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SMALLHOLDER SHEEP FEEDING BASED ON DEFOLIATED CASSAVA AND MAIZE LEAVES

[ALIMENTACIÓN DE OVEJAS A PEQUEÑA ESCALA BASADO EN YUCA DEFOLIADA Y HOJAS DE MAIZ]

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SUMMARY

The recent surge in the production of cassava and maize in Nigeria has generated a surplus of leaves which if adequately utilized could alleviate the feed shortage problem encountered by smallholder in sheep production as a result of seasonal reduction in feed supply and reduced pasture quality. An experiment was conducted with West African Dwarf yearling rams to investigate the feeding value of defoliated cassava leaves (CL) and maize leaves (ML) at different ratios (CL/ML) in the diets; 100:0 (solely ML)**;** 25: 75**;** 50: 50; 75: 25**;** and 0:100 (solely CL)**.** The experiment that lasted for 105 days involved twenty (20) rams in a completely randomized design used to evaluate the dry matter (DM) intake, weight gain, nutrient digestibility and nitrogen utilization as well as the effect of the diets on the haematological profile of the rams. Results showed that DM intake and digestibility of nutrients were similar in the mixed forage diets and significantly ($P<0.05$) higher than that of the sole forage diets of cassava and maize. Live weight gain (g/day) peaked at the ratio 75%CL/25%ML diet with rams fed sole forage diets having significantly lower gain in weight. The intake of the CP increased significantly as the component of CL in the diet increased. The N balance (g/day) and retention (%) were also highest in the mixed forage diets and lowest in the solely ML diets. Blood parameters monitored were not affected by the experimental diets. It was concluded that DM intake, weight gain, nutrient digestibility and nitrogen utilization of sheep can be enhanced by feeding 75:25 (CL/ML) in the diet.

Keywords: Cassava leaves; digestibility; maize leaves; sheep; smallholder; weight gain

RESUMEN

El reciente incremento en la producción de yuca y maíz en Nigeria ha generado una fuente de hojas las cuales podrían aliviar el problema de escasez de alimento para los pequeños productores de ovejas. Se condujo un experimento con carneros enanos de África occidental de un año de edad para investigar el valor nutritivo de hojas defoliadas de yuca (CL) y hojas de maíz (ML) en diferentes raciones (CL/ML) en las dietas; 100:0 (únicamente ML); 25:75;50:50;75:25; y 0:100 (únicamente CL). El experimento duro 105 días, incluyó veinte (20) carneros en un diseño completamente al azar, se evaluó el consumo de materia seca (DM), la ganancia de peso, digestibilidad de los nutrientes y utilización del nitrógeno así como el efecto de las dietas sobre los perfiles hematológicos de los carneros. Los resultados mostraron que el consumo de DM y digestibilidad de los nutrientes fueron similares en los forrajes mezclados y significativamente ($P<0.05$) más altos que aquellos con dietas de solo yuca y de maíz. La ganancia de peso (g/día) fue mayor en las dietas de 75% CL/25%ML, los carneros alimentados con forraje solo tuvieron una disminución significativa en la ganancia de peso. El consumo de CP se incrementó significativamente con una mayor cantidad de CL en la dieta. El balance de N (g/día) y la retención (%) también fueron más altos en las dietas de forraje mezclado y más bajos en las dietas de únicamente ML. Los parámetros de sangre no fueron afectados por las dietas experimentales. Se concluye que el consumo de DM, la ganancia de peso, digestibilidad de los nutrientes y utilización del nitrógeno de las ovejas puede ser mejorada con una dieta de 75:25

Palabras clave: Hojas de yuca; digestibilidad; hojas de maíz; oveja, pequeños productores; ganancia de peso.

INTRODUCTION

Sheep production in Nigeria is a growing enterprise among smallholders that combine sheep husbandry with other agricultural and non-agricultural activities. The production of sheep is however limited among other factors by inadequacy of year round feed availability. The use of concentrate rations based on cereal grains or root crops as energy feeds and grain legumes have led to direct competition with man and industries for the same resources (Fasae and Alokan, 2006). This coupled with high cost of concentrate has guided to the search for non- competitive alternative feedstuffs (Olorunsomo, 2008).

