LW	227.90	227.50	232.00	214.00	8.77
Feed intake g/$BW^{o.75}$	57.10	56.20	57.50	52.80	3.54
N-intake g/d	4.20	4.80	10.40	9.50	1.67
Apparent digestibility (%)					
Dry matter	63.70b	64.50b	67.20a	50.30c	1.72
Crude protein	74.00a	74.60a	72.80a	55.70b	1.13
Ether extract	41.50d	63.80b	67.00a	49.50c	2.31
Nitrogen free extract	63.50b	61.30c	67.00a	49.50d	1.34
Organic matter	67.80a	66.70b	67.90a	52.10c	1.69
Acid detergent fibre	74.20a	59.40c	65.20b	50.60d	1.42
Neutral detergent fibre	67.60a	60.50b	68.60a	55.30c	1.07
Hemicellulose	49.50d	61.40c	80.80a	75.40b	1.39
Nitrogen balance g/d	3.20c	3.40c	7.30a	5.10b	0.41
Nitrogen absorption g/d	3.30c	3.60c	7.60a	5.40b	0.41
Nitrogen retention (%)	97.00a	94.40c	94.70c	96.30b	0.64

*Means with the same letters on horizontal rows are not significantly different at 5% or 1% level,
**Means without letters are not significantly different at 5%.

The nitrogen balance and nitrogen absorption, but not the percentage nitrogen retention was significantly influenced by the diets. The nitrogen balance values showed an increasing trend with increased level of inclusion of cassava leaf silage up to 40% in the diets. Treatment III with 40% inclusion level of cassava leaf silage gave the highest value of 7.30 g/d and this differs significantly ($p<0.05$) from what was obtained in treatments I, II and IV. Animals on diet III absorbed and retained the highest amount of nitrogen. This may be due to a better balance of nutrients particularly nitrogen from cassava leaf silage and carbohydrate from *Panicum*. The values of nitrogen balance recorded in this study were higher than those earlier reported by Oginni (1989) who obtained a range of 0.48 to 1.66 g/d. The range of values of 3.30 to 7.60 g/d was recorded for nitrogen absorption and 94.40 to 97.00% for nitrogen retention in this study. These values were higher than those reported by Oginni (1989). A range of 0.66 to 0.81 was reported for nitrogen retention when same author fed goats with Panicum-based diets supplemented with *Samanea saman* at 10, 20, 30 and 40% levels, respectively. The higher values obtained in this study may be due to higher nitrogen content of cassava leaf silage with 5.10% (that is 31.90% protein divided by a factor of 6.25) compared to *Samanea saman* with 2.40% nitrogen.

Conclusion

Although, the results of this study have not shown a significant influence of cassava leaf silage on dry matter intake of West African Dwarf goats, its influence on the digestibility of nutrients shows that it is possible to improve the nutrients utilization of *Panicum maximum*-based diets of goats by supplementing with cassava leaf silage. However, this study revealed that inclusion of cassava leaf silage beyond 40% level in the diets of goats based on *Panicum maximum* had no significant effect.

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