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Research Article
Performance of Lactating West African Dwarf Goats Fed Guinea Grass Basal Diet and Cassava Peel and Leaf Meal Based Concentrate

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Abstract
Objective: This study was conducted to evaluate the performance of lactating West African Dwarf (WAD) goats fed guinea grass basal diet and cassava peel and leaf meal based concentrate as energy and protein sources. **Materials and Methods:** Lactating does were randomly assigned to four (4) treatments in a completely randomized design. The treatments were: T1 (control, 0% replacement), T2 (25% replacement of wheat offal (WO) and Palm kernel cake (PKC), with cassava peel meal (CPM) and cassava leaf meal (CLM), T3 (50% replacement of WO and PKC, with CLM and CPM) and T4 (75% replacement of WO and PKC, with CLM and CPM). Feed was offered (50 g DM kg^{-1} BW), in addition to water which was given *ad lib*. **Results:** Results showed that dry matter (DM) intake of concentrates was significantly ($p<0.05$) highest in T3 (818.37 g/day) and the lowest in T4 (698.05 g/day). There was non-significant difference in the average daily weight gain of the animals which varied from 11.43 g/day (T1) to 23.93 g/day (T3). The increased inclusion of CPM and CLM in the concentrate supplement did not significantly ($p<0.05$) affect the apparent digestibility of DM, CP, neutral detergent fibre (NDF) and acid detergent fibre (ADF), Ash and ether extract (EE). Milk yield varied from 272.50 to 332.18 g /day and different replacement levels of wheat offal and palm kernel cake with CPM and CLM in the respective diets did not influence the nutrient digestibility. **Conclusion:** Cassava peel meal and cassava leaf meal significantly improved the performance of West African dwarf goats.

Key words: Feed conversion ratio, feed intake, lactating does, milk yield, nutrient digestibility, weight gain

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The indigenous cattle have been the main source of domestic meat and milk supply in Nigeria. (Although other ruminants like camels, goats and sheep produce milk, but their production is not considered because their quantity is small compared to some Nigerian cattle breeds. However, goat milk is more widely produced than sheep milk and globally goat produce 60% of its value as milk, 35% as meat and 5% as skin[1]. The nutritional benefits of milk from some small ruminants such as the domesticated goat is making them a centre of attraction. Thus, the importance of goats as a source of milk is increasing[1] and these goats are milked at various times and fed to children, thereby improving the protein intake of these children, consequently, combating malnutrition status of infants in some communities[2,3].

In addition, the goat population is increasing which would enhance milk production. However, Its rearing is mainly traditional, and the lack of adequate feeding has necessitated the search for non-conventional and easily sourced feedstuffs, such as cassava peels and leaves, which are cheap and not in high demand by humans[4]. Cassava is mainly planted for its tuberous root, the leaves wither after roots are harvested, in addition to heaps of peels derived from peeling the tubers. Therefore, there is a need to develop an appropriate system to properly deal with this situation, in addition to problems related to environmental and health hazards associated with offensive odour. In order to meet the nutritional requirements of animals at different physiological stages of life, these cheap and easily obtainable feed ingredients should be combined to make the least costly but competitive and comparable rations. This study was therefore initiated to evaluate the performance of lactating West African Dwarf (WAD) goats fed guinea grass basal diet and cassava peel and leaf meal based concentrate as energy and protein sources.

MATERIALS AND METHODS

Lactation studies/management of kids: During lactation, 16 lactating West African dwarf does were monitored from a pregnancy study conducted one month before parturition in the Uniben farm project, Benin City, Edo State. After kidding, does were treated with Ivermectin (1%) against ecto- and endo-parasites and ear-tag number, weight of does and kids, date of kidding, litter size and kid sex on each lactating doe at the beginning of the study were recorded. Kids were ear-tagged on the second day of life; they were allowed to suckle for 14 days after which they were used to determine the daily milk yield of the does. In order to ensure that the animals are fed at the same time every day, the estimated daily feed was measured into individual poly bags the previous day using a digital scale. Daily feed was offered at 8 AM each day and leftovers were collected at the same time next day (8 AM to 8 AM) to ensure that the animals were exposed to the feed for a period of 24 hrs.

