

Intake and Digestibility of West African Dwarf Bucks Fed Cassava Leaf-Maize Offal Based Diets

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Abstract: Four bucks of the West African Dwarf (WAD) breed weighing between 8-10 kg and aged 6-8 months were housed separately in metabolism crates and fed cassava leaf-maize offal based diets. The diets, A, B, C and D containing 0, 10, 20 and 30% cassava leaf meal, respectively were formulated with Crude Protein (CP%) and gross energy (MJ kg⁻¹ DM) compositions of 6.91, 1.80, 9.10, 1.65, 10.0, 1.70 and 10.85, 1.75. The diets were consecutively fed to each animal in 4 phases of 28 days each in a 4×4 latin square arrangement. Parameters taken were weekly body weights and daily feed intake for each animal. Dry Matter Intake (DMI), nutrient digestibility and nitrogen balance status of each animal was also computed. Results showed that there were significant ($p < 0.05$) variations in DMI of animals fed different dietary treatments. The values were 456.43, 343.44, 373.26 and 357.35 g day⁻¹ for diets A, B, C and D, respectively. Nitrogen intake (g day⁻¹), faecal nitrogen and retained nitrogen (g day⁻¹) also differed significantly ($p < 0.05$) among diets, the corresponding values were 5.05, 1.51, 1.86 (A); 5.0, 2.36, 0.19 (B); 6.05, 2.71, 0.89 (c) and 6.20, 3.35, 0.10 (D) for the respective diets. Nitrogen in urine (g day⁻¹) was similar ($p > 0.05$) for all treatments and so also were N-absorbed (%) and apparent-N digestibility (%). Nutrient digestibility coefficients (%) for dry matter, ether extract Crude Protein (CP), Crude Fibre (CF), Nitrogen Free Extract (NFE), ash and Gross Energy (GE) were not also influenced ($p > 0.05$) by diets. All diets however, promoted positive nitrogen balance in the experimental animals.

Key words: Dry matter intake, nutrient digestibility, faecal nitrogen, urinary nitrogen, animal, Nigeria

INTRODUCTION

Feed shortage poses a major constraint to goat production in Nigeria. Even where fodder resources abound, seasonal fluctuations in nutritive value make sustainable gains in production from good management and disease controlled programs, unrealistic (Alli-Balogun *et al.*, 2003). Stemming from the above however, is the perpetual shortage and eventual hike in the price of goat meat, which also had contributed to the present low animal protein consumption (15 g day⁻¹) by Nigerians (FAO, 1980). Efforts to improve animal protein intake in Nigeria must first address the perennial shortage of feed and dry season scarcity of fodder for the ruminant livestock.

Recent attempts at providing sustainable feed for goat production in Nigeria have concentrated on the use of crop residues, browse plants and some industrial by-products because of their relative abundance during the dry season (Alhassan, 1985; Agishi, 1985). There are however, limitations associated with the use of these feedstuffs.

Crop residues may require physical or chemical treatments to enhance rumen microbial activity (Mohammed *et al.*, 1987; Nour, 1987). This is necessary to improve the utilization of the high fibrous-low carbohydrate residue (Dicon and Egah, 1987), however bulkiness, arising from low digestible nutrients, limit the intake of crop residues by ruminants (Jayasuriya, 1993). Browse plants on the other hand cannot solely sustain ruminant species for long period of drought or dry season owing to their relative tendency to deplete under pressure. Also, worrisome is the presence of anti-nutritional properties found in browse plants (Ibeawuchi *et al.*, 2002). Most industrial by-products also are either deficient in protein or energy and this naturally limit their utilization, solely, for livestock nutrition. A more practical step to increasing the efficiency of utilization of industrial by-products is by addition of protein or energy supplements, depending on which is limiting (Alli-Balogun *et al.*, 2003).

Maize offal is a by-product of maize processing. It contains about 2500 Kcal kg⁻¹ DM Metabolizable Energy (ME) and 10% CP (Pfizer, 2000). Its high fibre content

makes it easily utilizable by ruminants for production of energy (Houtert, 1993). Its feed value (CP) is however, low and therefore cannot be utilized solely for goat production unless when supplemented with a protein source. Cassava leaf is composed of leaves and small tender stems. It is also highly nutritious containing 17.8-34.8% CP (Tewe *et al.*, 1970; Smith, 1988; Alli-Balogun *et al.*, 2003). Limited use has been made of cassava leaf in goat feeding. If good harvesting technique is developed, cassava leaf meal has good potential as protein and vitamin supplement. Due to high demand for cassava in various forms and usage in Nigeria, there is enough cassava leaf for inclusion in goat diets (Balogopalan *et al.*, 1988). This advantage could be exploited to reduce cost of input in feed while addressing the seasonal fluctuations in feed supply. This will improve goat production and enhance animal protein supply.

