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GROWTH RESPONSE, NUTRIENT DIGESTIBILITY AND COST ANALYSIS OF WEST AFRICAN DWARF BUCKS FED DIETS CONTAINING GRADED LEVELS OF COWPEA (*Vigna unguiculata*) HUSK WITH GMELINA (*Gmelina arborea*) LEAVES AS BASAL DIET

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ABSTRACT

A total of twenty (20) growing WAD bucks of about 7 - 9 months and having average weight of 9.64 kg were used in an 84 day trial to investigate the performance response of West African Dwarf (WAD) goats fed diets containing cowpea husk (CPH). Cowpea husk used for the study was collected from Nasarawa Eggon Local Government Area of Nasarawa State. Four experimental diets were formulated to replace maize offal with cowpea husk and designated A (0%), B (25%), C (50%), and D (75%) and used to feed the bucks. Results showed that none of the performance parameters showed treatment effect (P>0.05). The mean daily weight gain was 56.55 g/day, 52.75 g/day, 42.81 g/day and 50.49 g/day for diets A, B, C and D respectively. The mean daily feed intake ranged between 458.40 g/day -503.00 g/day, with treatments D and B having the highest and lowest numerical values, respectively. The apparent nutrient digestibility coefficient of dry matter (DM), crude fibre (CF), ash, nitrogen free extract (NFE) showed significant differences (P<0.05) among the treatments and some crude fibre fractions like neutral detergent fibre (NDF) and acid detergent lignin (ADL) were significantly different (P<0.05) among the treatments means. The concentrate feed cost/kg diet was between ₦63.85-₦73.74. The cost/kg weight gain was best for treatment B (₦617.05). The production efficiency was less than one for all the treatments. Cowpea (*vigna unguiculata)* husk can be used in the diets of West African dwarf goats without adverse effect on the performance indices and profitability.

Key words: Cowpea husk, Nutrient digestibility, Nutrient intake, West African Dwarf goats, Production efficiency

INTRODUCTION

The goat is a multi-functional animal and constitutes a very important part of the livelihood of livestock farmers in Nigeria (Okoruwa *et al.*, 2013). They are one of the most important domesticated small ruminants in Nigeria (Tsado *et al.*, 2009). FAOSTAT (2011) had earlier reported that they constitute the largest group of small ruminant population. Their ability to tolerate harsh climate, trypano-tolerance in some breeds (Salako, 2004), suitability to traditional systems on account of small size, short generation interval (Abdul-Aziz, 2010) as well as their ability to thrive on poor quality forages, emphasize their importance. Goats provide the cheapest source of domestic meat in the tropics because of their fecundity and low feed requirement when compared to cattle (Tsado *et al.*, 2009). Although these groups of small ruminants have these amazing natural endowments, feed availability all the year round has been a key factor bedevilling their increased productivity. Bawala and Akinsoyinu (2002) earlier reported that the inability of ruminant livestock farmers to feed their animals with high quality forages all the year round remains the most widespread technical constraints facing ruminant animal productivity in the developing nations like Nigeria. This shortage of quality feed materials is occasioned by the long dry season which occurs yearly, and the impact is usually more intense in the drier areas of the country. Grasses which are most abundant basal feed for ruminants most of the times dry up and become dormant during the long dry season (Lakpini, 2002), this situation usually leads to a decrease in the nutritive and digestibility values of the grass species and consequently, loss in body weight of animals. Lamidi *et al.* (2010) had long agreed to this by reporting that the available forages for most part of the year are low in protein content, and this leads to marked decreased voluntary intake and digestibility, and subsequently a substantial weight loss of the animals during this period. Available forage during the dry season proper is fibrous, lignified with low protein value and even in short supply (Babayemi *et al.,* 2003). Supplementation with concentrate feeds is therefore imperative to ameliorate the harsh feed scarcity that occurs during this long dry period. This to a very large extent will help forestall the attending consequences of inadequate feed supply orchestrated by the dry periods.

