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PERFORMANCE AND NUTRIENT DIGESTIBIITY OF WAD GOATS FED BAMBOO LEAVES AND SUPPLEMENTARY DIETS WITH GRADED LEVELS OF CASHEW NUT SHELL

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ABSTRACT

In a feeding trial the nutrient intake, performance, dry matter and nutrient digestibility of twenty (20) growing West African Dwarf (WAD) goats fed bamboo leaves and supplementary diets with graded levels of cashew nut shell were evaluated. The goats were fed diets (T1- T4) containing graded dietary levels of cashew nut shell at 0, 10, 15 and 20% for T1, T2, T3 and T4 respectively, at 100g/goat/day. The goats were fed bamboo leaves at 200g/goat/day 2 hours before the concentrate was fed while water was served ad libitum. The experiment lased for 100days after an adjustment period of 14 days. In the last 21days of the experiment the goats were moved into metabolic crates for faecal collections which lasted for fourteen days. The values for feed intake, dry matter, organic matter and those of other nutrients intakes were significant ($p < 0.05$). Values obtained for goats on T1 and T2 were similar and significantly ($p < 0.05$) higher than those of T3 and T4 for all the parameters considered except for ether extract intake. The crude fibre digestibility decreased steadily from 52.91% (T1) to 41.75% (T2) and were significantly ($p < 0.05$) different. All other digestibility parameters were not significantly ($p > 0.05$) different. The dry matter digestibility values ranged from 77.56% (T4) to 286.73% (T1). It was therefore concluded that the daily intakes of all the nutrients were quite adequate for growing goats in the tropics and the digestibility values obtained indicated that the diets are suitable for ruminant. Also, 10% level of inclusion of cashew nut shell in growing WAD goat's diets is recommended as it enhanced optimal nutrient intake and digestibility.

Keywords: Nutrient, Digestibility, Performance, WAD Goats, Cashew nut shell.

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INTRODUCTION

The principal aim of animal production is the production of high quality protein in the form of meat, milk and eggs for human nutrition. The production of these requires adequate feeding in terms of quality and quantity. The provision of adequate nutrition to ruminants has been identified as one of the biggest management problems faced by stock owners in the tropical parts of the world especially during the long dry season. (Lufadeju and Lamidi, 1993).

According to Norton (1994) 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 consumption. NRC (1996) reported the critical protein requirement for goats to be 8 %. Preston

(1986) reported that for any feed stuff to be considered a ruminant feed it should have a dry matter digestibility coefficient of 40 – 50 %.

Digestibility is an important measure of the nutritive value of food 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.

This study was therefore designed to determine the performance in terms of nutrient intake, dry matter and nutrient digestibility of concentrate diet containing graded levels of cashew nut shell as supplement to bamboo leaves fed to growing West African dwarf goats.

MATERIALS AND METHODS

The feeding trial was carried out at the Sheep and Goats Unit of the Livestock Teaching and Research Farm, Department of Animal Production, Kogi State University, Anyigba (Latitude 7^0 15^1' and 7^0 29'N of the equator and Longitudes 7^0 11^1 and 7^0 32^1 East of the Greenwich Meridean (Ifatimehin *et al.,* 2009). It is located in the derived Savannah zone of Nigeria. The annual rainfall ranges between 1400mm – 1500mm with about 6-7 months of rainfall. The ambient temperature ranges from 25 ^{0}C to 35 ^{0}C with the highest in March and April (Kowal and Knabe, 1972).

The experimental feed materials were cashew nut shell, bambara nut offal, maize offal, table salt, rice offal, fish offal meal, wood ash, bone-meal and bamboo leaves. The rice offal was collected from Alaide in Benue State while the Bambara nut offal was purchased from market women in Anyigba, Kogi State. The cashew nut shell used, which has been steam treated for 20 minutes was obtained from the Cashew Kernel Processing Factory of 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. The bamboo leaves were harvested from Kogi State University, Campus, Anyigba.

