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Nutrient Intake and Digestibility of West African Dwarf Bucks Fed Cassava Peel-Cassava Leaf Meal Based Diets in South Eastern Nigeria

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Abstract: Four West African Dwarf (WAD) bucks averaging 8.0 kg and aged 6-8 months were used to determine the intake and digestibility of cassava peel-cassava leaf meal based diets. The four diets (A, B, C and D) were formulated to contain cassava peel, palm kernel cake, brewers' dried grain, bone meal, soya bean meal, common salt and 0, 10, 20 and 30% cassava leaf meal respectively. The diets were assigned individually to the four animals in metabolism cages in a 4x4 Latin square design experiment. Feed intake, Dry Matter Intake (DMI), nutrient digestibility and the nitrogen balance status of each animal were measured. The dry matter intake, faecal-N, absorbed-N and N-balance values increased in the goats as the N-intake increased. The apparent N-digestibility did not follow any definite pattern. The faecal-N values differed significantly ($p<0.05$). These values were 2.53, 3.95, 3.12 and 3.15 g/d for diets A,B,C and D respectively. The digestibility coefficients of DM, CP and EE did not differ significantly ($p>0.05$) while those of CF, NFE and energy differed significantly ($p<0.05$) among experimental animal. The Metabolic Faecal Nitrogen (MFN) (g/100 gDM), Endogenous Urinary Nitrogen (EUN) (g/day/Wkg$^{0.75}$) and Digestibility Crude Protein (DCP) (g/day/Wkg $^{0.75}$) values for maintenance were 0.25, 0.1420, 0.89; 0.26, 0.0279, 1.79; 0.32, 0.0232, 1.09 and 0.30, 0.0301, 2.01 respectively for diets A, B, C and D. All the diets promNoted positive N-balance. The cassava leaf meal fed diets required 1.81 times as much DCP yielded 1.17 times as much MFN and 0.19 times as much EUN as the control animals for maintenance.

Key words: Daily feed intake, total nitrogen intake, faecal-N, Retained-N, Apparent-N digestibility and positive nitrogen balance

INTRODUCTION

Protein inadequacy in the diets of most people in a developing country like Nigeria has been a major concern to animal scientists. The current level of consumption of meat and animal protein is estimated at 8g per caput per day (Ndubuisi, 1992). The average daily consumption of 54 g of protein with 6.5 g from animal sources fall below the recommended daily protein intake of 86 g and 34 g of animal protein (Ejiofor, 1998). The low nitrogen content of dry season fodder usually confer severe nutritional stress on ruminants. The dry season results in a rapid decline in the quantity and quality of forages leading to low forage intake and digestibility with resultant poor animal performances. It has been reported (Adegbola, 2002) that poor quality roughages fed to ruminants without supplementation during the dry season caused considerable weight losses and finally the death of the animal. The prices of conventional sources of protein in livestock ration have risen exorbitantly (Akinmutimi, 2004) and this has necessitated the search for cheap alternative feed materials that can meet nutritional requirements of farm animals. Again these alternative feed materials should not be in high demands by humans and should be cheap (Amaefule, 2002). Cassava leaf has high protein content (16.7-39.90%) (Yousuf *et al.*, 2007) with almost 85% of the crude protein as true protein (Ravindran, 1991). This is due to the presence of tannins which form tannin-protein complex that bypass the rumen (Wanapat *et al.*, 1997). Cassava peel is also rich in metabolizable energy and very well degraded in the rumen (Smith, 1988).

This study is therefore aimed at evaluating the nutrient intake and digestibility of West African Dwarf bucks fed cassava peel-cassava leaf meal based diets.

MATERIALS AND METHODS

Experimental site: The study was conducted in the research and teaching farm of Michael Okpara university of Agriculture, Umudike in Abia State of Nigeria on Latitude 05^{o} 28^{1} north, Longitude 07^{o} 31^{1} East and at an altitude of 122 m above seal level. It falls within the rainforest zone of West Africa characterized by long duration of rainfall (7-9 months) and short period of dry season. Average rainfall is 2169 mm in 148-155 rain days while average ambient temperature is 26^{o}C with maximum and minimum of 32^{o}C and 22^{o}C respectively. Relative humidity ranges from 50-95%.

The cassava peels used for the trials were collected after harvesting the cassava tubers from the processing unit of the National Root Crop Research Institute, Umudike. The fresh cassava peels were sun-dried on a concrete floor for 3-5days depending on the intensity of the sun. The sun-dried cassava peels were then milled and bagged in sacks. The cassava leaves were collected from the cassava plantation of the National Root Crops Research Institute, Umudike. The cassava leaves were sun-dried on a concrete floor for 3 days. The dried leaves were milled and bagged in sacks for feed formulation as in Table 1.

