



Growth Performance and Digestibility of Growing West African Dwarf Goats Fed Bamboo Leaves and Supplementary Diets Containing Varying Levels of Cashew Nut Shell

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Abstract

Sixteen (16) growing West African dwarf bucks aged between 6 and 9 months of age, with a weight range of 6.16 – 6.33 kg were used in a feeding trial to evaluate the digestibility and performance of growing West African dwarf goats, fed varying dietary levels of cashew nutshell. The goats were fed diets containing varying levels of cashew nut shell at 0%, 10%, 15% and 20% for treatments T1, T2, T3 and T4, respectively, at 100 g/goat/day. The goats were fed bamboo leaves at 200 g/goat/day one hour before the concentrate was fed. Water was provided *ad libitum*. The experiment lasted for 50 days after a preliminary feeding period of 7 days. In the last 14 days of the experiment, the goats were moved into metabolic crates for faecal collection which lasted for seven days. Samples of the supplementary diets and the bamboo leaves were analyzed for their proximate composition using standard methods. The experimental design was a complete randomized design. Data were analyzed by a one-way analysis of variance, with the aid of SPSS 16. The values for all the performance parameters except forage intake were all significant ($P < 0.05$). The values for total dry matter intake, daily weight gain and feed conversion ratio ranged between 134.71 and 196.95 g, 6.00 and 14.00 g and 14.07 and 22.45, respectively. The crude fibre digestibility decreased steadily from 51.65% (T1) to 40.50% (T4) and were significantly ($p < 0.05$) different. All the other digestibility parameters were significantly ($p < 0.05$) different, except that of ether extracts. The dry matter digestibility values ranged from 72.65% (T4) to 84.55% (T1). It was therefore concluded that the digestibility values obtained indicated that the diets were all suitable for ruminants. 10% level of inclusion of cashew nut shell in supplementary diets for growing West African Dwarf goats was recommended since it enhanced the growth performance and digestibility of the goats.

Keywords: Performance, Digestibility, West African dwarf Goats, Cashew nut shell.

Introduction

Livestock production in Nigeria, especially sheep and goats play a significant socio-economic role in the lives of the people. Goats have a high reproductive rate, widely distributed, have a fairly large population and have the ability to thrive in harsh conditions (Ozung *et.al.*, 2011). An intensive approach

to goat production worldwide however would entail the use of alternative feed sources other than the conventional ones (Ojebiyi *et al.*, 2008). Since the cost of feeding animals is high much can be achieved by reducing the quantity of expensive feed ingredients and making them up with non-conventional feedstuffs or by-products without

compromising feed quality. In Nigeria, there exists a largely untapped potential for utilizing these products for feeding ruminants and one of such agro by-products is the cashew nutshell which is a by-product of the cashew kernel processing industry (Ocheja *et al.*, 2013).

The nutritive value of a feed is measured by its ability to deliver nutrients to an animal for maintenance and growth in absence of toxic factors. It is a function of feed digestibility and voluntary feed intake. (Norton, 1994). Lakpini *et.al.* (2002) reported the critical protein requirement for goats to be 7- 8 %. This is needed to guarantee adequate ammonia, for normal function of the rumen. Preston (1986) reported that for any feed stuff to be considered a ruminant feed it should have a dry matter digestibility of 40 – 50 %.

Digestibility is an important measure of the nutritive value of feed stuffs and is defined as the difference in value between the food eaten and materials voided out by the animals expressed as percentage of food eaten (Javier,1995). *In-vivo* Method that involve feeding experiments with animals and indirect laboratory estimation methods (*in vitro* nylon bag techniques) have been developed to measure digestibility of feeds (Javier, 1995). A number of factors are known to affect digestibility. They include composition of the feed, ration composition, preparation of feed, animal factor and level of feeding etc. From the foregoing, it is therefore expedient to evaluate the nutrient and digestibility potentials of feed materials for ruminant. Research data on performance and digestibility for growing West African dwarf goats fed cashew nut shell- based supplementary diets are available (Okolo *et.al.*, 2012; Ocheja *et.al.*2018), but there may be need to carry out similar study with some modifications with a view to establishing earlier findings.