Utilization of unconventional feed materials which are viable, cheap and not in high demand by humans (Amaefule *et al*., 2004) are of utmost importance in animal production. Cowpea husk is one such unconventional feedstuff. Cowpea (*Vigna unguiculata)* is one of the most popular legume grains in Africa. It is a member of the *Vigna* (peas and beans) genus. *Unguiculata* is Latin for "with a small claw", which reflects the small stalks on the flower petals (Ernest, 2009). Most cowpeas are grown on the African continent, particularly in Nigeria and Niger, which account for 66% of world cowpea production (FAO. 2012). Cowpea is called the "hungry-season crop" because it is the first harvested crop, before the cereal crops. Cowpea husk; a by-product of cowpea production, is obtained after the seeds have been removed by threshing the pods and winnowing out the husks to collect the seeds. The husk is most of the time left on the farm to rot or they are burnt off. Makkar (2012) reported that cowpea husk contains 95.49% DM, 12.79% CP, 33.40% CF, 7.00% EE, 10.70 Ash and 41.63% NFE. Oluokun, (2005) reported that cowpea husk is characterized by a high level of crude fibre (about 31%) and a relatively low level of protein (12-13%). Cowpea husk has been used in the diets of sheep (Okoruwa *et al.*, 2013) without adverse effect on the animals. This study was therefore designed to evaluate the effect of cowpea husks on the performance and nutrient digestibility of West African Dwarf (WAD) growing bucks fed diets containing graded levels of cowpea husks with Gmelina leaves as a basal diet.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Teaching and Research Farm, University of Agriculture Makurdi. Makurdi is located between latitude 7° 14' N and longitude 8° 21'E. The area is warm with wet season from April to October and dry season from November to March. It has the minimum temperature range of 17.30°C - 24.50°C and a maximum temperature range of 29.80°C - 35.60°C. During the dry hot season between February and March, temperatures may reach 35°C - 40°C. The annual rainfall is between 1500 mm – 1800 mm (Wikipedia, 2013).

Collection of test ingredient

The test material was obtained from farms in Nasarawa Eggon Local Government Area of Nasarawa State where the cowpea had already been threshed and the husk left on the farm. The cowpea husk were then parked into synthetic bags and transported to the animal farm and stored there for use.

Experimental diets

Four experimental diets were compounded using the cowpea husk and the diets contained 0%, 25%, 50% and 75% of the cowpea husk, and these diets were tagged treatment A, B, C and D respectively.

Experimental animals, housing and management

A total of twenty (20) bucks aged of average weight of 9.64 kg were bought from medium scale farmers within the University and its environs and used for the study. A week to the arrival of the animals, the experimental house was washed thoroughly using detergent and disinfectant (Izal) and allowed to dry. The floor of each compartment was covered with wood shaving which served as litter materials and beddings. The feeding troughs and drinkers were also washed, sun-dried and kept in each compartment. On arrival to the farm, the animals were treated against endo and ectoparasites using ivermectin and vaccinated against *Peste des petits ruminants* (PPR) disease using the PPR vaccine. The animals were weighed and randomly distributed into four (4) treatments groups and each treatment group had five replicates. About 14 days were allowed for adjustment to the feed as well as the environment before data collection commenced. Daily, 250 g of the concentrate supplements was offered to the animals at about 8:00 hour, then at 10:00 hour, the Gmelina forage was served to the animals and this was *ad libitum*. Feeding of the forage was done twice, the first feeding was at about 10:00 hour while the second feeding was at 14:00 hour. Feeding the forage twice daily was to help reduce wastage of the forage and encourage intake. Feeding of the forage was done by tying the forage together in small bundles and suspending it from the roof of each compartment, down to the animals using small ropes. Mineral supplement was provided for each animal in the form of mineral blocks. All the experimental animals were provided daily with fresh clean water *ad libitum*. Feed intake was measured by subtracting the weight of the left-over feed from the total weight of feed supplied. The animals were weighed weekly in order to find out their body weight changes.