Individual pens measuring 1 m×1.5 m and 4 treatments were assigned to the pregnant goats. Before milking, the udder was washed with warm clean water and wiped with a clean napkin/towel and the first squirts of milk were discarded and milking was continued for 2-3 min. Milk collection commenced 2 weeks after kidding and the does were monitored from the first day of milking up to the 16 weeks of lactation. Milk yield was determined using the suckling method[5]. According to this procedure, the does and the kids were separated from 7.00 PM to 7 AM. They were weighed (initial weight = W1) and reunited with their does for 15 min for thorough suckling, under close supervision. The kids were then re-weighed to get the new weight (final weight = W2). The difference between W1 and W2, represent the milk yield for a period of 12 hrs. This process was repeated at 1 PM and at 6 PM and to determine the milk yield for the day, a weight differential representing the milk intake of the kids over the three periods was summed with the quantity hand milked.

Milk samples were collected weekly from the 12 lactating does for analysis during the lactation period. Lactation length was calculated from 3 weeks post-kidding (WPK) until 16 weeks post-kidding during which the goats were milked once weekly. Similarly, the quantity of milk obtained from each goat during the lactation period was recorded to determine the milk yield. That is, 3 WPK-16 WPK. In order to determine the milk yield per goat per week, the volume of milk obtained each week was summed up to ninety-eight (98) days at the end of the 16 week period. The milk samples collected during this period were put into sample bottles immediately after collection and stored at -4°C in the refrigerator in order to determine the composition of milk. In addition, at each milking, the quantity of milk collected was recorded.

Experimental design: A completely randomized design (CRD) was used. Three goats were randomly assigned to one of the four experimental diets.

The following statistical model was used:

$$Y_{ij} = \mu+\alpha_i+e_{ij}$$

Where:

Y_{ij} = Individual observation
μ = general mean of population
α_i = treatment effect due to diets
e_{ij} = error effect

Research hypothesis:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \cdots\cdots \mu_j$$

H_0: Dietary inclusion of cassava leaves and peels at different levels did not affect the performance of goats during lactation.

$$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \cdots\cdots \mu_j$$

H_1: Dietary inclusion of cassava leaves and peels at different levels affected the performance of goats during lactation.

Variables monitored: The parameters monitored during this study were: feed intake, live weight, feed conversion ratio, feed digestibility and milk yield.

Chemical analysis: The dry matter content of concentrate feeds, Guinea grass and faeces was determined by drying pre-weighed samples at 100°C until constant weights were obtained. Representative samples of the feeds and faeces collected were milled to pass through 1 mm mesh sieve and stored for the laboratory analysis. Known weights of milled samples in triplicates were used for chemical analysis. The feed and faeces were analyzed for their respective components of crude protein (N×6.25) and OM according to the procedure of AOAC[6] while NDF and ADF components were determined by the detergent method[7].

Statistical analysis: The data were analyzed by one-way analysis of variance (ANOVA) using Statistical Analysis System[8], differences between treatments means were compared by Duncan New Multiple Range Test[9]. Differences of $p<0.05$ were considered statistically significant.

RESULTS

Chemical compositions of the *Panicum maximum*, cassava peel meal and cassava leaf meal: Table 1 shows the ingredient composition (%) of experimental diets for lactating does with graded levels of cassava peels and leaves. The chemical composition of the *Panicum maximum*, cassava peel meal and cassava leaf meal is shown in Table 2. The dry matter (%) content of the CLM (92.25) was the highest though not significantly different from the dry matter of CPM (89.50). *Panicum maximum* had the least DM (30.44). The crude protein (%) of the *Panicum maximum*, CPM and CLM were characterized by significant variations. *Panicum maximum* had the least crude protein content while CLM had the highest crude protein content and it is observed that in the four experimental dietary treatments the crude protein of the respective diets increased with an increase in the quantity of CLM. The values obtained were 8.75, 10.50 and 28.00 for *Panicum maximum*, CPM and CLM, respectively.