Twenty (20) growing West African dwarf bucks with weight range of 6.15 to 6.30 kg and aged between 7 and 9 months, were sourced from Anyigba and its environs. They were conditioned to stability by feeding them adequately for 1 week. The animals were treated with Ivomec at 0.25 mL/goat to control both *endo* and ecto-parasites. They were also injected with antibiotics (Oxytetracycline hydrochloride and procaine penicillin at 3 mL and 2 mL per goat respectively) to take care of scouring, nasal and ocular discharges and to provide a good health status. The animals were ear-tagged for identification and were randomly divided into 4 treatments of 5 animals each. The experiment lasted for 100days, after an adjustment period of seven (7) days. Animals in treatments T_1, T_2, T_3, and T_4 were fed with experimental diets containing 0, 10, 15 and 20 %, levels (of inclusion) 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. All the animals were given water *ad libitum*. Dry matter intake was calculated from differences between absolute feed served and leftover. Weekly weight gains were taken in the morning before feeding.

In the last three weeks (21 days) of the feeding trial, each animal was moved into a metabolic crate. Faecal collection began after an adjustment period of 2 weeks (14 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 digestibility coefficients using the formula:

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

The nutrient intake was calculated from the proximate composition of the diets and Bamboo leaves as well as the feed intake records.

Table 1: Composition of experimental diets (% DM)

Treatments	**T_1**	**T_2**	**T_3**	**T_4**
Levels of Cashew nut shell (%)	**0**	**10**	**15**	**20**
Ingredients;				
Maize offal	20	15	13	10
Cashew nut shell	0	10	15	20
Bambara nut offal	52	52	52	52
Fish offal meal	5.0	5.0	5.0	5.0
Rice offal	18	13	10	8.0
Wood ash	2.0	2.0	2.0	2.0
Table salt	1.0	1.0	1.0	1.0
Bone meal	2.0	2.0	2.0	2.0
Total	**100**	**100**	**100**	**100**
Calculated values (% DM):				
Crude protein	18.70	18.15	18.09	18.01
Crude fibre	16.31	16.32	16.46	16.83
ME (Kcal/kg DM)	3000	3050	3095	3132

DM = Dry matter; ME = Metabolizable energy**.**

RESULTS AND DISCUSSION

The nutrient intake of growing West African dwarf goats fed diets containing graded levels of steam-treated cashew nut shell is as presented in Table 3. The values for intakes of dry matter, organic matter and those of all other nutrients showed significant ($p < 0.05$) differences. With values for T_1 and T_2 being similar and significantly ($p < 0.05$) higher than those of T_3 and T_4 for all the parameters considered except for ether extract intake

Table 2: Proximate composition and fibre fractions of experimental diets (% DM) fed to growing WAD goats

Treatments	**T1**	**T2**	**T3**	**T4**
Levels of CNS (%)	**0**	**10**	**15**	**20**
Parameters:				
Crude protein	18.89	18.44	18.39	18.20
Crude fibre	16.33	16.58	16.62	16.85
Nitrogen free extracts	50.11	44.93	46.95	45.91
Ether extracts	5.05	8.75	10.64	12.33
Ash	9.62	8.30	7.40	6.71
Dry matter	93.35	94.99	95.57	91.75
Acid Detergent fibre	16.54	17.82	17.82	17.08
Neutral Detergent fibre	30.51	30.29	29.36	29.67
Cellulose	10.43	10.83	10.50	10.20
Hemicellulose	13.97	12.47	12.28	12.59
Lignin	6.11	6.79	6.58	6.88

CNS = Cashew nut shell; CNS = Cashew nut shell.

The daily dry matter intake range of 42.18 (T_4) to 51.85 g/day/$W^{0.75}$ (T_1) were lower than 93.21 – 94.01 g/day/$W^{0.75}$ reported by Ngi (2012) for growing West African dwarf goats fed sweet orange peel meal based diet. This difference may be due to the supplement and forage fed. The difference in dry matter intakes of the animals across the treatments also gave rise to significant differences in the intakes of the nutrients. The differences in the composition of the nitrogen free extracts and ether extract in the diets across the treatments was an additional factor responsible for the significant ($p < 0.05$) differences in nitrogen free extracts and ether extracts intakes. The daily intakes of all the nutrients were quite adequate for growing goats (NRC, 1996).