The recent surge in the production of cassava and maize in Nigeria has generated a lot of leaves which are currently underutilized. These leaves are considered waste products in settled rural areas and they are readily available for smallholder and their use in agro-pastoral systems of the region. Their availability and abundance makes them a cheap source of nutrients especially dietary energy, protein and fermentable products for sheep production. This is because sheep can conveniently handle these fibrous wastes through microbial fermentation (Adebowale and Taiwo, 1996). Cassava and maize leaves have been found to be a valuable feed material for ruminants, meeting the nutritional requirement for growth, reproduction and maintenance of ruminants' year round (Semenye et al. 1994; Wanapat et al. 2000). In a previous study, Fasae et al. (2009a, b) assessed the effect of defoliation time on leaf yield of cassava (TMS 30572 variety) and maize (DMR-SR-L-Y variety) plants, they found that cassava and maize leaves can be defoliated after 5 and 3 months planting, respectively and fed to ruminants without adverse effect on the crop yield. Also, earlier reports presented by Muller (1977) and Wanapat et al. (1997) showed that cassava foliage could be harvested after 4 months planting to ensure high nutrient content and to avoid reduction in tuber yield while Abate and Abate (1994) reported that maize defoliated after 79 days can be a source of quality feed for ruminants. This however, shows the potential of defoliated cassava and maize leaves as available sources of nutrients for sheep production thereby addressing the major problem facing stockowners in Nigeria as a result of provision of adequate nutrition for sheep especially during the dry season.

This study therefore investigates the feed intake, weight gain, nutrient digestibility, nitrogen utilization and haematological profile of West African Dwarf sheep fed varying levels of defoliated cassava and maize leaves diets which are readily available feedstuffs among smallholders in Nigeria.

MATERIALS AND METHODS

Animals and management

The study was conducted in the small ruminant experimental unit of the Teaching and Research Farms, University of Agriculture, Abeokuta, Nigeria. Twenty West African Dwarf (WAD) yearling rams with average body weight of 15.25 kg were purchased from smallholder farmers in villages near to the University. Prior to the experiment, the rams were kept under inspection for 30 days. During this period they were vaccinated with broad spectrum Terramycin L.A. (1 ml/10 kg body weight) and dewormed with albendazole tablets (12.5 g/kg body weight) and diazintol solution (6 ml/Lt).

On arrival at the experimental site, the rams were housed individually in open sided well ventilated disinfected pens, with slatted floors to prevent direct contact with their faeces and urine. They were randomly allocated to 5 treatments of 4 rams each balanced for body weights. Rams were allowed to adapt to the experimental diets for two weeks before the beginning of the experiment.

Experimental diets preparation

Cassava leaves (CL) TMS30572 and maize leaves (ML) DMR-SR-L-Y were randomly defoliated during the late rainy season (October to November) from an established plot of an hectare each at 5 months and 12 weeks after planting, respectively as in Fasae et al., (2009a, b). Leaves were chopped by a cutlass into smaller parts of about 4cm and sun dried for 5 days. Animal feeding lasted 105days and 4% of the rams' body weight was fed and they had clean water *ad libitum*. . The rams were randomly assigned to the treatments of dehydrated CL and ML at different ratio (CL/ML) in the diets; 100:0 (solely ML)**;** 25: 75**;** 50: 50; 75: 25**;** and 0:100 (solely CL)**.** Each treatment was supplemented with 100g of concentrate composed of 40% wheat bran, 35% corn bran, 22% palm kernel cake, 2% bone meal, 0.5% common salt and 0.5% vitamin premix balanced for protein and energy requirements (NRC, 1975). Individual troughs were used for placing the feed and water.

Apparent digestibility and nitrogen balance trials

The rams were transferred immediately after the growth trial into individual metabolic crates which allowed collection of total faecal and urine outputs. Each experiment consists of a 7-day dietary adjustment period followed by a 7-day balance trial. The feed was offered to the animals twice daily at 9 a.m. and 2 p.m., respectively. The quantity of feed offered and refusal, faeces and urine were determined

for each sheep in the last 7 days of the trial. Nitrogen loss by volatilization was prevented by introducing 15 ml of 10% H_2SO_4 into urine collection container. Samples collected were pooled over a 7- day period, and then frozen until subsequent laboratory analysis.
5 ml of blood samples were collected in ethylenediamine tetracetic acid bottles from each ram used at the beginning and end of the experiment. Blood samples were obtained from jugular vein (Shewati and Dagash, 1994) to determine the effect of the diets on the blood cells. Blood samples were taken to the laboratory to determine the packed cell volume, red blood cells, White blood cells, glucose, blood urea nitrogen, total protein (Lamb 1991; Davice and Lewis, 1991).