This study therefore was designed to determine the intake and digestibility of maize offal based diet supplemented with cassava leaf meal by the West African Dwarf goat.

MATERIALS AND METHODS

Processing of cassava leaf meal: Cassava leaves (variety TMS 3055) from 12-14 month old plants were collected fresh after harvest of the (cassava) tubers from the cultivated plots belonging to the commercial Garri processing unit of the National Root Crop Research Institute (NRCRI), Umudike, Abia State, Nigeria. The lot was sun-dried for 2 days to about 10% moisture content before being milled and used in this study as dried Cassava Leaf Meal (CLM).

Experimental animals: Four WAD bucks averaging 9.00 kg (range 8.00-10.00 kg) in weight and aged 7-8 months were selected from the goat band of the Michael Okpara University of Agriculture, Umudike, Teaching and Research Farm. The animals were dewormed and purged of external parasites using Ferbendazole and Pfizona, respectively. Prior to the study, the animals were kept under zero grazing and supplemented with concentrate at 1.5% body weight dry matter consumption per animal per day.

Experimental design: The animals were transferred to and housed in separate metabolism cages provided with facilities for collection of faeces and urine separately. They were fed four experimental diets in a 4×4 latin square arrangement. The experimental diets designated A, B, C, D were formulated from maize offal, palm kernel cake, bone meal and common salt to contain 0, 10, 20 and 30%

Table 1: Constituents and proximate compositions of experimental diets

Ingredients (%)	Diets			
	A	B	C	D
Maize offal	83	73	63	0
Cassava leaf meal	0	10	20	30
Palm kernel cake	10	10	10	10
Bone meal	5	5	5	5
Salt	2	2	2	2
Total	100	100	100	100

cassava leaf meal (Table 1). Each animal received the experimental diets consecutively, in 4 phases. During phase 1, which lasted for 28 days, each animal received 1 kg of an assigned diet. Drinking water was freely provided per animal daily. Daily voluntary feed intake was also determined. Total faeces and urine voided by the experimental animals were collected in the last 7 days (22-28) of this initial phase. During phases 2-4, each animal was offered each of the remaining (3 experimental) diets in consecutive periods of 28 days each. The last 7 days in each of the respective phases were used as in phase 1 for total urine and faecal collection.

Leftovers of diets offered to goats were collected after 24 h, daily, then weighed and used to determine the voluntary intake. Samples of each diet were collected and used for Dry Matter (DM) determination and chemical composition analysis.

Total faeces were collected in the mornings before feeding and watering, during days 22-28 of each period. The faeces were weighed fresh, dried and bulked for each animal. A sub-sample from each animal was dried in forced draft oven at 100-1050°C for 48 h and used for DM determination. Another sample was dried at 600°C for 48-72 h for determination of proximate composition.

Total urine from each animal was collected daily in the morning before feeding and watering. The urine was trapped in a graduated transparent plastic container placed under each cage and to which 15 mL of 25% concentrated sulphuric acid had been added to curtail volatilization of ammonia from the urine. The total volume of urine output per animal was measured and about 10% of the daily outputs were saved in numbered plastic bottles and stored in a deep freezer at -50°C. At the end of each 7 day collection period, the samples collected were subjected to analysis.

Analytical procedure: All feed and faecal samples were analysed for proximate components using AOAC (1990) methods. Nitrogen in urine samples was also determined by AOAC (1990) methods. The data obtained in this study were subjected to analysis of variance (ANOVA) appropriate for a 4×4 latin square experiment (Steel and Torrie, 1980). Significant means were separated using Duncan (1955)'s Multiple Range Test.

RESULTS AND DISCUSSION

Experimental diets: The proximate composition of experimental diets offered to goats is presented in Table 2. The Dry Matter (DM) contents of the diets did not differ significantly ($p>0.05$) even though it tended to increase from A-D as percentage CLM in diets increased. Whereas CLM has been reported to contain high Crude Protein (CP) and Crude Fibre (CF) (Smith, 1988; Balogopalan *et al.*, 1988), increasing levels in the experimental diets (A-D) did not significantly influence ($p>0.05$) dietary compositions of CP and CF. The Ether Extract (EE), Nitrogen Free Extract (NFE) and Gross Energy (GE) values were however similar ($p>0.05$) for all treatments diets.

