NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 54 Number 2, December 2023 Pg. 208-213
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Linear Body Parameters, Teat Measurements and Weight of Pregnant of West African Dwarf Goat Fed Cassava Leaf Concentrate Diet

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Abstract
A 52-week feeding trial was conducted to investigate the effect of a cassava leaf concentrate diet on linear body measurements, teat morphometric parameters and weight using twenty (20) pregnant West African dwarf (WAD) goats. Cassava leaf concentrate diets were fed at 0, 10, 20, and 30% replacement levels. The goats were equally and randomly allotted to the diets while water and other routine management practices were carried out throughout the study. Liveweight and Linear body parameters data were collected on body length (BL), height of withers (HW), heart girth (HG), rump height (RH), abdominal circumference (AC) and Linear body parameters and weight gain (WG) were collected at two weeks interval. Data on udder parameters (Distance between teat (DBT), Teat circumference (TC) Teat length (TL) and Height of teat from ground (HTG) were collected on every trimester (0, 50, 100 and 150 days) of the pregnancy period. Postpartum data which commenced 4th day of kidding were also collected on dams for 14 weeks of the postpartum period. Results showed that diet had a significant ($P<0.05$) effect on rump height with 0%, 20% and 30% cassava leaf meal replacement levels having the highest value among the parameters observed. Diet had a significant ($P<0.05$) effect on distance between teats (DBT) with the highest value recorded for DBT in pregnant Doe on 10% cassava leaf meal replacement. DBT value was the highest in pregnant does fed 30% cassava leaf meal inclusion. A high positive and significant ($P<0.05$) correlation was obtained among the linear body measurement, weight and udder measurement with the highest correlation recorded between heart girth, weight and abdominal circumference.
Keywords: linear body, Teats, West African Dwarf, cassava leaf, and udder

Introduction

Goats (*Capra hircus*) are unique ruminants owing to their ability to meet their nutritional requirements because of their moveable mandibles and ability to stand with their hind limbs which enables them to browse the most nutritious plant parts and even from thorn bushes and high tree branches (Ahamefule *et al.*, 2005). The hardy, short-legged West African Dwarf goats are restricted to high-altitude areas and humid forests of West Africa, they are relatively small-sized. The other two are Red Sokoto which is found in the savannah zone and the long-legged Sahel found in the arid and Sahel regions (Adu *et al*., 1979; FAO, 2021). Cassava (*Manihot esculenta*) is a staple preferred food crop in Nigeria, grown year-in and year-out in many parts of the country. The leaves are readily available as underutilized agro by-products after the tuber harvest and have also been found to have the potential of being managed as semi-perennial forage that can be harvested at two-month intervals to serve as a source of feed for ruminants (Preston, 2001). Cassava leaf meal is rich in crude protein, which is a major limiting nutrient to ruminants on fibrous crop residues and agro-industrial wastes and has been found to have a high nutrient profile which can effectively speed up the growth of small ruminant production (Anaeto *et al*., 2013; Jiwuba *et al*., 2016a). Cassava or its by-products (Tijani *et al*., 2012; Jiwuba and Ezenwaka, 2016; Jiwuba *et al*., 2018) have been used as feeds for sheep and goats. The cassava leaf meal is very nutritious with nutrient compositions higher than the fresh leaves. The chemical profile of cassava leaf meal revealed high protein content of 16.6% to 39.9% (Khieu *et al*., 2005; Jiwuba *et al*., 2018), high mineral content and also a major source of vitamin B1, B2, C and carotenes (. High amino acid profile and ME value (1,590 kcal/kg to 1,800 kcal/kg) Khajarern

and Khajarern, 2007) have been reported. Similarly, cassava root sieve proximate composition revealed 87.06% DM, 1.07% CP, 0.084% EE, 3.25% CF, 2.01% ash, 84.71% NFE and 3330 Kcal/kg energy (Salami and Odunsi, 2003). Measurement of animal body parts such as chest girth, Height at withers, Body length, shoulder width, Hind leg length, foreleg length, Rump height, and udder dimensions have been used to determine important functions in livestock (Okon, *et al,* 1997). There are few reports of body measurements about milk yield. Studies have confirmed that the milk yield of a dairy ewe is associated with udder circumference in 'Cattle and Goats' (James, 2000; Adewumi, 2011). This experiment was therefore designed to study the effect of cassava leaf meal concentrate on diet liner body, teat measurement parameters and weight of pregnant WAD Does.