The results showed that there was a significant difference between the ether extract content of the *Panicum maximum* (2.00) and CPM (5.70) but not between CPM and CLM. There was a significant variation between the ash (%) content of *Panicum maximum* (8.55), CPM (2.55) and CLM (6.00). The organic matter content of CPM (97.45) was the highest though not significantly different from that of CLM (94.00). The

Table 1: Ingredient composition (%) of experimental diets for lactating does with graded levels of cassava peels and leaves

	Diets			
Ingredient	T1	T2	T3	T4
Maize	17.00	17.00	17.00	17.00
Wheat offal	40.00	30.00	20.00	10.00
Cassava peel meal	0.00	10.00	20.00	30.00
PKC	35.00	26.25	17.50	8.75
Cassava leaf meal	0.00	8.75	17.50	26.25
SBM	5.00	5.00	5.00	5.00
Bone meal	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Vitamin/mineral premix*	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**
Metabolizable energy (kcal kg^{-1} DM)	2704.60	2642.55	2580.50	2518.45
Crude protein (%)	17.56	16.84	16.32	15.76

*Contains vitamin A (I.U): 10,000.00, Vitamin D2: (I.U) 2,000,000, Vitamin E (I.U): 20,000, Vitamin K (mg): 2,250; Riboflavin (mg): 5000, Pyridoxine (mg): 275, Biotin (mg): 50, Pantothenic acid (mg): 7500, Vitamin B1 (mg): 175; Vitamin B12 (mg): 15.0, Niacin (mg): 27,500, Folic acid (mg): 7500, Choline chloride (mg): 400, Antioxidant (mg): 125, Fe (g): 20.0, Zn (g): 50.0, Mn (g): 80.0, Cu (g): 5.0 g, I (g): 12.0, Co (mg): 200, Se (mg): 200

T1: Control (0% replacement), T2: 25% replacement, T3: 50% replacement and T4: 75% replacement

Table 2: Chemical compositions of the *Panicum maximum*, cassava peel meal and cassava leaf meal

	Diets			
Parameters	*Panicum maximum*	CPM	CLM	SEM
Composition (%)				
DM	30.44^{b}	89.50^{a}	92.25^{a}	0.778
CP	8.75^{b}	10.50^{b}	28.00^{a}	0.507
EE	2.00^{b}	5.70^{a}	2.75^{b}	0.194
Ash	8.55^{a}	2.55^{c}	6.00^{b}	0.204
OM	21.89^{b}	86.95^{a}	94.00^{a}	0.900
NDF	58.00^{a}	27.30^{b}	27.00	0.404
ADF	33.00^{a}	24.90^{b}	26.00^{b}	0.569
HMC	25.00^{a}00	2.40^{b}	1.30^{b}	0.238

SEM: Standard error of mean, ^{ab}Means bearing different superscript letters within the same row differ significantly (p<0.05), CPM: Cassava peel meal, CLM: Cassava leaf meal, DM: Dry matter, CP: Crude protein, EE: Ether extract, OM: Organic matter, NDF: Neutral detergent fibre, ADF: Acid detergent fibre and HMC: Hemicellulose

Table 3: Chemical composition (%) of the experimental diets for the lactating WAD goats

	Diets				
Parameters	T1	T2	T3	T4	SEM
Composition (%)					
DM	85.65^{b}	89.64^{a}	90.98^{a}	85.56^{b}	0.562
CP	17.50^{b}	17.50^{b}	21.00^{ab}	24.50^{a}	0.949
EE	13.85^{b}	19.25^{a}	12.90^{b}	13.00^{b}	0.471
ASH	4.65^{b}	4.95^{b}	6.85^{a}	7.15^{a}	0.287
OM	81.00^{bc}	84.69^{a}	84.13^{ab}	78.41^{c}	0.722
NDF	49.50^{a}	43.00^{b}	35.50^{c}	32.70^{d}	0.550
ADF	25.70^{a}	21.90^{b}	19.10^{c}	17.90^{c}	0.283
HMC	23.80^{a}	21.10^{b}	16.40^{c}	14.80^{c}	0.395

SEM: Standard error of mean, ^{ab}Means bearing different superscript letters within the same row differ significantly (p<0.05), Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

organic matter content of *Panicum maximum* (91.45) was the least and significantly different from those of CPM and CLM. Table 3 presents the chemical composition of the diets fed to the lactating West African dwarf goats. The dry matter (%) content of T2 (89.64) and T3 (90.98) was the highest and showed no significant variations (p>0.05). Also, no significant variation (p>0.05) was observed between T1 (85.65) and T4 (85.56).