Chemical Analyses

The chemical compositions of the leaves and faecal samples as well as nitrogen in urine were determined following the methods described in AOAC (1990). The DM was determined by oven drying at 100^0C for 24 hours, Crude protein by Kjedhal method and fat by Soxhlet fat analysis. The concentration of neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin both in feed and faecal samples were also determined by the method of Van Soest et al. (1991). The hydrocyanic (HCN) content of cassava leaves in feed and faeces were also determined as described by Bradbury et al. (1999). Analyses of tannins were carried out by methods described in Makkar et al. (1993).

Data Analysis

Data collected from parameters investigated were based on completely randomized design and subjected to one way analysis of variance using the statistical package (SAS, 1999). Significant means were separated using Duncan Multiple Range Test (Duncan, 1955).

RESULTS

The DM content of the sole and mixed forages of cassava and maize leaves was similar across the treatments. The CP content of the diets differs across the treatments with an increase with the inclusion of cassava leaves in the diets (Table 1). The NDF content was higher in ML relative to CL while ADF and ADL contents were lower in ML compared the CL. HCN and tannins were not detected in ML sole diet. The CL sole diet was richer in calcium compared to ML while phosphorus content was vice versa.

Table 1. Chemical composition (g/Kg DM) of cassava and maize leaves based diets fed to West African Dwarf sheep.

	Diets					
Composition	0%CL	25%CL	50%CL	75%CL	100%CL	Conc.
Dry matter	908.2	903.4	910.0	912.1	909.1	84.24
Crude protein	118.5	147.0	160.8	181.4	205.0	167.2
Neutral Detergent Fibre	645.6	609.1	571.1	550.7	527.6	296.2
Acid Detergent Fibre	404.0	394.4	381.1	357.3	344.0	412.4
Acid Detergent Lignin	72.0	70.3	68.3	65.1	62.4	31.4
Energy (MJ/kg DM)	14.9	15.6	14.9	16.2	17.2	17.9
Hydrocyanic acid (Mg/kg)	0.00	11.1	16.3	19.8	22.4	0.00
Tannin	0.00	1.0	1.4	1.6	1.8	nd
Calcium	5.0	6.3	7.8	10.1	13.4	nd
Phosphorus	4.0	3.9	3.3	2.9	2.3	nd

[MH] Maize hay [CH] Cassava hay [Conc.] Concentrate [nd] Not determined

The DM intake was highest (P < 0.05) in 75:25 (CL/ML) diets which ranks the same statistically with other mixed forage diets, compared the sole forage diets of cassava and maize (Table 2). The intake of the CP increased (P < 0.05) with an increase in the level of CL in the diet while the average DM intake for concentrate diets which was all consumed was 84.2g/day in all the treatments. The live weight gain (g/day) in rams fed mixed forage diets was significantly (P < 0.05) higher compared to those fed sole cassava and maize forage. The feed conversion ratio was statistically similar (P > 0.05) in all the treatments.

The DM and CP digestibilities varied significantly (P < 0.05) across the treatments with the mixed forages having the highest (P < 0.05) compared to the sole diets (Table 3). The DM digestibility was least in 0%CL diet and highest (P < 0.05) in the mixed forage diets. The NDF digestibility coefficient varied (P < 0.05) across the treatments. Significant differences (P > 0.05) was not observed in the ADF and ADL digestibilities.

Table 2. Performance indices of West African Dwarf sheep fed cassava and maize leaves based diets.

