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Carcass Characteristics of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell

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Abstract: Twenty (20) West African dwarf backs were used to investigate the effects of diets containing graded levels of cashew nutshell on carcass characteristics. The goats were randomly allotted to five (5) treatments of four (4) goats each, the goats were fed the supplement containing 0%, 10%, 15% and 20% cashew nut shell for T_1, and T_2, T_3 and T_4 respectively, at 100g / goat/day. The experiment lasted for 100 days after an adjustment period of 14 days. On the last day of the feeding trial three (3) goats each were slaughtered per treatment and carcass yield, whole sale cuts and organo-leptic properties evaluated. Completely randomized experimental design was used and data were analysed using a one way analysis of Variance. Treatment means were separated using least significant difference with the aid of SPSS (2006) 16th version. The dressing percentage ranged from 53.14% (T_3) to 57.54% (T_1) but was not significantly ($p>0.05$) different. There were significant ($p>0.05$) differences in the values for slaughter weight, dressed weight and meat to bone ratio. The values did not follow any definite trend. There was no significant ($p>0.05$) difference in the relative weight of the head; neck, thigh, shoulder, Ribs, back and Belly. The values for flavor ranged from 3.8 (T_1) to 4.0 (T_2, T_3andT_4) but were not significantly ($p>0.05$) different. The values for juiciness, tenderness, leanness, palatability and overall carcass quality showed significant differences. It was concluded that goats in T_2 (10% level of inclusion of cashew nut shell) had the best carcass characteristics. Further research using other species of ruminants like sheep and cattle was suggested.

Keywords: Carcass, West African dwarf Goats, Steam-Treated, Nut Shell

1. 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).Grasses which are the most abundant basal feed for ruminants most of the time dry up during the long dry season or become dormant (Lakpini, 2002). In Nigeria, this problem is very pronounced in the savannah and rain forest zones where small ruminants are tethered to prevent destruction of crop farms. The resultant effect of which is low dry matter intake of forages by animals resulting from high moisture content of the forages. During the dry season available herbage are of low quality and crop residue availability often exceed animal requirement so much so that the excess is either burnt or allowed to decompose. This seasonal variability in the quality and quantity of natural forages therefore results in annual cyclical pattern of live weight gains and losses with incredibly high losses, the slow

improvement in crop yield and competition between humans and animals for the available grains and tubers make nutritional requirements at reasonable cost difficult to achieve since a viable livestock industry is dependent on agro products, consequently animals are unable to meet both protein and energy requirements. There is not only weight loss, lowered diseases resistance and death but also seasonal anoestrus, reduced fertility and slow growth rate (Osori, 1976). Studies have also shown that there is a general dearth in animal protein supply in the tropics (Okai *et al*., 2005).

Given the above scenario it would be worthwhile to seek alternative feed materials that are readily available, cheap, safe, and nutritionally adequate and at the same time not in direct use by humans. By so doing, the cost of animal protein is reduced, thereby making it more affordable for Nigerians.

Babatunde *et al.* (1975) observed that the incorporation of agro by-products into ruminant rations hold tremendous potential for alleviating the short supply and high cost of feeds. One of such agro by-product that holds promise in ruminant nutrition but has not been utilized in ruminant feeding is cashew nut shell. Cashew nut shell is the by-product of cashew kernel industry. It is the left over after cashew kernels have been removed from the shell.

2. 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° 15' and 7° 29'N of the equator and Longitudes 7° 11^1 and 7° 32^1 East of the Greenwich Meridian (Ifatimehin *et al.,* 2009). It is located in the derived Guinea Savannah zone of Nigeria. The annual rainfall ranges between 1400mm – 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)

