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Performance, Haematological and Serum Biochemical Profiles of Weaner West African Dwarf Goats Fed with Diets Containing Graded Levels of Cashew Nut Shell

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Abstract: *The performance haematological and serum biochemical characteristics of West African Dwarf Goats Fed Diet containing Graded Levels of cashew nut shell were determined. 12 male weaners Goats were weighed and randomly allotted to four (4) dietary treatments consisting of three (3) goats per treatment, with T_1 as the control diet containing 0% cashew nut shell while T_2, T_3, and T_4 contained 10%, 20% and 30% cashew nut shell respectively. Each animal received the diets for 50 days and data collectedwere subjected to one way analysis of variance (ANOVA). Blood sample were collected for haematology and seralogical tests. The performance characteristics were significantly ($p < 0.05$) different in the daily weight gain, daily supplement intake, daily forage intake, daily dry matter intake and feed conversion ratio which ranged from 8.00g(T_4)-15.00g(T_1), 17.46g (T_4)-76.05g(T_1), 230.31 (T_1)-300.7 (T_3), 265.1 (T_4)-333.24(T_3) and 25.25 (T_1)-35.52(T_4) respectively.6.35(T_2)- 11.95×10^{12}/ l (T_1),3.74 (T_3)- 10.74×10^{9}/l (T_3,), 31% (T_3)- 49% (T_1), 0.00% (T_2)-1.00(T_1 and T_3) and 1.00% (T_1 and T_4)- 2.00% (T_3) respectively Blood sample for haematology were analyzed for packed cell volume, Haemoglobin concentration, Red blood cell, White blood cell, Neutophils, Basophils and Eosinophils. There was no significant ($p < 0.05$) difference in pack cell volume and haemoglobin concentration. But Red blood cell, White blood cell Neutrophils Basophils and Eosinophils were significantly ($p < 0.05$) different and values ranged from Blood sample for serological analysis were collected in sample bottle without ethylene diamine tetra acetic acid (EDTA). Total protein decreased steadily ($P<0.05$) from T_4 (5.77) to T_1 (6.77). Creatinine and Alkaline phosphate values increased respectively from T_1 (0.16 and 365.24) to T_4 (0.52 and 458.51) and both values were significantly ($P>0.05$) diferent. Cashew nut shell up to 30% inclusion levels in supplement rations had no advance effect on the haematological and serum biochemical values of weaner West African Dwarf goats. However, supplement intake and growth performance were adversely affected at 20 and 30% level of inclusion. Hence, the level of cashew nut shell in supplement diets for weaner West African Dwarf goats should not exceed 10%. Further research using other levels of inclusion (5%, 7.5% , 15%) as well as other classes, breed and other species of ruminants is recommended.*

1. INTRODUCTION

Nigeria as well as other developing countries are predominantly marked by inadequate protein intake especially of animal source. Animal protein is one of the most important components of human diet and its consumption varies from country to country (Okai *et al., 2005*). Rapid human population coupled with low protein intake constitutes a major problem facing developing countries.

Collection of observations showed that an average Nigerian consumes only about 10g per day of the minimum daily intake of 35g animal protein source recommended by Food and Agricultural Organization (FAO, 1997). Perhaps as a result of the increasing population and dismal productivity of livestock in developing countries like Nigeria. The demand for protein of animal origin has far

exceeded the supply. Another cause of this problem of animal protein shortage may be seasonal variation that affects the availability and quality of feed most especially in the dry season.

Adeniji (2002) suggested that the solution to the problem of poor consumption of animal protein by an average Nigerian is to increase the level of production of highly productive animals with short gestation intervals, like poultry, pigs, rabbit, sheep and goats. Goat is one of the most efficient in terms of protein utilization among livestock species.