	Diets					
Parameters	0%CL	25%CL	50%CL	75%CL	100%CL	SEM
DM Intake (g/Kg DM/day)						
Cassava leaves	-	1244.1	2382.2	3868.0	4599.1	
Maize leaves	4265.2	3577.0	2589.1	1342.3	-	
Concentrate	842.4	842.4	842.4	842.4	842.4	
Total	5107.6^{b}	5663.5^{ab}	5813.7^{ab}	6052.7^{a}	5441.5^{b}	33.50
Live weight gain (g/day)	38.8^{c}	44.5^{b}	46.4^{ab}	47.9^{ab}	41.6^{c}	1.51
LW gain (g DM/$W^{0.75}$/day)	62.5^{b}	68.4^{a}	68.3^{a}	67.2^{a}	61.0^{c}	1.89
Feed conversion ratio	13.1	12.7	12.5	12.6	13.1	0.82

Table 3. Digestibility coefficients (g/Kg DM) of major nutrients of the experimental diets fed to West African Dwarf sheep.

	Diets					
Parameters	0%CL	25%CL	50%CL	75%CL	100%CL	SEM
Dry matter	614.4^{c}	675.6^{ab}	716.4^{a}	742.2^{a}	649.1^{b}	19.8
Crude protein	634.4^{b}	691.4^{a}	712.4^{a}	718.1^{a}	649.7^{b}	16.3
Neutral detergent fibre	635.5^{b}	665.0^{ab}	696.1^{a}	723.5^{a}	633.2^{b}	6.79
Acid detergent fibre	649.1	673.5	698.1	719.5	659.0	6.17
Acid detergent lignin	496.3	531.8	540.4	565.7	531.5	8.32

Mean values in the same row with the same superscripts are not significantly (P > 0.05) different.

The nitrogen intake in rams increased (P<0.05) with increase in the level of CL in the diets (Table 4). The faecal and urinary N excretions varied among treatments with the excretions from sheep fed sole CL and 75:25 (CL/ML) having significantly (P < 0.05) higher levels compared to the other treatments. The N balance was least (P < 0.05) in 0%CL diets and highest (P < 0.05) in sole CL and 75:25 (CL/ML) diets. However, the N retention values were highest (P < 0.05) for mixed forage diets than the sole diets of cassava and maize.

The ranges and mean values for the hematological parameters of the experimental sheep prior and after the experiment are presented in Table 5. The results indicate that the experimental diets did not have significant (P > 0.05) effect on the blood parameters of the animals.

DISCUSSION

The CP contents of CL and ML suggests that they contain nutritional characteristics that can support sheep production as they were higher than the minimum range of 11% of CP recommended for growing sheep by Gatenby, (2002). They are therefore adequate for meeting the protein requirement for growing sheep thereby generating a high level of ammonia in the rumen to ensure an efficient digestion process (Orskov, 1995). The NDF contents were close to 60% which is considered safe for acceptable intakes of forage in ruminants (Messiner et al., 1991). The ADF and lignin contents were however lower than the majority of the Nigerian browse as reported by Onwuka et al. (1989).

The HCN and tannin contents of CL are lower than 50mg/kgDM and 4%, respectively recommended as a safety level for animals (Becker, 1997 and Phuc et al., 2000). Tannins above 4% of DM inhibit microbial activity and depress voluntary intake (Neptana et al., 2001). The calcium and phosphorus contents of both CL and ML appeared adequate for ruminant animals based on recommended by Puls (1994).

Table 5. Hematological parameters of West African Dwarf sheep prior and after feeding cassava and maize leaves based diets.

Parameters	Diets						
	RPE	0%CL	25%CL	50%CL	75%CL	100%CL	SEM
Packed cell volume (%)	22.4-36.7	29.5	27.1	30.5	32.0	31.5	2.20
Red blood cells ($x10^2L$)	2.3- 4.5	2.8	2.8	3.0	3.1	2.9	0.83
White blood cells ($x10^9L$)	5.9-6.7	6.4	6.2	6.6	6.6	6.4	1.10
Glucose (mmol/L)	2.1-3.3	2.9	2.6	3.1	3.2	2.9	0.68
Blood urea N (mmol/L)	3.4-5.7	3.9	3.7	4.2	4.3	3.7	0.94
Total protein (g/dl)	35.3-57.8	44.3	41.0	45.6	45.5	44.3	5.11

Mean values in the same row are not significantly different (P > 0.05)
RPE Range prior to experiment.