This study was therefore designed to evaluate the performance, and digestibility of concentrate diets containing varying levels of cashew nut shell as supplement to bamboo leaves fed to growing West African dwarf goats.

Materials and Methods

Location of Experiment

The feeding trial was carried out at the Small Ruminant Unit of the Livestock Teaching and Research Farm, Department of Animal Production, Kogi State University, Anyigba, Anyigba is located between Latitude 7° 15' and 7° 29'N of the equator and Longitudes 7° 11' and 7° 32' East of the Greenwich Meridian (Ifatimehin *et al.*, 2009). It is located in the derived Savannah zone of Nigeria. The annual rainfall ranges between 1400mm and 1500mm with about 6-7 months of rainfall. The ambient temperature ranges from 25 °C to 35 °C with the highest in March and April (Kowal and Knabe, 1972).

Experimental Animals, Feed Materials/Preparation and Experimental Procedure

The experimental feed materials were cashew nut shell, bamabara nut offal, maize offal, table salt, rice offal, fish offal meal, wood ash, bone-meal and bamboo leaves. The cashew nut shell was collected from the Cashew Kernel Processing Factory, Kogi State University, Anyigba. The cashew nut shell was pounded using a mortar and pestle. All the feed ingredients were mixed together in varying proportions and ground to compound the experimental diets (Table1). The bamboo leaves were harvested from Kogi State University, Campus, Anyigba, Nigeria.

Sixteen (16) growing West African dwarf bucks with weight range of 6.16 - 6.33 kg and aged between 6 and 9 months old, were sourced from Anyigba and its environs. They were conditioned to stability by feeding them adequately for one (1) week. The goats were

ear-tagged for identification and were randomly divided into 4 treatments of 4 goats each. The experiment lasted for 50 days, after a preliminary feeding period of seven (7) days. Animals in treatments T₁, T₂, T₃, and T₄ were fed with concentrate diets containing 0, 10, 15 and 20 %, levels of cashew nut shell respectively at 100 g/goat/day. The Bamboo

leaves were fed at 200 g/goat/day on cut and carry basis after wilting for 24 hours to reduce the moisture content. All the animals were given water *ad libitum*. Feed intake was calculated from differences between absolute feed served and leftover. Weekly weight gains were taken in the morning before feeding.

Table 1: Composition of Experimental Diets (% DM)

Ingredients	Diets/Treatments			
	T ₁	T ₂	T ₃	T ₄
Cashew nut shell	0.00	10.00	15.00	20.00
Maize offal	20.00	15.00	13.00	10.00
Bambara nut offal	52.00	52.00	52.00	52.00
Fish offal meal	5.00	5.00	5.00	5.00
Rice offal	18.00	13.00	10.00	8.00
Wood ash	2.00	2.00	2.00	2.00
Table salt	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00
Calculated nutrient content (% DM)				
Nutrients				
Crude protein	18.10	17.95	17.90	17.80
Crude fibre	16.68	16.48	15.25	16.28
ME (Kcal/kgDM)	2864.60	2963.65	3057.85	3144.11

ME= Metabolizable Energy

Digestibility Experiment

In the last two weeks (14 days) of the feeding trial, each animal was moved into a metabolic crate. Faecal collection began after an adjustment period of one week (7 days) in the metabolic crates. Faecal collection from each

animal (which lasted 7 days) were bulked, oven dried, and pooled for each treatment, weighed and samples analyzed for their proximate constituents and thereafter used to compute dry matter and nutrient digestibilities using the formula:

$$\text{Nutrient Digestibility (\%)} = \frac{\text{Nutrient Consumed} - \text{Nutrient in faeces}}{\text{Nutrient Consumed}} \times 100$$

Chemical Analysis

Samples of experimental diets, and bamboo leaves were prepared for analysis of their proximate composition. The protein content of the samples was determined by Kjeldahl method. Ether extract, crude fibre and ash content determination were according to

standard procedure (AOAC, 2000). The nitrogen free extract (NFE) was calculated by subtracting the sum of the percentages of crude fibre, ether extracts, crude protein and ash from 100. The fibre component of each experimental diet, cashew nut shell and the bamboo leaves were further analyzed for

cellulose hemicellulose, lignin, Acid detergent fibre (ADF) and Neutral detergent fibre (NDF), according to the methods of Van Soest *et al.*(1991).

