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The dry season pregnancy and cost-benefit of West African dwarf goats fed cassava leaf meal- based diets

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Abstract

The successful delivery of pregnant West African Dwarf (WAD) goats is closely tied to the quality of available feed, particularly during the dry season. Investigating appropriate dry season feeding for optimal performance becomes imperative. This experiment aimed to assess the cost-benefit ratio and reproductive efficiency of West African Dwarf does when fed concentrate diets incorporating cassava leaf meal during the dry season. Twenty WAD does were utilized and categorized into four groups based on weight ranges. Each animal received a feed at a rate of 3.5 percent of their body weight throughout the 19-week experiment. Daily feed consumption was recorded, and weights were measured every two weeks. Maximum feed intake was observed in the late stages of pregnancy (895.25g), with consistently higher feed intake across all pregnancy stages, although no significant difference was noted among treatments (P>0.05). Growth parameters of pregnant West African Dwarf Does showed no significant differences when fed a diet containing concentrated cassava leaf meal. Optimal weight gain in animals was achieved by feeding 10% cassava leaf meal. These findings indicate that supplementing concentrates with cassava leaf meal at inclusion levels of 10%, 20%, and 30% enhances feed intake during each pregnancy phase, with 10% inclusion demonstrating the most cost-effective weight gain. It is recommended to feed late-pregnancy West African Dwarf Does with a 10% inclusion level of cassava leaf meal.

Keywords: Diet, stages of pregnancy, cost benefit, air-dried, dry season, West African dwarf

La gestation en saison sèche et le rapport coût-bénéfice des chèvres West African Dwarf nourries avec un régime à base de farine de feuilles de manioc

Résumé

La réussite de la mise bas de chèvres West African Dwarf (WAD) gestantes est étroitement liée à la qualité de l'alimentation disponible, en particulier pendant la saison sèche. Il devient impératif d'étudier une alimentation appropriée en saison sèche pour des performances optimales. Cette expérience visait à évaluer le rapport coût-bénéfice et l'efficacité de reproduction des chèvres West African Dwarf lorsqu'elles sont nourries avec des régimes concentrés incorporant de la farine de feuilles de manioc pendant la saison sèche. Vingt femelles WAD ont été utilisées et classées en quatre groupes en fonction de *tranches de poids. Chaque animal a reçu une nourriture à raison de 3,5 pour cent de son poids corporel tout au long de l'expérience de 19 semaines. La consommation quotidienne d'aliments a été enregistrée et les poids ont été mesurés toutes les deux semaines. La consommation alimentaire maximale a été observée aux derniers stades de la grossesse (895,25 g), avec une consommation alimentaire constamment plus élevée à tous les stades de la grossesse, bien qu'aucune différence significative n'ait été observée entre les traitements (P > 0,05). Les paramètres de croissance des femelles West African Dwarf gravides n'ont montré aucune différence significative lorsqu'elles ont été nourries avec un régime contenant de la farine concentrée de feuilles de manioc. Un gain de poids optimal chez les animaux a été obtenu en leur donnant 10 % de farine de feuilles de manioc. Ces résultats indiquent que la supplémentation en concentrés avec de la farine de feuilles de manioc à des niveaux d'inclusion de 10 %, 20 % et 30 % améliore la prise alimentaire au cours de chaque phase de gestation, une inclusion de 10 % démontrant le gain de poids le plus rentable. Il est recommandé de nourrir les femelles West African Dwarf en fin de gestation avec un niveau d'inclusion de 10 % de farine de feuilles de manioc.*

Mots-clés : régime alimentaire, stades de la grossesse, coût-bénéfice, séchage à l'air, saison sèche, West African Dwarf

Introduction

During the dry season, the native rangelands and crop residues available for ruminants after crop harvest are usually fibrous and devoid of most essential nutrients including proteins, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal (Osuji et al; 1995) resulting in weight losses, low birth weights, lowered resistance to disease, and reduced animal performance (Onwuka et al., 1989). In response to these challenges, the usual practice has been to supplement livestock diets with protein rich ingredients such as groundnut cake (GNC), brewery dry grain (BDG), soybean meal (SBM) and cotton seed cake (CSC.) and due to the rising cost and chronic shortage of this feed resources over the years' attempts has been made to expand the animal industries in developing countries by which is what led to the consideration of cassava leaf as a feed supplement. Cassava (*Manihot esculenta* Crantz) is a drought-tolerant, staple food crop that is grown in tropical and subtropical areas. As an important raw material, cassava is a valuable food source in developing countries, and extensively employed for producing starch, bioethanol and other bio-based products (e.g., feed, medicine, cosmetics, and biopolymers) (Shubo Li *et al.,* 2017). Cassava leaf was often left on the farm to serve as green manure, as just the root and stem were what mattered to farmers, some part of Africa also uses a variety of cassava leaf as boiled vegetable (Jones, 1959). Unlike the popular use of cassava peel as feed supplement, The pregnant performance and cost-benefit of West African Dwarf does fed cassava leaf meal concentrate is the focus of this study, which is one of the few studies to test the high nutritional value of cassava leaf for feeding ruminant animals.