Materials and Methods

Experimental Location

The experiment was conducted at a small ruminant unit; Directorate of University Farms [DUFARMS], Federal University of Agriculture, Abeokuta. The altitude of the region is 76 m as the landfall within latitude $7^0$8'N and longitudes $3^0$11.2' - $3^0$2.5'E. It was founded on latitude 14^0 N in the Southwestern part of Nigeria. It is at an altitude of about 640m above sea level. The prevailing climate is humid with a mean annual rainfall of 1037mm. The annual mean temperature and average humidity are 29-32.70c and 82% respectively (Google Earth, 2022)

Experimental animal and management

A total of twenty (20) matured West African dwarfs were used for the experiment. The weight of the animals ranged between 8 – 15kg including 1 buck which was used to serve the Does. The experiment comprised four (4) treatments with five Does in each experimental treatment and the parity of the Does ranged as nulliparous, 1st, 2nd and 3rd parity. The buck was used for the mating of the nulliparous Does. The animals were raised on a semi-intensive system of management where they were normally released to graze in the paddock between the hours of 10 am and 4 pm local time. The animals were allotted to four experimental treatments with five animals in each treatment. The treatments were 0, 10, 20 and 30% respectively. The research was conducted for 52 weeks.

Experimental diet

The cassava was obtained from freshly harvested cassava from farmers around Olodo Village and CAEDESE farm in Abeokuta. The cassava leaves were plucked after harvesting sorted for foreign materials and then air-dried until crispy to the touch. The air-dried cassava leaves were then taken to the feed mill for milling and mixed with another ingredient to form concentrate diets. The other ingredients 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, and salt. The composition of the experimental diet is shown in the table below

Experimental design

The animals were divided into four (4) treatments replicated four times and they were allotted to the experimental dietary treatments in a completely randomized design.

Data collection

Data on body weight linear, body measurements and teat measurements were collected at two two-week intervals using measuring tape and a hanging scale.

Linear body measurements taken were:

- ***Body length (BL):*** Body length was measured using a tape-rule, as the distance from the occipital protuberance to the base of the tail.
- ***Height at withers (HW)**:* The height at wither was measured as the distance from the surface of the platform to the withers using a measuring tape.
- ***Heart girth (HG):*** The Heart girth was measured by measuring the circumference of the chest with a tape rule.
- ***Rump height (RH):*** The rump height was measured as a distance from the surface of the platform to the rump using a measuring stick.
- ***Abdominal circumference (AC):*** This was measured as the circumference of the region immediately after the hind leg towards the abdomen

Measurements of teat Morphometric parameters

Data were collected every trimester (0, 50, 100 and 150 days) of the pregnancy and weekly after kidding for 14 weeks commencing 4 days postpartum using a flexible graduated canvas tape according to the procedures of Agbede *et al*. (1997); James and Osinowo, 2004a and 2004b.

- ***Height of the teat from the ground (HG):*** This was measured as the distance between the teat tips to the ground.
- ***Teat length (TL):*** This was measured as the distance between the teat tip and the base of attachment to the udder.
- ***Teat circumference (TC):*** This was recorded as the distance around the widest points of the teats (middle).
- ***Distance between teats (DBT):*** This is the distance between the two teats of the udder.