Digestibility studies: Four West African Dwarf Bucks averaging 8.0 kg (7.0 kg-9.0 kg) in weight and aged 6-8 months were purchased from a nearby village. The animals were quarantined during which they were vaccinated against PPR, dewormed against endoparasites and sprayed against ectoparasites with appropriate acaricides. Each of the animals was assigned to one of the four experimental diets (Table 1) in a 4 x 4 Latin square design and subsequently housed individually in previously disinfected metabolism cages and fed in 4 periods. There was a 14-day preliminary feeding phase. Each animal received 1 kg of one of the four experimental diets for 28 days. Drinking water was provided *ad libitum* to the animals. Daily feed intake was determined. Total faeces and urine voided by the animals were collected during the last 7 days in periods 2-4, each animal was offered each of the remaining three experimental diets in rotation of 28 days each. Faeces and urine voided were collected in the morning before feeding and watering. The faeces were weighed fresh, dried and bulked for each animal. A representative faecal sample from each animal was dried in forced draft oven at 100-105^{o}C for 48 h and used for DM determination. Another sample was dried for 48-72 h for determination of proximate composition. Urine volumes were measured immediately after collection and 10% of the daily out put saved. Each urine collecting bucket contained 5 ml concentrated sulphuric acid. The daily samples of urine for each animal were bulked and stored in a freezer at 0^{o}C until required for analysis.

Analytical procedure: All feed and faecal samples were analyzed for proximate components usually AOAC (1990) method. Nitrogen in urine sample was also determined by AOAC (1990) methods.

Statistical analysis: The data obtained were subjected to analysis of variance (ANOVA) applicable to a 4x4 Latin Square Experiment (Steel and Torrie, 1980). Where ANOVA detected significant treatment effects, difference among treatment means were determined by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The proximate constituents of the experimental diets, the cassava peels and the cassava leaf meal used in this study are shown in Table 1. The proximate values for the cassava peel fell within the range reported by Ifut (1988) and Ahamefule *et al.* (2000). The dry matter percent was similar for diets A and B and tended to increase as the levels of inclusion of cassava leaf meal increased from diets A to D. The crude protein was highest in diet D and lowest in diet A. The crude fibre contents were declining with increase in cassava leaf meal levels. The ether extract, ash and energy values increased from diets A to D while the nitrogen-free extract values did not show any consistent trend among the diets.

The dry matter, nutrient intake and digestibility of WAD goats fed cassava peels-cassava leaf meal based diets are summarized in Table 2. The least (Dry Matter Intake) DMI was recorded by the goats on diet A (291.55 g/d), the control diet. The highest DMI was recorded by goats on diet D (313.42g/d) followed by those on diet C (310.03 g/d) and diet B (305.89 g/d).

This is in line with the reported inverse relationship existing between DMI and Fibre content of feed (Reid and Kloptentstein, 1983). Diet D with the least crude fibre content recorded the highest DMI. This tends to suggest that with the decreasing levels of crude fibre contents, palatability increased. The faecal nitrogen increased from diets A to D. The values were significantly different ($p<0.05$).The faecal nitrogen increased with nitrogen ingestion as reported by McDonald *et al.* (1995). The N-balance (g/d) values were also higher for the CLM containing diets when compared with the control. The values were 1.27, 1.57, 1.99 and 1.97 for diets A to D respectively. The values were all positive indicating that the maintenance requirements of the experimental animals were adequately met by the rations consumed.

Faecal nitrogen (g/d) was correlated with N- intake (g/d) as shown in Table 3.

The coefficients of correlation (r) were 0.843, 0.099, 0.606 and 0.736 for diets A to D respectively. The correlation coefficient was highest for diet A, lowest for diet B and tended to increase as the percentage of cassava leaf meal in diet C and D increased. The intercept on the Y-axis gave the nitrogen excreted in faeces for each diet when the nitrogen intake was hypothetically zero (i.e. the Metabolic Faecal Nitrogen (MFN)). The values were 0.25, 0.26, 0.32 and 0.30 g/100 gDM for diets A, B, C and D respectively. The mean MFN value of 0.28±0.05 g/100 gDM obtained in this study compared favourably with the value of 0.27±0-05 g/100 gDM reported by Ahamefule (2005) but lower than 0.43 g/100 gDM reported by_Akinsoyinu (1974) for WAD goats. Variations with breed may occur due to nutrition, environmental conditions and seasons of study.