The crude protein (%) contents of four dietary treatments were characterized by significant variations. The high crude protein of CLM (28.00) was observed in the four dietary treatments, where the crude protein of the diets increased with an increase in the quantity of CLM. The values obtained were17.50, 17.50, 21.00 and 24.50, respectively. The chemical composition of the diets revealed that ether extract content (%) of T2 (19.95) was significantly highest. The ether extract content of T1 (control, 13.85) was not significantly different from those of T3 (12.90) and T4 (13.00). However, there was significant variation in the ether extract content of the control and T2 (19.25).

The ash (%) content of the respective experimental diets was influenced by the replacement of wheat offal and PKC with CPM and CLM respectively. No significant variation was observed between T1 (4.65) and T2 (4.95) likewise between T3 (6.85) and T4 (7.15). The organic matter content (%) of T2 (84.69) was significantly different (p<0.05) from the organic matter contents of T1 (81.00) and T4 (78.41) but not from T3 (84.13). The NDF content of the respective concentrate supplements were characterized by significant variations, the highest NDF (49.50) was observed in T1 while the lowest NDF was observed in T4 (32.70). Significant variation was also observed between NDF values of T2 (43.00) and T3 (32.10). The ADF composition (%) of the four experimental treatments [T1 (25.70), T2 (21.90), T3 (19.10) and T4 (17.90)] varied significantly. In the experimental treatments, the ADF content decreased as wheat offal and PKC were replaced with cassava peels and leaf meal. The hemicellulose content (%) of the respective experimental diets varied significantly (p<0.05) and followed a similar trend to the NDF and ADF contents of the dietary treatments. Values obtained were 23.80, 21.10, 16.40 and 14.80 for the respective dietary treatments 1-4.

Table 4: Dry matter intake of lactating West African dwarf goats fed the experimental diets

	Diets				
Parameter	T1	T2	T3	T4	SEM
Dry matter intake (g/day)					
Concentrate	555.89[bc]	596.66[b]	652.97[a]	540.54[c]	7.34
Grass	161.75[a]	159.80[a]	165.39[a]	157.50[a]	2.56
Total	717.64[b]	754.47[ab]	818.37[a]	698.05[b]	9.87

SEM: Standard error of mean, [ab]Means bearing different superscript letters within the same row differ significantly (p<0.05), Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal and Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

Table 5: Weight changes of lactating West African dwarf goats fed the experimental diets

	Diets				
Parameters	T1	T2	T3	T4	SEM
Weight changes					
Initial body weight (kg)	23.60[a]	20.99[a]	24.67[a]	20.53[a]	0.82
Final body weight (kg)	25.99[a]	22.27[a]	26.28[a]	23.21[a]	0.88
Total weight gain (kg)	2.38[a]	1.28[a]	1.62[a]	2.68[a]	4.96
Total weight gain (g)	2383.00[a]	1280.00[a]	1617.00[a]	2680.00[a]	496.29
Average daily weight gain (g/day)	21.28[a]	11.43[a]	14.43[a]	23.93[a]	4.43

SEM: Standard error of mean, [ab]Means bearing different superscript letters within the same row differ significantly (p<0.05), Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

Table 6: Milk yield and litter performance characteristics of lactating West African dwarf goats fed the experimental diets

	Diets				
Parameters	T1	T2	T3	T4	SEM
Lactation length (days)	98.00	98.00	98.00	98.00	0.00
Milk yield (g/day)	272.50[a]	308.27[a]	260.43[a]	332.18[a]	56.88
Feed conversion ratio (FCR)	2.77[a]	3.15[a]	3.29[a]	2.31[a]	0.34
Litter size	1.33[a]	1.33[a]	1.00	1.67[a]	0.27
Kids Birth weight (kg)	1.34[a]	1.24[a]	1.41[a]	1.11[a]	0.10
Kids final weight (kg) (16 weeks)	2.35[a]	2.59[a]	3.06[a]	1.49[a]	0.29

SEM: Standard error of mean, [ab]Means bearing different superscript letters within the same row differ significantly (p<0.05), Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

There were significant (p<0.05) variations in the average daily dry matter intake (g/day) of concentrate but not in the grass intake of the lactating WAD goats. The total dry matter intake in T3 (818.37) was significantly different (p<0.05) from those of T1 (717.64), T2 (754.47) and T4 (698.05) (Table 4).