Nutrient Digestibility

During the last week of the experiment, the animals were transferred into metabolic cages fitted with plastic nets below to collect the faecal droppings. Faecal samples were collected daily from each animal, weighed, oven-dried to constant weight and kept in desiccators before weighing again. At the end of seven days, all the samples were bulked by replicates, thoroughly mixed and ground. Sub-samples were then taken from each replicate for analysis of their proximate constituents and crude fibre fraction components. The proximate analysis of the feed and the faecal samples were carried out according to the methods outlined by AOAC (2000). The fibre fractions were determined using the methods of Van Soest *et al.* (1996). The hemicellulose was calculated as the difference between NDF and ADF while cellulose was calculated as the difference between ADF and ADL respectively. The apparent nutrient digestibility was calculated using the formula;

Apparent nutrient digestibility =

$$\left(\frac{\%\,Nutrient\ consumed - \%\,Nutrient\ voided}{\%\,Nutrient\ consumed}\ X\ 100\right)$$

The cost/kg of feed and the cost of processing of each experimental diet were determined based on the current prices of feed ingredients in Makurdi. The cost of feeding the bucks on a particular treatment for the period of the study was calculated as the product of the cost/kg of the diet and feed intake. Feed cost/kg weight gain (₦) was calculated by multiplying feed cost/kg (₦) by feed conversion ratio. The net profit was computed as the selling price of live weight of mature buck less the total cost of production. Efficiency of production was obtained by dividing the net revenue by total cost.

Experimental design

The completely randomized design (CRD) was used for the experiment.

Statistical Analysis

Data collected from the study were subjected to analysis of variance (ANOVA) using Minitab 16 (2004) statistical software. Where significant differences occurred, it was separated using Fisher's least significant difference (LSD).

RESULTS AND DISCUSSION

The dietary and proximate composition of the experimental diets fed to West African dwarf goats is presented in Table 1. The dry matter values were between 89.00-91.00%. Dry matter values were high indicating a long shelf life. Crude protein values were between 17.30-18.75%, values increased with increasing levels of cowpea husk in the diets. Observed values were adequate for optimal microbial activities. The CP values were comparable with 15.60-18.22% CP reported by Nsidinanya *et al*. (2020) for Red Sokoto goats fed brewer's dried grains and malted sorghum sprouts in *Andropogon tectorum* hay meal based diets. Fajemisin *et al*. (2018) however, reported higher CP values of 19.03-20.55% in the diets of West African dwarf growing goats fed *Panicum maximum* supplement with *Myrianthus arboreus* leaf meal concentrates. Ether extract values were between 9.50-10.92%, indicating additional energy sources for the goats. Observed values of EE were higher than 2.87-3.19% reported by Nsidinanya *et al*. (2020) for Red Sokoto goats fed brewer's dried grains and malted sorghum sprouts in *Andropogon tectorum* hay meal based diets, while higher EE values of 11.01-12.62% were reported by Fajemisin *et al*. (2018) for West African dwarf goats fed *Panicum maximum* supplement with *Myrianthus arboreus* leaf meal concentrates. Ash values were 7.00%, 8.56%, 10.62% and 10.08% for treatments A, B, C and D, these values indicate that there was an appreciable amount of minerals in the diets. Ash values in the diets were lower than 7.89-13.94% reported by Amuda and Okunlola (2020) for WAD sheep fed ensiled maize stover and concentrate supplements. NFE values ranged between 48.44-53.61%, implying that there was appreciable fermentable carbohydrate available for use by the goats. Observed NFE values were within 41.64-57.90% reported by Olawoye *et al*. (2020) for West African dwarf goats fed formulated concentrate and palm kernel cake supplements, but lower values of 43.30 - 46.25% were reported by Amuda and Okunlola (2020) for WAD sheep fed ensiled maize stover and concentrate supplements.

Table 1: Dietary and proximate compositions of experimental diets fed to West African dwarf goats WAD (%)

Feed ingredient	Experimental diets			
	A	B	C	D
Maize offal	48.84	36.63	24.42	12.21
Fermented sweet orange peel meal	25.00	25.00	25.00	25.00
Cowpea husk	0.00	12.21	24.42	36.63
Soybeans meal	23.16	23.16	23.16	23.16
Bone ash	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Total	100	100	100	100
Determined analysis (%)				
Dry matter	90.00	89.00	91.00	90.00
Crude protein	17.50	18.20	18.32	18.75
Crude fibre	12.00	13.00	13.00	12.65
Ether extract	9.89	10.92	9.62	9.50
Ash	7.00	8.56	10.62	10.08
Nitrogen free extract	53.61	49.32	48.44	49.02
Neutral detergent fibre	46.00	70.00	68.00	64.00
Acid detergent fibre	37.00	18.00	26.00	23.00
Acid detergent lignin	1.00	4.00	6.00	6.00
Hemicellulose	29.00	52.00	22.00	41.00
Cellulose	36.00	14.00	20.00	17.00