The dry matter and nutrient digestibility coefficients of growing West African dwarf goats fed concentrate diets containing graded levels of steam-treated cashew nut shell is presented in Table 4. Dry matter, organic matter, Crude protein, nitrogen free extracts and ether extract digestibilities showed no significant ($p > 0.05$) differences. The organic matter digestibility values decreased steadily from T_1 (79.65 %) to T_4 (75.14 %) though the values were however not significantly ($p > 0.05$) different. The crude fibre digestibility decreased steadily from 52.91 % in T_1 to 41.75 % in T_4 and were significantly ($p < 0.05$) different.

The dry matter digestibility of 77.56 - 83.73% obtained in this study were higher than the values (65.20 % - 67.80%) reported by Arigbede *et al,* (2012) for WAD bucks fed cassava leaf-maize offal based-diets, but lower than 91.44 % to 95.44 % reported by Okpanachi (2014) for WAD Goats fed cashew pulp meal based diets, as well as 87.88 – 88.06% obtained by Adebisi *et. al.* (2016) for west African dwarf goats fed *Panicum maximum* supplemented with *Gmelina arborea* leave mixture. These disparities could be due to the nature of supplements fed. The increasing levels of ether extracts of diets T_2, T_3 and T_4 (i.e. 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 qualifies the experimental diets as 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 %.

Table3: Nutrient Intake (g/day/$W^{0.75}$ DM) of growing WAD goats fed bamboo leaf and supplementary diets with graded levels of steam-treated cashew nut

Treatments	**T1**	**T2**	**T3**	**T4**	
Levels of CNS (%)	**0**	**10**	**15**	**20**	**SEM**
Parameters:					
Dry matter	51.85[a]	51.48[a]	48.00[b]	42.18[c]	1.65
Organic matter	47.45[a]	47.80[a]	43.20[b]	39.99[c]	2.03
Crude protein	13.31[a]	13.19[a]	12.03[b]	11.07[c]	0.47
Crude fibre	14.79[a]	15.06[a]	13.13[b]	13.07[b]	0.79
Nitrogen free extracts	30.38[a]	29.90[a]	26.99[b]	24.30[c]	1.02
Ether extracts	5.43[c]	6.59[a]	6.50[a]	6.03[b]	0.26
Ash	8.74[a]	8.83[a]	9.39[a]	8.25[b]	0.49

[a-c]Means on the same row with different superscripts differ significantly ($p < 0.05$).
WAD = West African dwarf goat; DM = Dry matter; CNS = Cashew nut shell; SEM = Standard error of mean.

The performance data of growing West African dwarf goats fed diets containing graded levels of steam- treated cashew nut shell is summarized in Table 5. Initial weights of the animals as well as the daily forage intake were not significantly ($p > 0.05$) different. Daily supplement intake decreased steadily from 91.54 g/day (T_1) to 44.65 g/day (T_4) and showed significant ($P<0.05$) difference across the treatment means. Final weight gain, total weight gain and daily weight gain decreased steadily from T_1 (7.46 kg, 1.30 kg and 13.0 g to 6.70 kg, 0.50 kg and 5.0 g respectively. Values for these three parameters showed significant ($p < 0.05$) differences across the treatment means. The total daily feed intake ranged from 56.49 (T_4) to 65.04 g/$W^{0.75}$ (T_1).

Feed conversion ratio showed significant ($p < 0.05$) difference with values obtained for goats on T_1 and T_2 which were similar and significantly ($P<0.05$) higher than those of T_3 and T_4. The trend in daily supplement intake was due to inclusion of cashew nut shell in the diet in increasing order from T_2 – T_4, which led to a corresponding decrease in the supplement intake. The mean daily weight gain range of 3.34 to 6.85 g$W^{0.75}$ were lower than 3.45 – 10.58 g$W^{0.75}$ reported by Ngi (2012) for yearly WAD Goats fed sweet orange peel based diet. This difference may be due to the class of goats as well as the feeds used in the experiments.

Table 4: Dry matter and nutrient digestibility (%) of growing WAD goat fed bamboo leaf and supplementary diets with graded levels of steam-treated Cashew nut shell.