Weight changes of lactating West African dwarf goats fed the experimental diets: Table 5 shows the changes in weight of lactating WAD goats fed Guinea grass basal diet and concentrate supplement. For lactating WAD goats, there were significant variations (p<0.05) in daily dry matter intake (g/day) of concentrate but not in grass intake. The total dry matter intake in T3 (818.37) was significantly different (p<0.05) from those of T1 (717.64), T2 (754.47) and T4 (698.05). The average initial live weight (kg) of the lactating goats did not differ significantly (p>0.05). In addition, the average final live weight (kg) of the animals were not influenced (p>0.05) by the experimental diets. A non-significant difference was also found in the average daily weight gain (g) and the total weight gain (g) of lactating WAD goats.

Milk yield and litter performance characteristics of lactating West African dwarf goats fed the experimental diets: Table 6 shows the effect of replacing wheat offal and palm kernel cake with cassava peel meal and cassava leaf meal on milk yield of dams and litter performance of lactating West African dwarf goats. The respective dietary treatments had no significant affect (p>0.05) on birth weight (1.11-1.34 kg) and final weight (1.49-3.06 kg) of the kids. Lactating does in T3 had the least number of kids with no multiple births and

Table 7: Nutrient intake of lactating West Africa dwarf goat fed experimental diets

	Diets				
Parameters	T1	T2	T3	T4	SEM
Intake (g/day)					
Crude protein	114.43^{b}	118.39^{b}	151.59^{a}	146.21^{a}	2.08
Ash	39.67^{c}	43.19^{c}	58.87^{a}	52.11^{b}	0.67
Ether extract	80.22^{b}	68.82^{c}	87.54^{a}	74.50^{bc}	1.00
Organic matter	677.90^{bc}	713.30^{ab}	759.50^{a}	645.94^{c}	18.40
NDF	368.98^{a}	349.25^{ab}	327.73^{b}	268.11^{c}	4.37
ADF	196.24^{a}	183.40^{ab}	179.29^{b}	148.73^{c}	2.37
HMC	172.70^{a}	165.80^{a}	148.40^{b}	119.40^{c}	4.00

SEM: Standard error of mean, ^{ab}Means bearing different superscript letters within the same row differ significantly (p<0.05), Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

consequently the least milk yield (260.43 g/day). Conversely, lactating does with multiple births and more kids had non-significantly higher milk yield (g) in T1 (272.50), T2 (308.27) and T4 (332.18). The Feed conversion ratio (FCR) of the lactating West African dwarf goats increased non-significantly with increasing levels of dietary replacement with CLM and CPM except for T4 (12.96), whose FCR ranked lowest. The dietary treatments had no significant effect on the FCR of the lactating West African dwarf goats whose FCR values were 2.77 (T1), 3.15 (T2), 3.29 (T3) and 2.31 (T4).

Nutrient intake of lactating West African dwarf goat fed the experimental diet: Table 7 shows the total nutrient intake (g/day) and g kg^{-1} $W^{0.75}$/day of lactating West African dwarf goat (g/day) fed Guinea grass basal diet and cassava peel and leaf meal-based concentrate supplement. Non-significant differences were observed in the mean CPI values both in g/day and g/day kg^{-1} $W^{0.75}$ between T1 (111.43 and 10.05) and T2 (118.39 and 11.81) as well as between T3 (151.59 and 13.51) and T4 (146.21 and 14.50). However, CPI values in T1 and T2 were significantly different from those of T3 and T4. Mean ash values (g/day) and g/day kg^{-1} $W^{0.75}$ obtained varied significantly. Ash intake (g /day) of lactating goats in T3 (58.87) was significantly different (p<0.05) from those of T4 (52.11) and T2 (43.19) and T1 (39.67). However, non–significant variations were observed between T1 and T2. Furthermore, non-significant variations were observed in the mean ash values (g d^{-1} kg^{-1} $W^{0.75}$) while T1, T2 and T3 showed significant variation. Ether extract intake (g/day) of lactating WAD goats in T3 (87.54) was significantly different from those of T1 (80.22), T2 (68.82) and T4 (74.50). In addition, non significant (p>0.05) variations were observed between T2 and T4, between the control and T4. The mean OMI values expressed in g/day ranged between 645.94 and 759.90 as well as between 61.02 and 71.14, respectively. The dietary treatment significantly (p<0.05) influenced OMI in g/day but not in g/day kg^{-1} $W^{0.75}$ among the four treatments. Lactating animals in T3 had the highest OMI (g/day), which was similar to that of T2 but varied significantly from those of T1 and T4 which also had non-significant variations.