CPH= Cowpea husk, A = 0% CPH, B = 25% CPH, C= 50% CPH, D = 75% CPH

The performance of the goats fed the diets is presented in Table 2. None of the performance parameters measured showed significant difference (P>0.05) among the treatments. Mean daily weight gain ranged from 42.81 - 56.55 g/day, showing that the diets containing cowpea husk were nutritionally adequate and compared favourably with the control diet as they also effectively supported weight gains of the goats. The total concentrates intake values ranged from 17.47-19.63 kg and there were no significant differences (P>0.05) among the treatments implying that all the treatments containing the test ingredients were equally palatable and acceptable to the animals so that, the diets were adequately consumed as much as the control. Average daily feed intakes range was between 458.40-503.00 g/day. Forbes (1995) reported that if the feed intake by the animals is low, rate of productivity will also be depressed, Do ThiThanh (2006) agreed to this by describing feed intake as one of the factors determining productivity in small ruminants. The similarity in feed intake across the treatments shows that CPH in the diets of the animals did not cause a depression in feed intake and productivity. Observed values of feed intake were higher than 313.18-340.34 g/day reported by Fajemisin *et al*. (2018) for West African dwarf growing goats fed *Panicum maimum* supplemented with *Myrianthus arboreus* leaf meal concentrates, but similar with 454.81-495.19 g/day reported by Jiwuba *et al*. (2016) for WAD goats fed diets containing *Moringa oleifera* leaf meal.

Mean daily weight gains values ranged from 42.81-56.55 g/day, indicating that all the diets supported weight gains. Observed values were higher than 12.68-25.89 g/day reported by Adebisi *et al.* (2019) for West African dwarf rams fed guinea grass supplemented with differently processed pigeon pea leaves, but within 38.69-68.00 g/day reported by Omotosho and Arilekolasi (2019) for West African dwarf goat-bucks fed molasses-treated biodegraded rice husk, while Oloche *et al.* (2019) reported comparable values of 42.63-64.76 g/day for Kano Brown goats fed *Gmelina arborea* leaves and supplemented with diets containing water soaked sweet orange peels. Feed conversion ratio values were 8.85, 8.76, 12.25 and 10.34 for A, B, C and D respectively, and they were similar (P>0.05) across the treatment. This shows that the utilization of feed by the animals for diets containing CPH was as good as the control diet. Observed values of feed conversion ratio were better than those of Fajemisin *et al*. (2018) who reported 17.55-43.84 FCR for WAD goats fed *Panicum maximum* supplemented with *Myrianthus arboreus* leaf meal concentrate and 14.70-19.09 reported by Oloche *et al*. (2018) for WAD goats fed water soaked sweet orange peel meal. Jiwuba *et al.* (2016) however, reported comparable values of 10.77-13.90 for West African Dwarf goats fed diets containing *Moringa oleifera* leaf meal.

Table 2: Performance of West African dwarf Bucks fed diets containing cowpea husk

	Experimental diets				
Parameters	A	B	C	D	SEM
Total concentrate intake (kg)	19.21	17.47	19.12	19.63	0.91^{ns}
Total forage intake (kg)	22.59	21.04	22.33	22.71	0.58^{ns}
Total feed intake (kg)	41.72	38.51	41.43	42.26	1.26^{ns}
Mean daily feed intake (g)	496.70	458.40	493.40	503.00	15.05^{ns}
Initial weight (kg)	9.68	9.67	9.68	9.51	0.63^{ns}
Final weight (kg)	14.43	14.11	13.28	13.75	0.67^{ns}
Total weight gain (kg)	4.75	4.43	3.60	4.24	0.30^{ns}
Mean daily weight gain (g)	56.55	52.75	42.81	50.49	3.62^{ns}
Feed conversion ratio	8.85	8.69	11.53	9.96	1.06^{ns}

A = 0% CPH, B = 25% CPH, C= 50% CPH, D = 75% CPH, SEM = Standard Error of the Mean, ns = Not Significant (P>0.05).