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 rice offal was collected from Alaide in Benue State while the Bambara nut offal was purchased from market women in Anyigba, Kogi State. The table salt was obtained from Anyigba market. The cashew nut shells (Steam -Treated for 20 minutes) were obtained from the Cashew Kernel Processing Factory, Kogi State University, Anyigba. The cashew nut shells were 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 6.15kg to 6.30kg 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 0.25ml/goat to control both *endo* and *ecto* parasites. They were also injected with antibiotics (*Oxytetracycline hydrochloride and procaine penicillin*) at 3mls and 2mls 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 100g/goat/day. The Bamboo leaves were fed at 200g/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. The following performance data were collected. Daily feed intake (supplement and forage), daily weight gain, Total weight gain and Feed conversion ratio

Table 1. *Composition of Experimental diets (% DM).*

Ingredients Treatments	T_1	T_2	T_3	T_4
Cashew nut shell	0	10	15	20
Maize 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 nutrient content (% DM)				
Nutrients				
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

At the end of the feeding trial, Three (3) animals from each treatment were sacrificed and their carcass parameters evaluated as follows:

a. Organ weights (liver, lungs, kidneys, heart and spleen) these were presented as percentage of slaughter weight
b. Whole sale cuts (Ribs, belly, neck, shoulder, back, head and thigh)
c. Carcass yield (slaughter weight, dressed weight, dressing percentage and meat to bone: ratio.)
d. Carcass organo-leptic properties (juiciness, tenderness, flavor, leanness, palatability and over all carcass quality.)

The weights of whole sale cuts were determined by cutting the respective parts and weighting. Dressing % was calculated using the formular:

$$\text{Dressing Percentage} = \frac{Dressed\ weight}{Live\ weight} \mathbf{X\ 100}$$

The meat: bone ratio was determined by clearly separating the flesh from the bones for each carcass. The flesh and bone were weighed separately and the ratio of the two determined. The abdominal fat was determined by removing the abdominal fat and weighing for each animal.

The carcass organo-leptic properties (sensory evaluation) were determined by cutting four (4) pieces of meat of same

weight (50g) from the same thigh of each slaughtered goat, the pieces of meat were cut in definite shapes for each treatment to facilitate easy identification.

T_1 Round
T_2 Triangular
T_3 Square
T_4 Rectangular.

There were 12 pieces of meat per treatment (4 pieces of meat x 3 replicates). All the pieces of meat from all the treatment were cooked in the same pot for 20 minute. A twelve member taste panel assessed the Organo-leptic properties. Each panelist tasted a piece of meat from each treatment. The panelist completed the questionnaire provided which was rated on a scale of 1-5 for each parameter as follows:-

Very Good	-5
Good	-4
Moderate	-3
Fair	-2
Poor	-1

The organo-leptic properties considered were-juiciness, tenderness, flavor, leanness, palatability and overall carcass quality. The assessments by the taste panel were done at the same time. There were a total of forty eight (48) assessments (1×4×12). The scores for each parameter were added together and divided by Twelve (12) to obtain the mean score for each parameter. The scores for each parameter were added together to determine the overall carcass quality for each replicates and hence treatments.

Samples of experimental diets, steam treated cashew nut shell, bamboo leaves and feaces (after drying in an oven) were analyzed for 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 1995), 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 forage were further analyzed for cellulose Hemicellulose, lignin, Acid detergent fibre (ADF) and Neutral detergent fibre (NDF), (Van Soest *et al.,* 1991). The analyses were carried out at the chemistry laboratory of the Federal University Lokoja. Nigeria.

The experimental design was a completely randomized design (CRD).Data were analysed by a one way analysis of variance (ANOVA) and significant means were separated using least significant difference (LSD). With the aid of statistical package for social science (SPSS) version 16 (2006)