Experimental Design and Statistical Analysis

The experimental design was a completely randomized design (CRD). Data were analysed by a one way analysis of variance (ANOVA) and treatment means were separated using least significant difference (LSD). With the aid of Statistical Package for Social Science version 16.0 (2006)

Results and Discussion

Proximate Composition of Supplementary Diets and Bamboo Leaves

The proximate composition of supplementary diets and Bamboo leaves is presented in Table 2 The protein values of about 18 % were iso-nitrogenous across the treatments, they were in line with the values of 12 to 18 % recommended for growing ruminants in the tropics by NRC ,(1996). The values were also well above the critical range of 7 to 8 % reported by Lakpini *et al.* (2002) needed to supply adequate ammonia and ensure proper functioning of the rumen. The ether extract value of 4.55% fell within recommended levels , while those for T2 (9.75) to T4(12.33), were above the range of 5 to 6 % which may impede feed intake and fibre digestion (Maithison, 1997).The crude fibre values were similar across the treatments.

Table 2: Proximate Composition of Experimental Diets, Cashew Nut shell and Bamboo Leaves (%DM)

Component Nutrients	Diets/treatments				Cashew Nut Shell	Bamboo Leaves
	T ₁	T ₂	T ₃	T ₄		
Dry matters (%)	93.35	94.99	95.57	94.75	90.55	60.66
Crude Protein	18.44	18.30	18.05	17.95	7.65	13.55
Crude fibre (%)	16.35	16.58	16.62	16.85	23.85	21.36
Nitrogen free extracts (%)	52.00	48.33	45.55	43.00	28.30	48.11
Ether extracts (%)	4.55	9.75	10.64	12.33	38.70	5.00
Ash (%)	6.71	6.90	8.80	9.62	1.15	11.88
Total	100	100	100	100	100	100
Acid detergent fibre (%)	16.54	7.82	7.08	15.36	8.95	28.00
Neutral detergent fibre (%)	30.51	30.29	29.36	28.67	26.30	30.80
Cellulose (%)	10.45	10.83	10.50	8.75	11.50	24.00
Hemicelluloses (%)	13.97	12.47	12.28	13.31	7.35	2.80
Lignin	6.11	6.99	6.58	6.88	7.45	4.00

Performance Characteristics of the Experimental Goats

The performance characteristics of the experimental goats is presented in Table 3. All the performance parameters evaluated were significantly (P<0.05) different, except daily forage intake (bamboo leaf). The values also followed a particular trend for all the

performance parameters determined. Daily supplement intake, daily weight gain and feed conversion ratio were all depressed from T1 – T4, however T1 and T2 were at par statistically in most cases. This could be due to increasing levels of cashew nut shell in the concentrate diet. These results were in line with those reported by other workers (Okolo

*et.al.*2012; Ocheja *et.al.* 2013 and Ocheja *et.al.*2020) who all obtained significant ($P>0.05$) differences in nearly all the performance parameters evaluated with growing West African dwarf goats fed supplementary diets containing graded levels of cashew nutshell. The total dry matter intake of 134.71 – 196.95 g was at par with 130.74 – 210.37 g reported by Arigbede *et al.* (2012), for West African dwarf goats fed cassava leaf-hay based diets, but lower than 253.00 – 399.87 g obtained by Oyibo *et al.* (2020) who fed some browse plants

supplemented with a concentrate diet to West African Dwarf goats. The daily weight gain of 6.00 – 14.00 g was lower than 32.22 – 45.88 g reported by Gboshe and Ukorebi (2020). The feed conversion ratio of 14.07 – 22.45 was superior to 16.54 – 31.36 reported by Okolo *et al.* (2012) for growing West African dwarf goats fed supplementary diets containing graded levels of cashew nutshell. These differences could be attributed to differences in the concentrates and forages fed to the goats.