Results and Discussion

Cassava (*Manihot esculenta* Crantz) leaves and peels are recognized as locally available feed resources with a high edible biomass yield for sheep and goat production in Nigeria. They have been successfully used as an alternative feed resource to overcome the dry season feeding challenges posed by seasonal fluctuations of grass forages (Fasae and Yusuf, 2022). Table 3 showed the least square means as affected by diets on linear body measurement of West African Dwarf goats; the parameters were HG, BL, RH, HL, AC, HT, and WT. The RH was significantly ($p<0.05$) influenced by the diet and recorded the highest value of 45.51 and 45.55

respectively. BL, HL, AC, HT, and WT were not significantly ($p>0.05$) influenced by the diet. The results obtained in this study indicate that the quantity of cassava leaves fed to the does during pregnancy was sufficient for both maintenance and production purposes. The increase in the doe's weight could also be attributed to fetal products such as placenta, fluid that develop during pregnancy (Ososanya *et al*., 2007). This result correlates with that of Mbagwu, (2016) who reported an increase in the weight of pregnant ewes fed a 6% sun-dried cassava peel-treated diet.The significant differences in the least square mean in heart girth and wither heights in the pregnant Does were indications that linear measurements have a significantly positive correlation with body weights (Adegun and Aye, 2022). The increase in body weight in this study is corroborated by the level of significance of the heart girth (Yunusa *et al*., 2014). The increase in udder and teat traits with gestation in Table 4 was similarly observed by (James and Osinowo, 2004b). The increase in the udder traits has been linked to endocrine control of pregnancy in preparation for parturition and lactation (Dijkstra *et al*., 1997). James (2000) reported that udder size in Goats largely reflects milk production potential. This could be attributed to further postnatal mammary growth and body measurement associated with weight. The results of the least square means of the effect of diet on udder dimensions of West African dwarf goats are shown in Table 4. Distance between teats recorded the highest value of 21.39 in the group fed 30% of the experimental diet. There was no significant ($p>0.05$) difference observed among other teat parameters. It was also observed that non-pregnant Does had the smallest udder same as Does that were nulliparous while Does within second and third parity have the largest udder confirmation. The smaller nature of the udder of old dams and nulliparous Does could be attributed to the smaller nature of breast tissues which were not filled with milk due to the physiological state of the animals. In this study, there were high correlations among teat circumference, teat width, distance between tea, heart girth, body length, abdominal circumference, and rump height about the body weight of pregnant West African Dwarf Goats used for the experiment. This supports the study of Afolayan *et al.,* (2001) who reported a high positive correlation between chest girth and body weight and among body measurements in adult sheep. However, negative correlations were observed among teat width and distance between teats, teat length and height of wither, abdominal circumference and distance between teats of pregnant West African Dwarf. This could to the position of these parameters on the body of the animals.

Conclusion

From this study, it was concluded that diet had a significant ($P<0.05$) effect on rump height with 0%, 20% and 30% Cassava leaves meal inclusion, having the highest value for rump height. The diet also had a significant effect on DBT and DT, with the highest value of DB recorded for pregnant Does on 10% Cassava leaf meal inclusion levels while DT value was the highest on pregnant Does fed 30% Cassava leaf meal inclusion.

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Table 1: Percentage composition (%) of the experimental diet

Ingredients	0% CLM	10% CLM	20% CLM	30% CLM
Maize	5	5	5	5
Cassava peel	40	40	40	40
Cassava leaf	0	10	20	30
BDG	25	15	7	0
PKC	20	21	20	19
GNC	5	4	3	1
Bone meal	2	2	2	2
Limestone	1.5	1.5	1.5	1.5
Salt	1	1	1	1
Premix	0.5	0.5	0.5	0.5

CLM = Cassava leaf meal, BDG = Brewer's dry grain, PKC = Palm Kernel Cake and GNC = Groundnut Cake