Materials and Methods

Experimental site

The experiment was conducted at the Small Ruminant Unit of the Directorate of University FARMS, Federal University of Agriculture. The farming region is located in latitude 7 10''N, longitude 3''E, and elevation 76mm above sea level. The farmland is situated in the south-western Nigerian savannah zone, which has a derived climate. With a mean annual rainfall of 1.037mm and a temperature of roughly 34,7°C, it also has a humid environment while being in a tropical area.

Experimental animals and management

A total of twenty West African dwarf does of within the age of 8 to 15 months. were acquired from local vendors in Bodija market, Ibadan, Oyo state. The goats were quarantine for seven days, then vaccinated against *pest de petit ruminate* (PPR). During, quarantine the animals were provided with forages, concentrate, cassava peels and water *ad-libitum*, after quarantine and acclimation to the control diet. The animals were given permission to breed with a chosen buck from the university farm, and they were then equally divided into four treatment groups by chance. The animals were also given the freedom to forage freely on the already-fenced farmland and were fed the experimental concentrate at a rate of 3.5% of body weight.

Experimental diet

Cassava leaves were obtained from freshly harvested cassava from farmers around Abeokuta, Ogun state, Nigeria. The cassava leaves after harvesting were sorted as foreign materials were removed from it and air dried. The air-dried cassava leaf was then taken to the feed mill for crushing and mixing with other ingredient to compound the concentrates feed. The other ingredient used to compound the experimental diet include brewery dried grain (BDG), bone meal, groundnut cake (GNC), palm kernel cake (PKC), premix, maize, cassava peel, oyster shell, common salt.

Table 1: Composition (%) of the experimental diets

Ingredients	Treatment			
	T1	T2	T3	T4
Maize	5	5	5	5
Dried cassava peel	40	40	40	40
Cassava leaf meal	0	10	20	30
Brewers dry grain	25	15	7	0
Palm kernel cake	20	21	20	19
Groundnut	5	4	3	1
Bone meal	2	2	2	2
Limestone	1.5	1.5	1.5	1.5
Common salt	1	1	1	1
Premix	0.5	0.5	0.5	0.5
Determined Analysis (%)				
Dry matter	92.21	90.97	90.34	90.78
Ether extract	3.03	4.2	4.56	5.42
Ash	19.12	13.5	13.93	11.65
Crude protein	14.24	14.43	14.53	16.86
Crude fibre	9.49	8.05	9.01	7.2
Nitrogen free extract	54.17	59.82	57.97	58.58
Nitrogen detergent fibre	59	59	60	65
Acid detergent fibre	43.13	48.14	43	41
Acid detergent lignin	9.27	7.21	7.21	8.49
Cellulose	33.86	40.93	35.79	40.51
Hemicellulose	15.87	10.86	17	19
Non-fibre carbohydrate	4.61	8.87	6.98	6.07

Experimental design

The goats were divided into four treatments replicated five times and they were allotted to the experiment dietary treatments in a completely randomized design (CRD).

Data collection

Data were collected based on weight of animal, feed intake, cost of feed ingredients and cost of producing feed.

Performance Parameters

- Initial weight of the does: This was the weight of the experimental does which was taken at mating.
- Final Weight of the: This was the weight of the does taken within 24 hours before kidding.
- Does' Live–weight after kidding (weight within 24hours post kidding): This was the weight of the does which was taken within 24hours after kidding. This was taken when the placenta, umbilical cord and other foetal membranes like allantois, chorion and amnion (with the amniotic fluid) were expelled.
- Live-weight changes during gestation period: this was determined by taking the initial weight of the animals at the introduction of bucks followed by weighing of the pregnant does on fourth-nightly (i.e. every two weeks) until the last doe kidded on the 161days.
- Weight change (Gross weight change): This was determined by deduction of initial weight at mating from the final weight of the doe taken 24hours before kidding using the following formula.

Weight change (kg) = final weight (kg) - initial weight (kg)

- Net weight change (weight gain by does after parturition): This was calculated by deduction of the initial weight of the does at mating from the doe's live-weight 24hours after kidding using the following formula.