Table 3. Performance of Growing West African Dwarf Goats Fed Bamboo leaf and supplementary Diets Containing Varying Levels of Cashew Nut Shell

Parameters	Treatments				SEM
	T ₁ (0 % CNS)	T ₂ (10 % CNS)	T ₃ (15 % CNS)	T ₄ (20 % CNS)	
Initial weight (kg)	6.33	6.26	6.16	6.30	0.10NS
Final weight (kg)	7.03a	6.92a	6.60b	6.60b	0.16
Total weight gain (kg)	0.70a	0.66a	0.44b	0.30c	0.12
Daily Weight Gain (g)	14.00a	13.20a	8.80b	6.00b	2.13
Daily supplement intake (g)	94.13a	85.80a	58.97b	24.80c	8.23
Daily forage intake (g)	102.82	104.81	109.67	109.91	3.57
Total daily feed intake (g)	196.95a	190.67a	168.64b	134.71c	5.59
Feed conversion ratio	14.07a	14.44a	19.16b	22.45b	2.03

a, b,c Means on the same row with different superscripts differ significantly ($P<0.05$).

NS= Not Significant

SEM = Standard Error of the Means.

CNS= Cashew Nutshell

Dry Matter and Nutrient Digestibility

The dry matter and nutrient digestibility values for growing West African dwarf (WAD) goats fed diets containing graded levels of cashew nut shell (CNS) is presented in Table 4. Dry matter, organic matter, Crude protein and nitrogen free extracts digestibilities were significantly ($P <0.05$)

different. That of ether extract was not significant ($P<0.05$).

The dry matter digestibility of 72.25 – 84.55% obtained in this study were higher than the 65.20 % - 67.80% reported by Arigbede *et al.* (2012) for West African Dwarf bucks fed cassava leaf-maize offal based-diets, but lower than 87.88 – 88.06%

obtained by Adebisi *et. al.* (2016) for West African dwarf goats fed *Panicum maximum* supplemented with *Gmelina arborea* leaf-mixture. These disparities could be due to the nature of supplements and forages fed to the goats. The crude protein digestibility values ranged from 71.00 (T4) to 83.50 (T1), the values were significantly ($P>0.05$) different. The crude fibre digestibility ranged from 40.50 – 51.65%, the values decreased steadily from T1 - T4, the values decreased significantly ($P<0.05$). The increasing levels of ether extracts of diets T₂, T₃ and T₄ (all above 6%) could be responsible for the

decreasing crude fibre digestibility. Maithison *et al.* (1997) reported a decrease in crude fibre digestibility when ether extracts level in ruminant diets exceeded 6%. The dry matter digestibility values obtained in this study indicated that the experimental diets were suitable ruminant diets. Preston (1986) had reported that for any diet to be considered a ruminant diet, it should have a dry matter digestibility of 40 - 50 %. The digestibility values for T1 (0 % CNS) were generally better than those of other treatments and in most cases at par with those of T2 (10 % CNS).

Table 4. Dry Matter and Nutrient Digestibility (%) of Growing West African Dwarf Goats fed Bamboo leaf and supplementary Diets Containing Varying Levels of Cashew nut Shell.

Nutrients	Treatments				SEM
	T ₁ (0 % CNS)	T ₂ (10 % CNS)	T ₃ (15 % CNS)	T ₄ (20 % CNS)	
Dry matter	84.55 ^a	79.85 ^b	77.40 ^b	72.25 ^c	1.15
Organic matter	86.70 ^a	81.00 ^b	57.63 ^c	73.80 ^c	1.09
Crude protein	83.50 ^a	83.00 ^a	76.60 ^b	71.00 ^c	2.35
Crude fibre	51.65 ^a	46.80 ^b	44.65 ^b	40.50 ^c	2.03
Ether extracts	90.00	86.60	89.05	89.00	2.10NS
Nitrogen free extract	79.85 ^a	74.10 ^b	73.70 ^b	75.20 ^b	2.01

a, b,c Means on the same row with different superscripts differ significantly ($P<0.05$).

NS= Not Significant ($P>0.05$)

SEM Standard Error of the Means

CNS= Cashew Nutshell

Conclusion

The results obtained showed that the diets were well digested and can be regarded as suitable ruminant diets. However, 10% level of inclusion of cashew nutshell in supplementary diets for growing West African dwarf goats produced feed intake, growth performance and digestibility values similar to the control. Therefore, 10% level of inclusion of cashew nut shell is recommended in supplementary diets for growing West African dwarf goats without compromising performance and digestibility.

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