Apparent digestibility: The apparent nutrient digestibility coefficients for all the experimental diets are shown in Table 3. All the nutrients (DM, CP, CF, NFE, EE) including energy were digested to the same extent ($p>0.05$). The high digestibility values obtained for the nutrients in all the diets suggest that the CLM based diets and the control were highly degraded in the rumen. This observation collaborate the views of Smith (1988) and the findings of Ahamfele *et al.* (2000). Devendra (1981) also reported that goats tend to utilize CLM and CLM based diets better than sheep.

Nitrogen balance and protein utilization: The nitrogen balance and utilization values for goats fed CLM based

diets are shown in Table 4. Dry matter intake differed significantly ($p<0.05$) among treatments. There was significant depression in Dry Matter Intake (DMI) in goats fed each of the CLM based diets (B, C, D) relative to the control (A). The DM depression also significantly ($p<0.05$) influenced DM intake per metabolic size ($\text{g day}^{-0.75}$) as well as nitrogen intake (g day^{-1}), for all treatment groups. The significantly higher DMI observed for goats fed the control diet in this study does not agree with the findings of previous studies. Investigations have shown that low protein diets depress intake (Ifut, 1988) and that animals consuming low energy diets tend to consume more feed to meet their energy requirements (Obioha, 1984). Contrary to these facts, diet A, which had the least CP and the highest energy content of all diets was consumed most. Earlier observation (Obioha, 1985) show that intake in ruminants is also influenced by a taste related factor-palatability. Beyond nutritional composition, animals tend to consume more of palatable diet (Ibeawuchi *et al.*, 2002). Cassava leaf meal is not a very palatable feed ingredient probably due to its high fibre content. Increasing levels of CLM in diets B-D increased the CP content, as well as the non-palatable factor and this may explain why the CLM diets were consumed less in relation to the control in this study. Meanwhile, among the CLM diets, diet 3 may have yielded the best-synchronized release of nitrogen and carbohydrate (Silva and Orskov, 1985) in the rumen required for microbial protein synthesis. This may have influenced the observed superior DMI for goats on diet C and the observed poor but relatively higher nitrogen utilization value for animals fed same diet (C).

Nitrogen intake (g day^{-1}) from the 10% CLM diet (B) compared fairly well with the value derived for the control diet but differed significantly ($p<0.05$) from those of diets C and D. The implication of this is that addition of CLM in goat diets at levels below 10% will not improve nitrogen intake. At higher levels however, nitrogen intake will improve but would be optimal at 20% CLM inclusion. CLM is a good source of nitrogen, which can be used to improve low protein-high energy feedstuffs²⁰. Its high fibre content makes it a good source of roughage for ruminants (Khajaree *et al.*, 1977).

Faecal nitrogen differed significantly ($p<0.05$) among treatment diets. The values obtained for goats fed CLM diets (B, C, D) were the similar ($p>0.05$) and differed significantly ($p<0.05$) only from those of goats fed the control diet.

This observation runs contrary to the findings of Black *et al.* (1973), who reported that faecal nitrogen was not affected by nitrogen intake. The significant faecal-N values observed for CLM diets may be associated with high quantity of faecal-N excreted in the goats fed CLM diets. Alli-Balogun *et al.* (2003)

Table 2: The proximate composition of the experimental diets

Proximate components	Diets			
	A	B	C	D
Dry matter	94.40	88.40	92.10	95.00
Crude protein	6.91	9.10	10.00	10.85
Crude fibre	17.25	15.25	16.70	17.75
Ether extract	6.45	4.00	4.25	4.52
Ash	40.25	4.25	6.00	6.50
Nitrogen free extract	59.54	55.80	55.15	55.38
Gross energy (Mj kg DM^{-1})	1.80	1.65	1.70	1.75

Table 3: Apparent digestibility coefficients of WAD goats fed maize offal based-cassava leaf diets

Nutrients (%)	Diets				SEM
	A	B	C	D	
Dry matter	72.50	59.20	55.50	66.90	6.36
Crude protein	73.00	84.90	79.60	71.90	5.36
Crude fibre	67.80	65.60	66.70	65.20	4.43
Ether extract	96.70	54.00	67.00	73.30	5.61
Ash	63.90	64.20	66.40	57.90	4.42
Nitrogen free extract	55.10	55.10	52.80	59.30	2.61
Gross energy	72.00	63.70	67.40	69.00	2.87