Treatments	**T_1**	**T_2**	**T_3**	**T_4**	
Levels of CNS (%)	**0**	**10**	**15**	**20**	**SEM**
Parameters:					
Dry matter	83.73	80.91	78.86	77.56	1.96
Organic matter	79.65	77.02	76.11	75.14	1.37
Crude protein	91.50	88.20	88.05	86.20	3.80
Crude fibre	52.91^{a}	50.10^{a}	43.25^{b}	41.75^{b}	1.64
Nitrogen free extract	74.10	76.11	75.66	73.76	1.30
Ether extracts	94.82	94.10	92.16	90.25	0.99

^{ab}Means on the same row with different super scripts differ significantly ($p < 0.05$).
SEM Standard Error of the Means; WAD = West African dwarf goat; DM = Dry matter; CNS = Cashew nut shell.

Table: 5 Performance of growing WAD goats fed Bamboo leaf and supplementary diets with graded levels of steam- treated Cashew nut shell

Treatments	**T_1**	**T_2**	**T_3**	**T_4**	
Levels of CNS (%)	**0**	**10**	**15**	**20**	**SEM**
Parameters:					
Numbers of observations	5	5	5	5	__
Duration (days)	100	100	100	100	__
Initial weight (kg)	6.16	6.20	6.27	6.20	0.14
Final weight (kg)	7.46^{a}	7.48^{a}	6.87^{ab}	6.70^{b}	0.15
Total weight gain (kg)	1.30^{a}	1.28^{a}	0.60^{b}	0.50^{c}	0.04
Total weight gain ($Wkg^{0.75}$)	$1,22^{a}$	1.20^{a}	0.73^{b}	0.59^{c}	0.06
Daily weight gain (g)	13.00^{a}	12.80^{a}	6.00^{b}	5.00^{c}	0.14
Daily weight gain ($gW^{0.75}$)	6.85^{a}	6.77^{a}	3.83^{b}	3.34	0.11
Daily supplement intake (g)	91.54^{a}	85.65^{a}	67.37^{b}	44.65^{c}	7.62
Daily supplement intake ($gW^{0.75}$)	29.59^{a}	28.15^{a}	23.51^{b}	17.27^{c}	2.41
Daily forage intake (g)	170.07	173.34	176.10	172.10	1.67
Daily forage intake ($gW^{0.75}$)	46.05	47.77	48.34	47.51	0.89
Total daily feed intake (g)	261.61^{a}	258.99^{a}	243.47^{b}	216.75^{c}	2.96
Total daily feed intake ($gW^{0.75}$)	65.04^{a}	64.56^{a}	61.64^{b}	56.49^{c}	2.43
Feed conversion ratio	20.12^{a}	20.23^{a}	40.58^{b}	43.35^{b}	9.37

$^{a-c}$Means on the same row with different superscripts differ significantly ($p < 0.05$)
SEM = Standard Error of the Means; WAD = West African dwarf goat; CNS = Cashew nut shell.

The values obtained for total daily feed intake 56.49 (T_4) to 65.04 g/day/$W^{0.75}$ (T_1) were lower than 109.69 – 112.99 g/day/$W^{0.75}$ reported by Oloche *et al.* (2013), who fed sweet orange peel meal based diets to yearling WAD goats, but higher than 130.74 g to 210.37 g reported by Arigbede *et al*. (2012) who also fed cassava leaves hay based-diet to WAD goats. These differences may be due to the breed/class of goats used as well as the feeds involved in the experiments. The lower supplement intake and lower daily weight gain ($p < 0.05$) in T_3 and T_4 may be due to the higher level of cashew nut shell in the diets. The cashew nut shell may have had an unpleasant taste. This again translated to lower total and daily feed intake. This may also have resulted in the lower weight gain reported in T_3 and T_4. T_1 and T_2 had the best feed conversion ratio. This could be that they best utilized the experimental diets.

The trend in the feed conversion ratio was similar to that reported by Okolo *et al.* (2012). Mafindi *et.al,* (2018) however reported a value of 7.50 for red Sokoto goats fed cowpea husk supplemented with graded levels of *Moringa oliefara* leaves.

CONCLUSIONS

- The daily intake of nutrients and the digestibility of cashew nut shell-based diets showed that they were quite adequate and suitable for growing goats in the tropics.
- Inclusion of up to 10% dietary cashew nut shell elicited optimal nutrient intake and digestibility, and overall performance in growing West African dwarf goats.

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