In improving animal production in Nigeria, it would therefore be reasonable to intensify research effort towards identifying and testing alternative supplementary feedstuff to ameliorate this unfavourable feed scarcity during the dry season (Ojebiyi *et al*., 2008). The provision of food (in form of meat and milk), income and raw materials (manure, hides and skin, wool etc) are the primary reason for domesticating animals in most part of the world. Cattle which produce majority of these products can be supplemented with the production of small ruminants especially goats which have a high reproductive rate, are widely distributed, have a fairly large population and most of all have the ability to thrive in harsh conditions (Ozungi *et al., 2011*). Small ruminants play a significant role in the food chain and overall livelihoods of rural households where they are largely kept as the properties of women (Labbie, 2004). According to Adu *et al*, (1999) Small ruminants are an integral component of the household where they contribute to the cultural, food and Socio-economic life of the people.

Fanimo *et al*, (2004) reported that feed cost accounts for 65-70% of the total cost of production in the intensive system of animal production. The situation is the result of competition between man and livestock for some feed and feed ingredients. This competition is rigorous in developing countries hence the urgent need to source for cheaply available feedstuff that meets requirements for growth and reproduction.

In Nigeria, semi-intensive and extensive systems of animal of animal production are the most common systems practiced in small ruminant production and these make grazing a major feed source for animals. The seasonal variation (wet and dry seasons) contributes largely to the availability of fodder and grasses for grazing. Forage plants and grasses are unable to withstand drought, deplete in nutrients and become unacceptable to small ruminants which are very selective in their choice of grazing resources (Odeyinka and Ajayi, 2004).

Agro-industrial by-products, crop by-products or residues and homestead by-products form the bulk of supplement for ruminants with low cost of purchase and transportation. In Nigeria, there exists a largely untrapped potential for utilizing these products for feeding ruminants. Among these is cashew nut shell, a by-product obtained from the processing of cashew kernel. Cashew nut shell has important value as a feed while lowering the cost of feed input (Fanimo, *et al.,* 2004). Cashew nut shell is readily available within the study area. However, research data on it use in ruminant nutrition is scanty thus, making this work expedient.

The aim of this study therefore was to evaluate the performance, haematological and serum biochemical profiles of weaner West African dwarf goats fed diet containing graded levels of cashew nut shell.

2. MATERIALS AND METHOD

The experiment was carried out at the sheep and goat unit of the Teaching and Research Farm of The Kogi State University, Anyigba, which lies on latitude 7^{o}15' and 7^{o} 29' of the equator and latitude 7^{o}11' and 7^{o}32' of the Greenwich meridian (Ifayimehin *et al*., 2009). The experimental location falls within the derived savannah zone of Nigeria lying in the warm humid climate of the middle belt zone of Nigeria with clear dry and raining season. The mean annual rain fall is 1,260mmwith peak in the months of July and September. A short dry period toward the end of July and early August called "August break" is usually observed in these months. The average temperature of Anyigba is 27^{o}c, which sometimes falls especially during the harmattan to temperatures slightly below 27^{o}c, but however, annual temperatures does not exceed 38^{o}c.

A total of Twelve (12) weaner male West African Dwarf goats were purchase from Anyigba market, and randomly alloted into four (4) dietry treatments. Each treatment had three (3) goats. The animals were weighed; neck tagged and treated with ivomec, procaine penicillin and oxytetracycline HCl, water was given to the animals *ad libtum*. The animals were fed the supplement at 150g/goat/day and

forage (*Pennisetum purpureum*) at 600g/goat/day three hours later. The experiment lasted for fifty (50) days after an initial adjustment period of seven (7) days.

Cashew nut shell was collected from the cashew kernel processing plant in Kogi State University Anyigba. The cashew nut shell was pounded using mortar and pestle to ensure ease of grinding and to increase the surface area. The crushed cashew nut shell was mixed with other feed ingredients like Bambara nut waste, rice offal, table salt, burukutu waste and wood ash, and ground

At the begining of the experiment the goats were weighed and subsequently on a weekly basis. The initial live weights were subtracted from the final live weight gain for each animal. Feed offered was weighed daily and left over were also weighed to determine the feed intake of the animals. Weighing of the goats took place in the morning (between 7.00-9.00 am) prior to feeding each week. Both values were used to determine feed conversion ratio (FCR). The following performance Data were also collected they include; Feed intake, total weight gain and feed conversion ratio.