The relationship between urinary nitrogen (g/d/Wkg$^{0.75}$) and absorbed-N (g/d/Wkg$^{0.75}$) as shown in Table 4. Both parameters were positively correlated in the diets except in diet D. Only diet D showed a significant ($p<0.05$) correlation coefficient. The intercept on the urinary

Table 1: Feed constituents and proximate composition of experimental diets

	Diets					
Ingredients %	A	B	C	D	DCP	CLM
DCP	62	57	52	47	-	-
CLM	0	10	20	30	-	-
Palm kernel cake	19	16	12	8	-	-
Brewers' dried grain	10	8	7	6	-	-
Soya bean meal	5	5	5	5	-	-
Bone meal	3	3	3	3	-	-
Common salt	1	1	1	1	-	-
Total	100	100	100	100	-	-
Analyzed contents %					-	-
Dry matter	87.52	87.52	89.62	89.64	87.60	93.00
Crude protein	12.56	13.00	13.00	13.52	4.90	25.10
Crude fibre	19.35	18.65	18.60	16.15	16.60	7.90
Ether extract	1.05	1.30	1.45	2.20	2.10	5.50
NFE	43.77	43.00	42.87	43.62	71.00	51.90
Ash	12.30	12.60	13.70	14.15	8.50	6.10
*ME(MJ/KgDM)	1.48	1.47	1.44	1.44	1.82	1.80

*Metabolizable energy, DCP = Dried cassava peel, CLM = cassava leaf meal, NFE = Nitrogen free extract

Table 2: Dry matter intake and nutrient digestibility of WAD goats fed cassava peel-cassava leaf meal based diets

	Diets				
Parameter	A	B	C	D	SEM
Mean Body wt (Kg)	7.80	7.58	7.70	7.81	0.20
Mean Body wt ($WKg^{0.75}$)	5.13	5.13	5.10	4.82	0.30
DMI (g/d)	291.55	305.89	310.03	313.42	2.61
DMI ($wkg^{0.75}$)	56.78	59.64	60.78	64.99	2.19
DMI as % BW	3.29	3.45	3.53	3.65	0.21
CP intake (g/d)	32.21	37.70	40.30	41.35	0.43
N-intake (g/d)	5.15	6.03	6.44	6.69	0.95
Faecal -N (g/d)	2.53^{c}	2.95^{b}	3.12^{a}	3.15^{a}	1.73
Urinary -N (g/d)	1.35	1.51	1.34	1.49	0.03
Absorbed -N (g/d)	2.62	3.08	3.28	3.47	1.01
N- balance (g/d)	1.27	1.57	1.99	1.97	0.78
N-intake ($g/d/Wkg^{0.75}$)	1.00	1.19	1.26	1.29	1.03
N- balance ($g/d/Wkg^{0.75}$)	0.24	0.31	0.38	0.38	0.03
N- absorbed ($g/d/Wkg^{0.75}$)	0.50	0.61	0.63	0.67	0.03
Apparent N- digestibility %	41.71	50.54	48.41	50.86	0.18

^{abc}Means on the same row with different superscript differ significantly ($p<0.05$)

Table 3: Regression equation between faucal -N (g/d) (Y) and N- intake (g/day) (x) in WAD goats fed cassava peel-cassava leaf meal based diet

Diets	Regression Equation	Correlation Coefficient (r)	Std. Error	Intercept On Y-Axis	MFN G/Day
A	Y = 2.50+0.05X	0.843*	0.063	2.50	0.250
B	Y = 2.57+0.06X	0.099^{ns}	0.028	2.57	0.257
C	Y = 3.16+0.07X	0.606*	0.028	3.16	0.316
D	Y = 3.04+0.07X	0.736*	0.095	3.04	0.304

MFN = Metabolic faecal nitrogen, ns = not significant

nitrogen (Y) axis gave the urinary nitrogen at zero nitrogen absorption which is the Endogenous Urinary Nitrogen (EUN) in $g/day/Wkg^{0.75}$.

The EUN values were 0.1420, 0.0279, 0.0232 and 0.0301 for diets A, B, C and D respectively. A mean EUN value of 0.124±0.005 was obtained for WAD goats in this study. This value is higher than the EUN value reported by Ahamefule (2005) for WAD goats. This variation in EUN values might be due to urea recycling effect as observed by Akinsoyinu (1974).