Net weight gain (kg) = wt within 24 hr after kidding (kg) - wt at mating

Daily weight gain (g/day) =weight gain (g) / gestation length (days)

- Metabolic weights
  a. weight gain (gday^{-1} W$^{-0.75}$) = (initial weight (kg) - final weight (kg))^75 2
  b. initial weight (gday^{-1} W$^{-0.75}$) = Initial weight (kg)$^{0.75}$ c. final weight (gday^{-1} W$^{-0.75}$) = Final weight (kg)$^{0.75}$
- Feed Intake: A known quantity of concentrate feed and grass were offered to each animal daily throughout the experimental period. The difference in total feed offered and feed left over were taken as the feed intake.

Feed Conversion Ratio= Total feed consumed (g) / weight gain (g)

- Cost- benefit analysis of the experimental diets: The prevailing prices per kilogram of feed ingredients were taken into consideration over the entire experimental period. Milling of the dried cassava leaf and transportation of feed were included as part of feed cost. The total cost of each experimental diet was recorded and the cost of feed consumed by each animal per weight gain was calculated.

Feed cost/kg diet = Quantity of each ingredient x Unit price/kg of the ingredient.

Cost of feed consumed = Cost/kg diet x Total feed consumed per replicate.

Cost per kilogram weight gain = FCR x Cost/kg diet.

Statistical analysis

Data collected during the experimental period were subjected to one-way analysis of variance (ANOVA) in completely randomized design using SAS (1999) and the means separated using Duncan multiple range test of the same software at 5% level of significance.

Results

Table 1 depicts the proximate analysis, revealing that crude protein reaches its highest point in T4, registering at 16.86% with a 30% inclusion level of cassava leaf. Conversely, the lowest peak occurs in T1, recording 14.24% at a 0% inclusion level. This aligns, in part, with NRC (2007) recommendations of 9–10% and 13–14% crude protein for early and late pregnancy stages in goats. These levels ensure the diet furnishes adequate nitrogen for rumen microorganisms, promoting optimal nutrient digestion and fostering healthy fetal growth without compromising the dam's health.

Table 2 shows the effect of the inclusion levels of Cassava leaf on the growth parameters of West African dwarf goats. The result shows no significant difference on any of the parameters across all levels of inclusion.

Table 3 shows effects of diets and stages of pregnancy on pregnant West African Dwarf Does fed diet containing graded level of cassava leaf meal. The result showed no significant difference ($P>0.05$) of the diets on the pregnant West African dwarf does, while the result also shows significance ($P<0.05$) in stage of pregnancy, with late stage of pregnancy having the most significant impact on the pregnancy performance of west African dwarf does followed by the mid and early stage of pregnancy, respectively.

The impact of meal high in cassava leaf concentrate on the costs and benefits for pregnant West African Dwarf does is shown in Table 4. The cost of feed consumed as a whole rangesd from #28239.05 at 0% cassava leaf inclusion to #19194.36 at 30% level of inclusion of cassava leaf meal. As the level of inclusion rises, the cost of feed per kg also falls.

Figure 1 show the effect of diet on weekly feed intake of pregnant West African Dwarf Does, the result show no significant difference in the feed intake across all diets. The total cost of feed consumed range.

Table 2: Effect of inclusion levels of Cassava leaf on the growth parameters of West African dwarf goats

PARAMETERS	LEVEL OF INCLUSION OF CASSAVA LEAF				SEM	P. VALUE
	0	10	20	30		
Initial live weight (kg)	12.78	10.67	12.51	11.87	1.39	0.715
Final live weight (kg)	19.62	16.47	16.80	15.44	2.57	0.699
Weight within 24hrs post kidding	16.94	14.04	14.00	12.57	2.25	0.587
Metabolic weight change (gday-1 $W^{-0.75}$)	4.10	3.59	2.64	2.50	0.90	0.544
Metabolic initial change ($gday^{-1}$ $W^{-0.75}$)	6.71	5.88	6.63	6.36	0.56	0.721
Metabolic final change ($gday^{-1}$ $W^{-0.75}$)	9.22	8.11	8.21	7.77	0.94	0.728
Weight change (kg)	6.84	5.80	4.29	3.56	1.71	0.543
Daily weight gain ($gday^{-1}$)	45.60	38.70	28.60	23.80	11.40	0.543
Total feed intake ($gday^{-1}$)	751.10	726.90	699.70	718.20	44.00	0.870

SEM = standard error mean   P-Value = Probability value

Table 3: Effect of diet and stages of pregnancy on West African Dwarf Does fed cassava leaf meal