3. Results and Discussion

3.1. Proximate Composition, Fibre Fractions and pH of Experimental Diets

The proximate composition, fibre fractions and pH of experimental diets fed to growing West African dwarf goats are summarized in Table 2. The experimental diets were iso-nitrogenous, with protein content ranging from 18.20% (T_4) to 18.89% (T_1). The fibre level for the experimental diets, 16.33% (T_1) to16.85% (T_4) were all similar. The Ether extract value increased steadily from T_1 to T4 with values ranging from 5.05% (T_1) to 12.33% (T_4) the acidity of the diet increased steadily from T_1 (6.82) to 6.10 (T_4). The crude protein content of about 18% and crude fibre content of about 16% were adequate for growing goats in the tropics (NRC, 1996; Lakpini *et al.,* 2002). The Ether extract content of 5.05% for T_1 was about the optimum for ruminant diets. However, 8.75% for T_2 to 12.33% for T_4 were above recommended levels for ruminant diets. These values however suggest high carotene and fat soluble vitamins content (Ambarasu *et al*., 2004). The ash content of 6.71% (T_4) to 9.62% (T_1) may suggest high mineral content of the experimental diets. The pH values were all within tolerable range for the rumen environment.

Table 2. *Proximate Composition, Fibre Fractions and pH of Experimental Diets (% DM) Fed to Growing West African Dwarf Goats.*

Nutrients (%)	**Treatments**			
	T1	**T2**	**T3**	**T4**
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
Total	100	100	100	100
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
pH	6.82	6.66	6.52	6.10

3.2. Feed Intake of Experimental Animals

The feed intake records are present in Table 3, the forage intake ranged from 165.07g (T_1) to 176.10 (T_3) and were not significantly ($P>0.05$) different, values for daily supplement intake and total daily dry matter intake showed significant ($P<0.05$)differences

Table 3. *Feed Intake of Experimental Animals.*

Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Daily supplement intake (g)	91.54^a	85.650^a	67.37^b	44.65^c	7.62
Daily forage intake (g)	165.07	173.34	176.10	172.10	1.67
Total daily dry matter intake (g)	256.61^a	258.99^a	243.47^b	216.75^c	2.96

a,b,c Means on the same row with different superscripts differ significantly ($P<0.0.5$)
SEM: Standard Error of Means

3.3. Carcass Yield of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell

The carcass yield of growing West African dwarf goats fed diets containing graded levels of steam-treated cashew nut shell is presented in Table 4, the dressing percentage ranged from 53.14% (T3) to 57.54% (T1). The values were statistically not significant ($p>0.05$) and did not follow any definite trend. The slaughter weight, dressed weight and meat: bone ratio were significantly ($p<0.05$) different. T1 had the highest values for meat: bone ratio (3.96:1). The dressing percentage in this study were higher than the range of 43.80%-47.30% reported by Ukanwoko *et al.* (2009), when they fed West African dwarf goats with cassava leaf- meal based diets. The higher dressing percentage in this study may be due to the inclusion of the gut, head, legs and internal organs such as heart, kidney, lungs, spleen and liver in the dressed carcass. Cassey and Van Nickrek (1988) had reported that dressing percentage can be influenced by many factors such as fleece and hide weight alimentary trait size and fill, slaughtering procedure and portioning of body fat. Also the dressing method can affect the dressing percentage because parts which are considered as offal may not be considered offal in some dressing methods. For instance, Fasae *et al.* (2007) considers hot carcass weight to be carcass weight that includes head, gastro intestinal tract but minus legs. However Ukanwoko *et al.* (2009) reported warm carcass weight to exclude all internal organs, skin, head, feet as well as the visceral and abdominal fat. This compared to the former will give a lower dressing percentage. The result for meat: bone ratio may indicate best feed utilization for meat production by animals in T_1.

Table 4. *Carcass Yield of Growing West African dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew nut shell.*

Parameters	T1	T2	T3	T4	Treatments SEM
Slaughter weight (kg)	6.59^{ab}	7.20^{a}	6.58^{ab}	6.03^{b}	0.16
Dressed weight (kg)	3.70^{b}	4.18^{a}	3.65^{b}	3.60^{b}	0.14
Dressing percentage (%)	57.54	56.22	53.14	55.98	1.48
Meat: Bone Ration	$3.96:1^{a}$	$3.22:1^{b}$	$3.45:1^{b}$	$2.67:1^{c}$	0.22

a, b, c Means on the same row with different superscript are significantly ($p<0.05$) different
SEM: Standard error of means