The relationship between Nitrogen balance ($g/day/Wkg^{0.75}$) and absorbed nitrogen ($g/day/Wkg^{0.75}$) is shown in Table 5. The correlation coefficients for diets A, B, C and D were 0.420, 0.002, 0.001 and 0.001 respectively. The gradients of line relating N-balance to absorbed nitrogen were the indices of Biological Values (BV) while the absorbed-N at zero N-balance when multiplied by 6.25 gave the Digestible Crude Protein (DCP) requirement for maintenance (Mba, 1975). The BV and DCP values obtained in this study ranged from 76.6

Table 4: Regression analysis and correlation between urinary -N (g/d/Wkg^{075}) (X) in WAD goats fed cassava peel-cassava leaf meal based diets

Diets	Regression Equation	Correlation Coefficient (r)	Std. Error	Intercept on Y-axis	EUN g/Day/Wkg$^{0.75}$
A	Y = 0.142+0.234 X	0.284^{ns}	0.080	0.1420	0.1420
B	Y = 0.0279+0.03 X	0.565^{ns}	0.010	0.0279	0.0279
C	Y = 0.0232+0.04 X	0.142^{ns}	0.008	0.0232	0.0232
D	Y = 0.0301 -\\0.02 X	0.003*	0.005	0.0301	0.0301

*(p<0.05), EUN = Endogenous urinary nitrogen.

Table 5: Regression analysis and correlation coefficients between N-balance (g/day/Wkg$^{0.75}$) (Y) and absorbed -N (g/day/Wkg$^{0.75}$) (X) in WAD goats fed cassava peels-cassava leaf meal based diets

Diets	Regression equation	Correlation coefficient (r)	Std. error	N-absorbed at zero N-balance	BV	DCP for maintenance g/day/Wkg$^{0..75}$
A	Y = 0.142+0.766X	0.420	0.080	0.142	76.6	0.89
B	Y = 0.279+0.969X	0.002	0.010	0.279	96.9	1.74
C	Y = 0.174+0.883X	0.001	0.010	0.174	88.3	1.09
D	Y = 0.322+0.909X	0.001	0.001	0.322	90.9	2.01

BV = Biological value, DCP = Digestible crude protein.

Table 6: Apparent digestibility coefficients (%) of WAD goats feed cassava peel-cassava leaf meat based diets

	Diets				
Constituents	A	B	C	D	SEM
Dry matter	52.99	53.21	55.39	55.68	1.14
Crude protein	56.07	58.71	64.72	66.33	1.72
Crude fiber	63.69^{a}	59.98^{ab}	54.69^{b}	53.98^{b}	0.97
Ether extract	66.22	67.52	69.07	69.88	2.53
N-free extract	70.11^{b}	72.89^{b}	70.30^{b}	73.91^{a}	1.02
Energy	63.86^{d}	65.94^{c}	69.97^{b}	73.09^{a}	0.69

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

in diet A to 90.9 in diet D and 0.89 g in diet A to 2.01 g in diet D. A mean BV of 96.67 for CLM diets was obtained for WAD goats in this study. This is higher than a mean BV value of 59.65 reported by Ahamefule (2005) for WAD goats and similar to a mean BV of 98 reported by Mba (1975) for Red sokoto goats. A high BV value recorded for the CLM diets over the control was an indication that the protein of CLM diets were better utilized than the protein in the control diet. A high mean DCP value of 1.61 g was recorded for the CLM diets over the control 0.89 g which shows that CLM fed goats required 1.81 times as much digestible protein as the control diets fed goats for maintenance.

The dry matter and nutrient digestibility coefficients are presented in Table 6. Dry Matter Digestibility (DMD) coefficients were 52.99, 53.21, 55.39 and 55.68% for diets A, B, C and D respectively. DMD coefficients did not differ significantly (p>0.05). DMD tended to increase from diets A to D just like the Dry Matter Intake (DMI). This did not agree with McDonald *et al.* (1995) who reported that DMD is negatively correlated with DMI. However, it is presumed that nutrient density and not DMD may be the over-riding factor influencing DMI. The crude fibre digestibility coefficient values differed significantly (p<0.05). The crude fibre digestibility coefficient tended to decrease as the percentage of cassava leaf meal increased from diets B to D. This is in line with percentage of crude fibre in the experimental diets where diet A with the highest crude fibre percentage had the highest crude fibre digestibility percentage and this declined from diets A to D. The N-free extract digestibility values were 70.11, 72.89, 70.30 and 73.91% respectively for diets A, B, C and D. These values were significantly (p<0.05) different. The energy digestibility values were significantly (p<0.05) different and increased as the energy contents of the diets declined (Table 1). This agrees with McDonald *et al.* (1995) who reported that energy digestibility is negatively correlated with energy intake.

Conclusion: Conclusively the incorporation of cassava leaf meal in cassava peel based diets improved diets improved nutrient intake and digestibility in WAD goats. Animal protein intake could be improved by the incorporation of cassava leaf meal in concentrate diet for WAD goats.

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