3. BLOOD SAMPLE COLLECTION

Blood sample were collected for haematological and serological studies in simple bottles from the jugular vein of the goats using needle and syringes. The blood samplefor serological analysis were put in sample bottles without EDTA. The serum total protein, Abumin, Globulin and Creatinine level were determined by the method of Woodton (1964). The blood samples for haematological analysis were collected in sample bottles containing ethylene diamine Tetra acetic acid (EDTA) and there after analysed for packed cell volume, Haemoglobin, Red blood cell count, white blood cell count as well as basophils eosinophils and neutrophils.

Samples of the cashew nut shell, experimental diets and forage were analyzed for their proximate composition using standard procedure (AOAC, 2000).

The experimental design was a completely randomized experimental design. Data were subjected to a one way analysis of variance. Means with significant differences were separated using least significant difference (LSD) with the aid of (SPSS) statistical package for social Science, 16th version.

Table 1. *Composition of Experimental Diets (%Dm)*

Ingredients	Composition/Treatments			
	T_1	T_2	T_{23}	T_4
Cashew nut shell	0	10	20	30
Maize offal	35	29	21	13
Bambara nut waste	24	24	24	24
Rice offal	30	30	30	30
Table Salt	10	6	4	2
Wood Ash	0.5	0.5	0.5	0.5
Total	0.5	0.5	0.5	0.5

4. RESULT AND DISCUSSION

4.1. Proximate Analysis

The proximate composition of experimental diets, cashew nut shell and *pennisetum purpureum* are presented in table 2.

Table 2. *Proximate composition of experimental diets, cashew nut shell and pennisetum purpureum*

NUTRIENTS %	TREATMENTS				Cashew Nut Shell	Pennisetum Purpureum
	T_1	T_2	T_{23}	T_4		
Crude protein	18.60	18.30	18.15	18.01	7.5	16.68
Crude Fibre	15.48	15.55	15.60	15.64	20.80	24.00
Nitrogen Free Extracts	55.77	52.53	49.00	47.82	31.50	38.32
Ether extracts	6.34	9.87	12.66	15.06	39.00	3.50
Ash	3.81	3.70	3.59	3.47	1.20	17.50
P.H	6.4	6.2	5.9	5.7	3.00	-
Gross Energy (KCAL/KGDM)	3149.5	3312.7	3410.3	3559.9	4570.95	2230.46
Dry Matter	90.00	90.00	95.00	97.00	93.50	65.00

The cashew nutshell used in this study had a protein content of 7.50% and crude fibre of 20.80%. the value of crude protein was almost the same with 7.60 reported by Okolo *et al.,* (2012) but slightly higher than 5.00% reported by Ocheja *et al.,* (2011) and the crude fibre was lower than 25.70% reported for cashew nut shell by Okolo *et al.,* (2012) but comparable with 20.75% crude fibre obtained by Ocheja *et al.,* (2011a). The crude protein value was slightly lower than the critical level of 8.00% crude protein level for ruminants as reported by N.R.C (1996). The nitrogen free extract and ether extract content values of 31.50% and 39.00% respectively where both higher than 28.00% and 37.50 reported by Okolo *et al.,* (2012) but lower than 32.91% and 40.25 respectively reported by Ocheja *et al.,* (2011a). However, the ash and dry matter contents of 1.20% and 93.50% was comparable with 1.20% and 92.52% respectively reported by Okolo et al., (2012), but higher than 1.09% ash and 92.21% dry matter reported by Ocheja *et al.,* (2011a).

The crude protein content of 16.68% obtained for *pennisetum purpureum* was higher than 10.55% obtained by Okolo *et al.,* (2012) and 9.70% obtained by Osakwe and Udeogu (2007). The crude fibre content of 24.00% was lower than 30.33% reported by Osakwe and Udeogu (2007) and 36.33 reported by Olorunsomo *et al.,*(2011). The nitrogen free extract and ether extract contents of 38.32% and 3.50 respectively were lower than 52.28 nitrogen free extract reported by Ocheja *et al.,* (2008) and 3.72% ether extract content reported by Amakiri *et al.,* (2011). The value of 17.50% obtained for ash was higher than 11.16% obtained by Okolo *et al.,* (2012) and 9.70% reported by Osakwe and Udeogu (2007). The dry matter content of 65.00% reported for (*pennisetum purpureum*) in this study was higher than 35.50% obtained by Okolo *et al.,* (2012). This disparity could be due to the stage of maturity of the grass. The differences observed in the proximate composition of these by-products can be attributed to the method of preparation which may affect their composition.