3.4. Whole Sale Cuts of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell

Whole sale cuts of growing West African dwarf goats fed diets containing graded levels of steam-treated cashew nut shell as shown in Table 5. The weight for the head was not significantly ($p>0.05$) different. However the weights for neck, thigh, shoulder, Ribs, back and belly showed significant ($p<0.05$) differences. T_1 (control) had the highest values for thigh (9.97) rib (6.04) back (11.19) belly (3.17) and neck (3.97). However T_2 was statistically at par with T_1 for neck, and thigh. It appears that goats in T_1 and T_2 best utilized the diets for muscle build up and hence meat production. Since they had the highest weights in the high muscle cuts i.e. neck, shoulder, thigh and back. The decrease in the weight of the head as the carcass weight increased agreed with the report of Omojola and Attah (2006).

Table 5. *Whole Sale Cuts of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell. (% of Slaughter Weight).*

Whole sale	Treatments				
Cuts	T1	T2	T3	T4	SEM
Head	7.80	7.06	7.56	8.20	0.19
Neck	3.97^{a}	2.94^{a}	3.09^{b}	3.54^{ab}	0.18
Thigh	9.97^{a}	7.55^{b}	7.75^{b}	8.12^{ab}	0.53
Shoulder	8.28^{a}	6.46^{b}	7.64^{ab}	8.93^{a}	0.39
Ribs	6.04^{a}	4.15^{b}	4.26^{b}	4.47^{b}	0.94
Back	11.19^{a}	8.51^{b}	9.62^{ab}	10.36^{a}	0.27
Belly	3.17^{a}	1.84^{b}	1.51^{b}	1.79^{b}	0.45

a, b Means on the same row with different superscripts are significantly ($p<0.05$) different.
SEM: Standard error of means

3.5. Sensory Evaluation of Carcass of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell

The results of sensory evaluation of carcass of growing West African dwarf goats fed diets containing graded levels of steam- treated cashew nut shell is presented in Table 6. There were significant ($p<0.05$) differences in juiciness palatability tenderness, leanness and overall meat quality. However flavor, was not significantly ($p>0.05$) different. The values for all the parameters did not follow any definite trend. T_2 (10% Cashew nut shell) had the best result for nearly all the parameters considered as well as the overall best carcass quality followed by T_1 (0% Cashew nut shell) and T_4 (20% Cashew nut shell) had the least values for nearly all parameters considered as well as overall, carcass quality. This may be due to highest ether extract contents of diet T_4. It also appears that the ether extract content of diet T_1 and hence the fat content of the diet was optimum as regards carcass quality. This result agrees with that obtained by Abdulkarim (2011) who reported best carcass quality for Goats fed 10% cashew nut shell as against 0%, 20% and 30% levels of inclusion of cashew nut shell.

Table 6. *Sensory Evaluation of Carcass of Growing West African Dwarf Goats Fed Diets Containing Graded Levels of Steam-Treated Cashew Nut Shell.*

Treatments Parameters	T1	T2	T3	T4	SEM
Juiciness	4.0^{b}	4.5^{a}	4.0^{b}	3.5^{c}	0.16
Flavour	3.8	4.0	4.0	4.0	0.15
Tenderness	4.0^{b}	4.5^{a}	4.0^{b}	3.5^{c}	0.14
Leanness	4.0^{b}	4.5^{a}	3.9^{b}	3.0^{c}	0.11
Palatability	4.5^{ab}	5.0^{a}	4.0^{b}	3.5^{c}	0.10
Overall carcass quality	20.30^{b}	22.50^{a}	19.90^{b}	17.50^{c}	0.18

a, b, c Means on the same row with different superscript differ significantly ($p<0.05$).
SEM: Standard error of means.

4. Conclusion and Recommendations

Animal in T_2 (10% level of inclusion cashew nut shell) had the best carcass parameters. Cashew nut shell at10% level of inclusion can be incorporated into supplemental diets for growing West Africa dwarf goats for improved carcass quality.

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