Table 2: Proximate and fibre fraction compositions of experimental diets

	Inclusion levels CLM			
Parameters	**0%**	**10%**	**20%**	**30%**
Moisture	7.79	9.03	9.66	9.22
Dry matter	92.21	90.97	90.34	90.78
Ether extract	3.03	4.20	4.56	5.42
Ash	19.12	13.50	13.93	11.65
Crude protein	14.24	14.43	14.53	16.86
Crude fibre	9.49	8.05	9.01	7.20
Nitrogen free extract	54.17	59.82	57.97	58.58
Neutral detergent fibre	59.00	59.00	60.00	65.00
Acid detergent fibre	43.13	48.14	43.00	41.00
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	17.00	19.00
Non-fibre carbohydrate.	4.61	8.87	6.98	6.07

CLM= Cassava leaf meal

Table 3: Least square means showing the effect of diet on linear body measurement of WAD goats

	HG	**BL**	**RH**	**HL**	**AC**	**HW**	**WT**
Diet							
1	58.03	39.10	45.51^{a}	37.30	65.76	41.86	14.12
2	55.67	37.39	43.51^{b}	35.609	63.05	40.16	13.22
3	57.85	37.98	44.61^{ab}	36.51	65.33	41.79	14.77
4	56.99	37.55	45.55^{a}	36.77	64.24	41.43	12.60
p-value	0.153	0.224	0.004	0.088	0.246	0.209	0.064
Mean +SEM	57.03±0.41	38.07±0.32	44.64±0.24	36.49±0.24	64.43±0.53	41.22±0.32	13.51±0.32

HG=Heart girth, BL=Body length, RH= Rump height, HL= Hind leg, AC=Abdominal circumference, HW=Height at wither, WT=Weight

Table 4: Least square means showing the effect of diet on teat dimensions of WAD Goat

	DB	**TL**	**DT**	**TC**	**TW**
Diet					
1	5.02^{b}	2.5	20.17^{ab}	2.71	1.19
2	6.02^{a}	2.09	18.80^{b}	2.72	1.01
3	5.79^{ab}	2.24	20.13^{ab}	2.88	1.10
4	5.12^{b}	2.14	21.39^{a}	2.78	1.12
Mean +SEM	5.48±0.12	2.24±0.10	20.12±0.22	2.75±0.07	1.09±0.03

Where the distance between teats, TL=Teat length, DT= Distance of teats from the ground, TC=Teat circumference, TW=teat width

Table 5: Phenotypic Correlation Among Linear Body Measurement, Weight and Udder Dimensions in Pregnant WAD Goats

	HG	BL	RH	HL	AC	HW	WT	DB	TL	DT	TC	TW
HG	0.00											
BL	0.48***	0.00										
RH	0.47***	0.33***	0.00									
HL	0.20**	0.34***	0.34***	0.00								
AC	0.81***	0.52***	0.55***	0.20**	0.00							
HW	0.38***	0.26***	0.53***	0.08	0.38***	0.00						
WT	0.83***	0.52***	0.57***	0.30***	0.83***	0.45***	0.00					
DBT	0.41***	0.41***	0.11	0.20**	-0.03	0.83***	0.45***	0.00				
TL	0.10	0.31***	0.02	0.63***	0.10	-0.25***	0.17	0.04	0.00			
DG	-0.25***	-0.27***	0.17*	-0.04	-0.28***	0.25***	-0.34***	-0.43***	-0.47***	0.00		
TC	0.60***	0.53***	0.27***	0.17**	0.59***	0.22**	0.57***	0.38***	0.23**	-0.34***	0.00	
TW	0.37***	0.41***	0.07	0.09	0.33***	0.11	0.30***	0.06	0.45***	-0.27***	0.63***	0.00

HG=Heart girth, BL=Body length, RH= Rump height, HL= Hind leg, AC=Abdominal circumference, HW=Height at wither, WT=Weight, DB=Distance between teats, TL=Teat length, DT= Distance of teats from ground, TC=Teat circumference, TW=teat width