The experimental diet were is nitrogenous with protein values ranging from 18.01 (T_4)-18.60 (T_1). The crude fibre content of the diets was similar. The nitrogen free extract content as well as ash content of the diets decreased from T_1-T_4 which could be attributed to increasing levels of cashew nut shell across the treatments which is low in nitrogen free extract and ash respectively. The ether extract content of the diets increased from T_1-T_4 this could be attributed to the increasing levels of cashew nut shell, T4 had the highest dry matter and energy content which could also be attributed to increasing levels of cashew nut shell inclusion. The crude protein content of about 18% obtained the experimental diets fell within the range of 12-18% recommended for growing ruminants in the tropics. They were also well above the critical protein requirement for goats as reported by NRC (1996).

4.2. Performance

The performance data is summarized in table 3.

Table 3. *Performance Characteristics of the Experimental Animals*

Parameters	Treatments				
	T_1	T_2	T_{23}	T_4	SEM
Number of goats	3	3	3	3	-
Duration (days)	50	50	50	50	-
Initial weight (kg)	5.5	5.25	5.50	5.55	0.36
Final weight (kg)	6.30^{a}	5.75^{b}	5.97^{b}	5.95^{b}	0.47
Total weight (kg)	0.75^{a}	0.50^{b}	0.47^{b}	0.40^{c}	0.25
Daily weight gain (g)	15.0^{a}	10.0^{b}	9.40^{b}	8.00^{c}	4.95
Daily supplement intake (g)	76.05^{a}	64.29^{b}	32.54^{c}	17.46^{d}	8.46
Daily forage intake (g)	230.31^{c}	265.35^{b}	300.7^{a}	265.1^{b}	13.12
Daily dry matter intake (g/dm)	306.36^{ab}	329.64^{a}	333.24^{a}	265.1^{b}	18.54
Feed converse on ratio	25.25^{a}	32.97^{b}	35.48^{b}	35.52^{b}	7.44

a, b, c, d = Treatment means on the same row with different superscript differ significantly ($p < 0.05$)
SEM = Standard error of mean

Daily weight gain increased steadily from T_4 (8.00g) to T_1 (15.00g) and showed significant (P >0.05) differences. The values obtained for daily weight gain were lower than that reported by Eniolorunda et al., (2008) who reported a range of 31.27 – 42.26g for WAD goats. the best value for total weight gain of T_1 (0.75)kg may be due to a higher supplement intake as well as best feed utilization.

Daily supplement intake decreased progressively from T_1 (76.05) – T_4 (17.46). And were significantly (P<0.05) different.

Treatment had significant effect (P<0.05) on forage intake. T_3(300.7g) had the highest daily forage intake while T_1(230.31) had the lowest. The daily dry matter intake (265.1g-333.24g) were in line with those reported by Ifut et al., (2011) who reported a range of 235 – 388.82gdm for WAD goats. Feed conversion ratio improved steadily (P<0.05) with T_1 (25.25) having the best which could be attributed to highest feed utilization.

4.3. Haematological Profile

The effect of the diets containing graded levels of cashew nut shell on the blood composition is presented in table 4.

Table 4. *Haematological Characteristics of Experimental Animals*

Parameters	Treatments				
	T_1	T_2	T_{23}	T_4	SEM
Pack cell	39.86	38.85	40.52	36.76	2.70
Volume (%)					
Haemoglobin (g/l)	197.6	205.5	209	198	18.56
Red blood cell ($\times10^{12}$/l)	11.95^a	6.35^d	7.82^c	10.37^b	0.50
White blood cell ($\times10^9$/l)	6.98^c	8.28^b	3.74^d	10.74^a	1.82
Neutrophils (%)	49.00^a	48.00^a	31.00^b	46.50^a	7.91
Basophils (%)	1.00^a	0.00^c	1.00^a	$0.5.0^b$	0.35
Eosinophils (%)	1.00^c	1.50^b	2.00^a	1.00^c	0.7

a,b,c,d = Treatment means on the same row with different superscript differs significantly (p<0.005)

SEM = Standard Error of Means.