The range for sheep intake compares favorably with 556.4 to 582.1g/day reported by Olateru and Adegbola (2001) for Yankasa sheep with an average weight of 18 kg fed sorghum stover. The concentrates fed to the rams would have increased the feeding value of the entire diet by addition of energy over and above that supplied by the leaves. Mpairwe et al. (2003) observed that providing supplements with adequate CP to ruminants has promoted DMI, rumen degradation and nutrient flow to the small intestine and culminated in higher animal performance.

The higher feed intake observed in rams fed mixed forage diets compared to the sole forage diets of CL and ML could be as a result of interaction within the diets. This supports the findings of Lamidi et al. (1998) who reported higher feed intake by sheep fed mixture of *Ficus thonningia* leaves with *Hyparrhenia spp* leaves compared to sole leaves. Moreover, the low feed intake observed for rams on 100%CL with sole cassava leaves despite the highest dietary CP content however, confirms the reports of Adu and Osinowo (1985) that DMI was significantly lower in diets containing 20% CP compared to those containing lower values when fed to lambs. The least DMI reported for rams fed with diet containing zero

level of cassava leaves (100%ML) could be attributable to the lower CP level of maize leaves compared to the other diets with the inclusion of varying levels of cassava leaves which supports the findings of Muniga *et al.* (1992) where inclusion of browse with high protein content in sheep's diet increased DM intake.

In the present study, all the rams fed the experimental diets gained weight, which confirms the reports of Devendra and Mcleroy (1982) that a CP of 11% is adequate for normal weight gain of sheep and goats. The variation observed in the daily gain in weight (g/day) of the rams could be attributed to the variation in the nutrient utilization by each animal from the diets. The observed weight gain of the experimental animals across the treatments could suggest the ability of the leaves coupled with the concentrate supplement to provide sufficient nitrogen and energy which ensure optimal microbial growth in the rumen.

The digestibility of nutrients in this study was generally high but highest in CL and ML forage mixtures which may imply that weight gain in rams was boosted by good DMI. The DM and CP digestibility seemed to be better digested at high levels of CL supplementation to ML. The NDF and ADF digestibility values fall within the range reported by Oduguwa et al. (2006) reported for the same breed of sheep fed forages with concentrate. The tannin content in CL seems not to have any adverse effect on the performance of the animals; it may even be responsible for the enhanced efficiency of utilizing the CP of the CL by sheep.

Moreover, the non-significant difference observed for FCR across the treatments implies equal efficient utilization of the animals in body tissue formation. The higher values obtained for FCR in this study could be as a result of the effect of the use of by products on these animals, which may not have allowed a very high growth performance. This is in consonance with the reports of Alkoriet et al. (2007) for Djallonke sheep fed cotton seed husks with *Panicum maximum* and cotton seed with 40 and 50% animal feed supplementation. However, lower values for FCR of 8 to 11 were observed by Wildeus et al. (2007) with hair sheep fed 100 % alfalfa hay and Hue et al. (2008) with lambs fed urea treated rice straw and molasses with different forage species.

The intake, faecal and urinary excretions of nitrogen was significantly affected by the dietary CP. This contradicts the reports of Rodehutscord and Preffer (1996) that faecal and urinary excretion of N in sheep was not significantly affected by dietary CP concentration. All animals were in positive nitrogen balance, an indication that the rams received adequate amounts of nitrogen from the diets fed which is a reflection of the potential of the leaves to enhance nitrogen utilization (Osakwe, 2006) and high digestibility of nutrients in the diets (Kawas et al. 2007).

The concentration of blood components of sheep was used in this study to monitor nutrient status between the treatments. The range of the hematological constituents of the rams before the commencement of the feeding trials were taken to serve as reference range for animals fed the experimental diets and to distinguish between the levels of the effect of each treatment on the animals. Values observed were within the normal range for sheep (Meyer and Harvey, 1998). These shows there were no appreciable effects of feeding this leaves on the blood profile of the experimental sheep. This reflects an efficient feed utilization that resulted in a stable energy and protein status of the animals.

CONCLUSION

Cassava leaves can be fed in mixture with maize leaves and can be used in diet mixtures of up to 75% of DM fed. This will improve feed intake, nutrient digestibility and N utilization leading to a better weight gain of sheep. Therefore, cassava and maize leaves which are otherwise waste materials can be converted to hay and used in seasons when grass forage supply is scarce especially in smallholder sheep production system.

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