Dry matter and nutrient digestibility (%) of lactating WAD goats fed Guinea grass basal diet and cassava peel and leaf meal-based concentrate diet: Table 8 shows the dry matter and nutrient digestibility (%) of lactating goats fed Guinea grass basal diet and cassava peel and leaf meal-based concentrate diet. Dry matter digestibility (DMD) was non-significantly (p>0.05) different among all the treatments and the values ranged from 79.25-86.73%. Although, CPD whose values ranged from 69.65-78.21% increased with increasing level of dietary replacement of PKC with cassava leaf meal, its digestibility did not vary significantly (p>0.05) among the respective treatments. Both EED (%) and ASHD (%) of the lactating animals showed non-significant (p>0.05) difference in the respective treatments and the values compared favourably with the control. EED values obtained for T1, T2, T3 and T4 were 87.15, 90.49, 86.72 and 89.84, respectively, while ash digestibility (%) values ranged from 50.42-63.74 (Table 8). The neutral detergent fibre, acid detergent fibre digestibility and hemicellulose were not significantly influenced by the experimental diets.

Average daily milk yield (g/day) of lactating West African dwarf goat fed experimental diets: Table 9 depicts the average daily milk yield (g/day) of lactating West African dwarf goats fed *Panicum maximum* and the experimental diet concentrate at 50% supplementation level during the early, mid and late lactation stages. As cassava peel and leaf meal were replaced with energy and protein sources in the concentrate of the lactating WAD does, average daily milk

Table 8: Dry matter and nutrient digestibility (g/100 g) of lactating WAD does fed *Panicum maximum* and concentrate supplement

	Diets				
Parameter (%)	T1	T2	T3	T4	SEM
DMD	79.25[a]	83.98[a]	83.50[a]	86.73[a]	1.453
CPD	69.65[a]	74.01[a]	74.90[a]	78.21[a]	2.197
EED	87.15[a]	90.49[a]	86.72[a]	89.84[a]	1.067
ASHD	60.10[a]	51.43[a]	50.42[a]	63.74[a]	2.577
OMD	74.64[a]	81.78[a]	81.53[a]	85.02[a]	3.520
NDFD	79.10[a]	80.35[a]	80.60[a]	81.43[a]	1.675
ADFD	72.49[a]	77.33[a]	78.53[a]	77.97[a]	2.121
HMCD	86.57[a]	83.68[a]	83.11[a]	85.74[a]	0.823

[a,b]Means bearing different superscript letters within the same row differ significantly ($p<0.05$), SEM: Standard error of mean, Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50 % CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal, PKC: Palm kernel cake, DMD: Dry matter digestibility, CPD: Crude protein digestibility, EED: Ether extract digestibility, ASHD: Ash digestibility, NDFD: Neutral detergent fibre digestibility and ADFD: Acid detergent fibre digestibility

Table 9: Average daily milk yield (g/day) of lactating West African dwarf goat fed experimental diets during the three stages of lactation

	Diets				
Milk yield/stages of lactation	T1	T2	T3	T4	SEM
Daily milk yield (g)	272.50[a]	308.27[a]	260.43[a]	332.18[a]	56.88
Early lactation	287.20	313.20[a]	319.50[a]	347.76[a]	74.90
Mid lactation	319.00[a]	319.80[a]	239.50[a]	384.60[a]	88.60
Late lactation	211.30[a]	291.80[a]	222.30[a]	242.60[a]	63.40

[a,b]Means bearing different superscript letters within the same row differ significantly ($p<0.05$), SEM: Standard error of mean, Treatment 1: Control diet 0% CLM replacement of PKC +0% CPM replacement of wheat offal, Treatment 2: 25% CLM replacement of PKC +25% CPM replacement of wheat offal, Treatment 3: 50% CLM replacement of PKC +50% CPM replacement of wheat offal, Treatment 4: 75% CLM replacement of PKC +75% CPM replacement of wheat offal, CPM: Cassava peel meal, CLM: Cassava leaf meal and PKC: Palm kernel cake

yield increased during the early stage of lactation. However, the increase and variations observed among the lactating does in the respective treatments during the early stage of lactation were not significantly different. Values (g/day) obtained were 287.20, 313.20, 319.50 and 347.76 for treatments 1, 2, 3 and 4, respectively. Variations observed during mid and late lactation stages did not follow a particular trend and varied non-significantly.