There was no significant (p <0.05) dietary effect on packed cell volume, haemoglobin concentration and Eosinophils. And the values for these parameters were comparable with the values reported by Okolo *et al*., (2012).

The Red Blood cell (RBC) values differed significantly (p<0.05), the value obtained in this study (6.35-11.95 $\times10^{12}$/l) fell within the range of 6.77-12.87 $\times10^{12}$/l reported by Ocheja *et al*., (2012) and 5.86-14.00$\times10^{12}$/l reported by Kauffmam, (1980). There were significant differences (p< 0.05) in the value of white blood cell, the range of 3.74 to 10.74$\times10^9$/l obtained in this study were similar to 8.65 to 9.74$\times10^{12}$ /l reported by Ocheja *et al*., (2012). There was significant differences (p<0.05) in the values of neutrophils, with T_1, T_2 and T_3 being similar. The range of 31.00 to 49.00% was lower than the range of (60-71%) reported by Ocheja *et al*., (2012). There were significant differences (p<0.05) in Eosinophils, the range of 1.0-2% obtained in this study were at variance with 2% reported by Ocheja *et al*., (2012). All the haematological values however, fell within normal range for West African dwarf goats.

4.4. Serum Biochemical Profile

The total protein values decreased steadily from T_1 (6.77) to T_4 (5.77) and showed significant (P<0.05) differences, with T_1 and T_2 being similar but different from T_3 and T_4 which were also similar. This was however not in line with the report of Ocheja *et al* (2012) who reported no significant (P<0.05) differences in total protein values for growing West African dwarf goats. This disparity might be due to differences in the classes of the goats used. Creatinine levels increased steadily from T_1 (0.16) to T_4 (0.52), and were significantly (P<0.05) different. Alkaline phosphate

value also increased steadily from T_1 (365.24) to T_4 (458.51). All the serum parameters evaluated fell within normal values for weaners West African dwarf goats. The trends in the values of the serum profilesmay indicate that the protein quality as well as protein utilization of the diets decreased with increasing level of cashew nut shell.

The serum biochemical profile of experimental animals are presented in table 5.

Table 5. *Serum biochemical Profile of Experimental Animals*

Parameters	Treatments				
	T_1	T_2	T_{23}	T_4	SEM
Total protein (g/l)	6.77^{a}	6.66^{a}	5.84^{b}	5.77^{b}	2.60
Creatinine (4mol/l)	0.16^{d}	0.23^{c}	0.39^{b}	0.52^{a}	0.25
Albumin (g/l)	3.55^{ab}	2.79^{c}	3.97^{ca}	3.19^{b}	1.87
Globumin (mol/l)	3.22^{b}	3.69^{a}	2.05^{d}	2.58^{c}	1.09
Alkaline phosphate (1u/l)	365.24^{c}	401.20^{b}	458.16^{a}	458.51^{a}	1.17

a, b, c, d = Treatment means on the same row with different superscript differ significantly ($p < 0.05$)

SEM = Standard error of mean

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The control (T_1) performed best in terms of growth performance. inclusion of cashew nut shell in supplement diet for weaners West African Dwarf goats even at 10% level had adverse effect on performance.

However inclusion of cashew nut shell in supplement diets for weaner of West African Dwarf goat up to 30% level of inclusion had no adverse effect on haematological and serum biochemical profiles.

5.2. Recommendations

Cashew nut shell should be included at less than 10% level of inclusion in supplement diets for weaner West African Dwarf goats.

Other feed ingredients to be used alongside cashew nut shell in compounding rations for goats should be fairly high in crude protein and low in ether extracts so as to bring the levels of crude protein and ether extract of the diet to recommended levels

The use of feed additives as well as processing method for cashew nut shell geared towards improving feed intake is suggested.

Further research using other levels of inclusion i.e. (5%, 7.5%, 15% etc) as well as other classes and breeds of goats is suggested.

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