The nutrient digestibility of West African dwarf bucks fed the diets containing cowpea husk is presented in Table 3. Dry matter (DM), crude fibre (CF), nitrogen free extract (NFE), and ash showed significant differences (P<0.05) among the treatments, while the other proximate constituents were similar (P>0.05). FAO (1995) had earlier classified digestibility of feed as high (greater than 60%), medium (40-60%) and low (less than 40%). In this study the digestibility values of all the parameters measured were high, except the ADL value for the control treatment (57.60%) which was medium. This high digestibility of nutrients could probably be an indication that the protein content of the diets was sufficiently adequate and this may have influenced microbial protein synthesis, facilitating fermentation and consequently improved intake and digestibility. The digestibility values for DM were between 81.85-90.71%, treatments A (90.40%) and B (90.71%) were significantly higher (P<0.05) than treatments C (81.58%) and D (83.46%), but between treatment A and B, there was no difference, also between treatment C and D there was no difference. The high DM digestibility values implies that appreciable amounts of nutrients were released for absorption and that CPH in the diets of the goats did not interfere with digestibility of nutrients. Observed DM digestibility values were higher than 55.71-71.43% reported by Akinbode *et al*. (2018) for West African dwarf sheep fed sugar cane top silage but comparable with 72.73- 82,.70% reported by Fajemisin *et al*. (2018) for West African dwarf goats fed *Panicum maximum* supplemented with *Myrianthus arboreus* leaf meal concentrates.

Crude protein digestibility values ranged from 89.48-92.23%, cowpea husk contains saponin and tannins, (Yusuf *et al*., 2012), the presence of tannin and saponin seemed to have favoured the crude protein digestibility in the treatments with the test diets by decreasing protein degradation in the rumen so that appreciable quantity of protein was also available post-ruminally for digestion in these treatments. This is in agreement with the report of Babayemi and Bamikole (2006) who reported that the presence of tannin and saponin lowers the solubility of proteins entering the abomasum and small intestine for digestion. Observed values of CP digestibility were higher than 59.98-75.66% reported by Akinbode *et al*. (2018) for WAD sheep fed sugar cane top silage, 47.82- 73.32% reported by Amuda and Okunlola (2020) for west African dwarf sheep feed ensiled maize stover and concentrate supplements but similar with 85.41-92.92% reported by Jinadu *et al.* (2018) for West African rams fed diets containing graded levels of *Garcinia kola* (bitter kola) seed meal.

The CF digestibility values ranged between 84.72 - 89.21%**.** Odoemelan and Ahamefule (2006) reported that fibre is important in the diets of farm animals and some level of fibre enhances proper bowel movement. The level of fibre in the diets was adequate and digestibility was not effective. Observed values were high, this was probably so because the rumen fibrolytic bacteria were able to efficiently degrade the type of fibre involved in the diets. Observed CF digestibility values were comparable with 76.27-86.18% reported by Fajemisin *et al*. (2018) for West African dwarf goats fed *Panicum maximum* supplemented with *Myrianthus arboreus* leaf meal concentrates. The NFE digestibility which had a similar trend like DM digestibility also showed significant difference (P<0.05) among the treatments. Treatment A (82.135) and B (81.78%) were higher than treatments C (75.64%) and D (75.92%), but as can be seen all the treatments values were high, this means that appreciable quantities of fermentable carbohydrates were available for absorption. Observed values of NFE digestibility were similar with 74.51-84.26% reported by Jinadu and Okunola (2020) for WAD sheep fed ensiled maize stover and concentrate supplements, but higher than 60.42-72.74% reported by Yashim (2017) for red Sokoto goats fed varied levels of potato peels.

Ash values were between 83.18-90.65% and showed significant difference (P<0.05) among the treatments, the trend was similar to those of DM and NFE digestibility. The high values show that appreciable quantities of minerals were available for absorption. Observed values were similar to 83.18-91.08% reported by Jinadu *et al.* (2018) for sheep fed diets containing graded levels of *Garcinia kola* (bitter kola) seed meal, but higher than 19.27-32.77% reported by Amuda and Okunlola (2020) for WAD sheep fed ensiled maize stover and concentrate supplement. The NDF digestibility values were between 77.30-86.56%, while the ADF values were between 73.11-81.01%. Bakshi and Wadhwa (2004) reported that high NDF and ADL depress intake and digestibility, however, in this study NDF and ADF digestibility were enhanced, probably because CPH which was replacing maize offal in the diets of the bucks provided some additional quantity of protein which yielded a little more ammonia for the activities of the rumen microbes to better degrade the fibre type involved in the diets. Thus the presence of CPH in the diets of the experimental goats did not depress digestibility but enhanced it. The high digestibility of nutrients in this study is in agreement with the work of Fajemisin *et al*. (2018) who reported high digestibility in all nutrients when West African dwarf goats were fed *Panicum maximum* and supplemented with *Myrianthus arboreus* leaf meal concentrates. However, Ososanya and Alabi (2015) reported that graded supplementation of the diets of West African dwarf ewes with CPH produced increased nutrients digestibility with increasing levels of CPH.