SEM = Standard error of the mean

Table 4: Nitrogen balance and utilization values for WAD goats fed maize offal based-cassava leaf diets

Parameters	Diets				SEM
	A	B	C	D	
Average live weight (kg)	8.50	10.00	8.00	8.00	0.78
Av. live weight (g day ⁻¹ Wkg ^{0.75})	4.98	5.62	4.76	4.76	0.55
DMI (g day ⁻¹)	456.43 ^a	343.44 ^b	378.26 ^b	357.35 ^b	19.80
DMI (g day ⁻¹ Wkg ^{0.75})	98.52 ^a	79.48 ^b	85.88 ^b	82.13 ^b	3.30
Nitrogen intake (g day ⁻¹)	5.05 ^b	5.00 ^b	6.05 ^a	6.20 ^a	0.25
Faecal-N	1.51 ^b	2.39 ^{ab}	2.71 ^{ab}	3.35 ^a	0.35
Urinary-N	1.68	2.42	2.42	2.75	0.42
Retained-N	1.86 ^a	0.19 ^c	0.89 ^b	0.10 ^c	0.47
N-Absorbed (%)	52.54	34.87	26.65	28.90	3.51
N-Retained (%)	36.83 ^a	3.80 ^c	14.71 ^b	1.61 ^c	9.33
N-Balance (g day ⁻¹ Wkg ^{0.75})	0.37	0.03	0.19	0.02	0.10
N-Absorbed (g day ⁻¹ Wkg ^{0.75})	0.71	0.46	0.70	0.60	0.09
Apparent-N digestibility (%)	70.10	52.20	55.21	45.67	6.75

^{a-c}Means on the same row with different superscripts differ significantly (p<0.05); DMI = Dry Matter Intake

reported similar findings, when they fed CLM diets to sheep. Urinary nitrogen (g day⁻¹) values were higher for goats fed CLM diets the differences were however, not significant (p>0.05), when compared with the control. The non-significant urinary nitrogen values may be due to the generally low nitrogen ingestion by goats for all diets. Urinary nitrogen is a function of nitrogen ingested, the more the N intake, the more the quantity excreted in the urine (Ibeawuchi *et al.*, 1993).

Nitrogen retained (g day⁻¹) was higher in goats fed the control diet than those fed CLM diets. These values differed significantly (p<0.05). Though all the diets promoted positive nitrogen balance, more nitrogen was lost absolutely in the urine and faeces of goats fed CLM diets than the control suggesting therefore that nitrogen retention in the goats fed maize offal-CLM based diets was poor. This notwithstanding, the best relative performance was observed in goats fed 20% CLM diet. Alli-Balogun *et al.* (2003) collaborated this finding, when they fed cassava foliage to sheep and observed high faecal and urinary nitrogen, which also led to poor nitrogen retention among the experimental animals. This finding calls for serious consideration by animal nutritionists, when formulating CLM based diets for ruminants.

The positive nitrogen balance observed in all treatment groups suggest that the nitrogen absorbed, which is the difference between nitrogen intake and faecal nitrogen was well tolerated and utilized by the animals. The present results showed that N-absorbed (%), N-retained (%) and urinary-N output (g day⁻¹) did not differ in WAD goats fed CLM based diets. The findings of Ahamefule *et al.* (2000) also support this view. In a recent study (Ahamefule, 2005) however, significant (p<0.05) urinary-N output in WAD goats fed pigeon pea-cassava peel based diets was reported. The peel and not the leaf may be responsible for the variations in the results observed.

Apparent-N digestibility values also did not differ significantly (p>0.05) among treatment diets. Except for diet B, the values tended to decrease for A-D as nitrogen intake increased. This observation collaborate the views of McDonald *et al.* (1995), who reported that digestibility is negatively correlated to intake. This implies that low N-intake would naturally provoke greater retention time for N in the rumen allowing for effective utilization of the substrate for microbial protein synthesis and which subsequently would lead to high digestibility value. The converse is also true.

CONCLUSION

In conclusion, cassava leaves in maize offal based diets generally depressed intake in goats. Nitrogen retention was also generally poor in goats fed the CLM diets. Nevertheless, maximum N-retention was observed at 20% CLM inclusion.

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