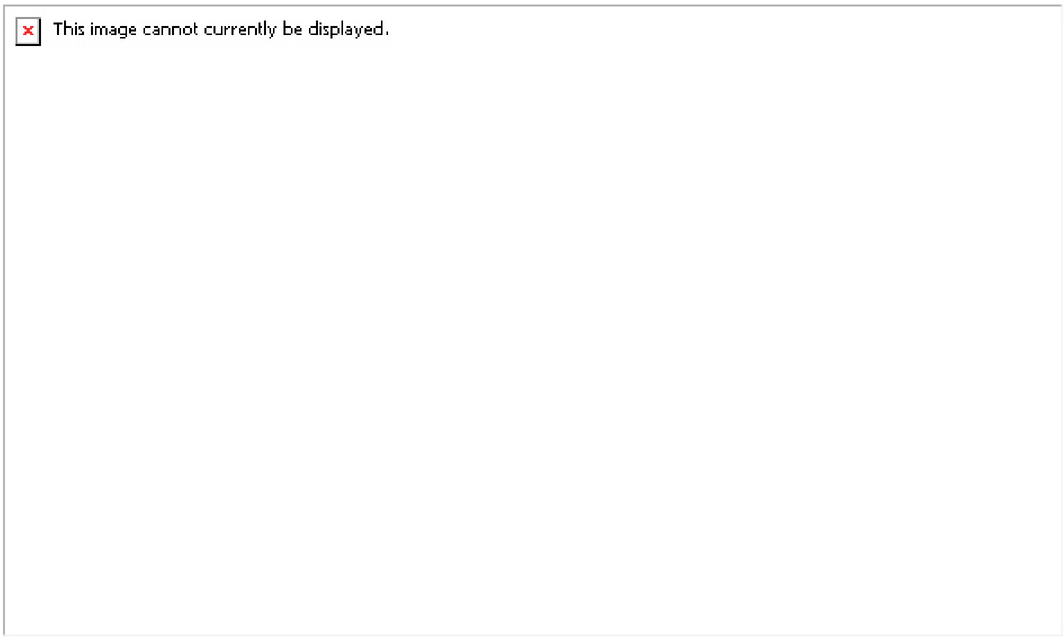
	Diet				SEM	P-Value	Stage of pregnancy			SEM	P-Value
	0%	10%	20%	30%			1st Trimester	2nd Trimester	3rd Trimester		
Feed intake	784.9	795.9	774.8	769.3	10.6	0.52	594.5^c	837.9^b	895.2^a	10.6	0.00

SEM = standard error mean P-Value = Probability value

Table 4: Effect of cassava leaf concentrate diet on cost benefit of pregnant West African dwarf goats

	Diet			
Parameters	0%	10%	20%	30%
Total feed consumed per (kg)	438.15	370.61	333.28	385.04
Total cost of feed consumed (#)	28239.05	22254.96	18413.63	19194.36
cost of feed/kg	64.45	60.05	55.25	49.85
feed consumed/weight gain (kg)	64.06	63.90	77.69	108.16
Cost of feed consumed/weight gain(#)	4128.52	3837.06	4292.22	5391.67

Figure 1: The effect of week of pregnancy on feed intake



Discussion

In contrast to the findings of Mike Metzger (2014), who found that in late pregnancy of goats and sheep the feed intake decreases because the fetuses restrict the amount of space available for the rumen, the feed intake recorded significantly increased across the stages of pregnancy with the highest recorded in late stage of pregnancy (895.2g); but are consistent with the findings of Odusanya *et al.* (2017), who found that increasing the amount of cassava leaf meal by 10, 20, or 30% increases feed intake throughout the stages of treatment. The high feed intake at the late stage of pregnancy can also be attributed to the high nitrogen content present in the feed, which, according to Odusanya *et al.* (2017), enhances the activity of microorganisms in the rumen (2017).

According to Kholif *et al*., (2016) plant leaf meal and tree foliage have been reported to be cost-effective protein sources that can be used in ruminant feed, and the inclusion of cassava leaf meal in the experimental diet is observed to reduce the cost of production more than the control diets (0%). The findings of the current study are also consistent with Adegun and Aye's (2013) observation that supplementation levels increase with a considerable decrease in cost per kg of live body weight gain. At a 10% inclusion level of cassava leaf, the pregnant West African Dwarf consumed 370.61g of total feed, and the cost of feed per gram of weight gained is #3837.06. This is the feed that costs the least per gram of weight acquired, and it somewhat coincides with Ahmad *et al.* (2017) who found that as supplementation levels increased, the cost per gram of live body weight gained decreased significantly.

Conclusion

From this study, since increase in supplementation of cassava leaf-meal based concentrates at 10, 20 and 30% levels increased the feed intake in the three stages of pregnancy and supplementation of cassava leaf meal at 10% inclusion level has the lowest cost to weight gain.

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