Table 3: Apparent nutrient digestibility of West African dwarf bucks fed diets containing cowpea husk

	Experimental diets				
Parameters (%)	A	B	C	D	SEM
Dry matter	90.40^{a}	90.71^{a}	81.85^{b}	83.46^{b}	1.16^{*}
Crude protein	92.23	91.95	89.68	89.48	0.84^{ns}
Crude fibre	88.27^{ab}	89.21^{a}	85.94^{bc}	84.72^{c}	1.01^{*}
Ether extract	91.94	91.96	89.40	88.99	1.05^{ns}
Nitrogen free extract	82.17^{a}	81.78^{a}	75.64^{b}	75.92^{b}	1.56^{*}
Ash	90.49^{a}	90.65^{a}	86.75^{ab}	83.18^{b}	1.39^{*}
Organic matter	93.60	91.63	92.63	92.85	0.74^{ns}
Nutrient detergent fibre	85.20^{a}	86.56^{a}	82.32^{ab}	77.30^{b}	1.75^{*}
Acid detergent fibre	81.01	79.11	78.03	73.61	2.02^{ns}
Acid detergent lignin	57.60^{c}	71.52^{a}	68.78^{ab}	63.74^{bc}	2.14^{*}
Hemicellulose	91.65	91.67	86.25	87.88	1.52^{ns}
Cellulose	84.49	82.39	79.84	78.99	2.21^{ns}

A = 0% Cowpea husk, B = 25% Cowpea husk, C= 50% Cowpea husk, D = 75% Cowpea husk, SEM = Sum of Error Mean, ns = Not significant (P>0.05), * = Significant (P<0.05).

The cost analysis of the West African dwarf bucks fed diets containing cowpea husk is presented in Table 4. Feed cost/kg diet was between ₦73.74-₦63.85. The feed cost/kg diet decreased with increasing levels of cowpea husk diets. This is in agreement with the report of Ogundipe *et al.* (2003) who reported that there was a need to lower feed cost in order to produce affordable meat and other animal products for the populace for improved living standards. The profit/per mature buck showed that all the treatments brought in revenue and there were no losses. Treatment A (₦4,259.83) however, had the highest profit, while the lowest profit was in treatment C (₦2,938.25). Efficiency of production was less than one (1) in all the treatments with C and D having slightly lower values than A and B. Jiwuba *et al.* (2016) reported that the lower the value of production efficiency the better.

Table 4: Cost analysis of West African dwarf bucks fed diets containing cowpea husk.

	Experimental diets			
Parameters	A	B	C	D
Concentrate feed cost/kg diet (₦)	73.74	70.44	67.15	63.85
Feed cost /buck (₦)	1,410.40	1,230.5	1,283.60	1,244.80
Cost/young buck (₦)	5,000.00	5,000.00	5,000.00	5,000.00
Miscellaneous cost/buck (₦)	800	800	800	800
Total cost of production (₦)	7,284.14	7,100.94	7,150.75	7,108.65
Average final weight/buck (kg)	14.43	14.05	13.28	13.55
Selling price/kg live weight/buck (₦)	800	800	800	800
Total revenue/mature buck(₦)	11,544	11,240	10,089	10,282
Profit/mature buck (₦)	4,259.86	4,139.06	2938.25	3173.35
Efficiency of production	0.58	0.58	0.41	0.45

A = 0% CPH, B = 25% CPH, C= 50% CPH, D = 75% CPH

CONCLUSION

Cowpea husk can be used in the diets of West African dwarf goats up to 75% without negatively affecting the performance of the goats. Therefore, farmers can incorporate cowpea husk in the diets of their goats to help alleviate the challenge of feed cost and availability all the year round.

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