DISCUSSION

Chemical compositions of the *Panicum maximum*, cassava peel meal and cassava leaf meal: In the present study, the crude protein of cassava leaf meal (CLM) was 28.00% which is slightly higher than those obtained by Kharjaren and Kharjaren[10] (23.2%) and Iheukwumere *et al.*[11] (25%). This may be due to age of harvesting and climatic factors. It was observed that there was no significant difference in dry matter intake and crude protein intake. The dietary metabolizable energy (ME) (2518.45-2704.60 kcal kg^{-1} DM) and CP (15.76-17.56%) obtained in this study (Table 1) were similar to the recommended range of 2.1-2.7 Mcal kg^{-1} ME and 14-18 %, respectively[12] for lactating goats.

Feed intake and body weight parameters during lactation: The dry matter intake, crude protein intake and ash intake increased progressively among the treatments. This is in consonance with the results of Oboh[13] who suggested that diets with higher levels of CPM and CLM have higher nutrient intakes. In addition, the above nutrients decreased in treatment 4. MacDonald *et al.*[14] reported that mixed diets and those containing smaller particles showed marked reduction in intake per unit increase in feeding level and this may lead to negative associative effects at higher feeding levels. According to this study, the apparent nutrient intake decreased with increasing levels of CPM and CLM. There was a greater intake of crude protein among the treatments, indicating that the dietary protein was better absorbed by the does. This could be due to the inclusion of cassava leaves in the diet which is high in protein. Dietary protein has been shown to enhance intake[4]. The neutral detergent intake and acid detergent intake showed a marked increase from control diet to treatment 2 with a further decrease across the treatment. Results of the current study showed that the dry matter of *Panicum maximum* was lower than that reported by Adebayo[15] (36.1%) while the dry matter (92.25%) and crude protein (28.00%) of cassava leaf meal observed in this study were similar to 93.00% dry matter and 25.10% crude protein. In addition, the crude protein of the concentrate supplements of the respective treatments (17.50-24.50%) were close to the recommended range (14-18%) of crude protein for lactating does[16]. However, crude protein contents of the CLM-replaced diets were comparable to and higher than those of the control diets. As CLM levels increased in the diet, the crude protein content of the respective treatments increased, which can be attributed to the high crude protein of the CLM used in the study.

It was also observed that the body weight of dams was the heaviest during the first week of lactation and decreased as lactation progressed. As their kids need milk, goats use/mobilize their body fat reserves to produce milk. This is in agreement with the findings of Makun *et al.*[3] and Eknaes *et al.*[17].

Apparent nutrient digestibility in lactating does: In addition, it was observed that nutrient digestibility values for crude protein, neutral detergent fibre, acid detergent fibre, ether extract, ash, and dry matter were not significantly different among treatments. However, high digestibility values indicate that the diets were highly absorbed and degraded in the rumen. This is in agreement with the findings of Eniolorunda *et al.*[18] who reported that ruminants have the ability to digest carbohydrates with high digestibility cell wall fractions and obtain nutritional benefit from them. The DM digestibility in this study was found to be highest in T4 (75% CLM and 75% CPM) and lowest in T1 (0% CLM and 0% CPM). The crude protein digestibility was not significantly different among treatment means. Crude protein digestibility value ranged from 69-78%. Treatment 4 had the highest protein digestibility value (78.21%) and T1 had the lowest value (69.65%). It was observed that protein digestibility increased with increasing levels of dietary protein. The daily dry matter intake was highest in goats fed diet supplemented with 50% CPM and CLM. However, lactating animals in T4 had a higher digestibility of all the measured parameters and this showed a better usage of the feed. With the inclusion of CPM and CLM in the diets, a general increase in nutrient digestibility was observed, reflecting the high degree of nutrient utilization. This is in accordance with the findings of Devendra[19]. There was an increase in dry matter digestibility in diets with higher crude protein levels. Mtenga and Shoo[20] reported that high dry matter intake is often associated with higher protein intake, resulting in faster passage of diets through the gastrointestinal tracts.

Further, the milk yield of lactating does was not significantly affected by the respective treatments, confirming that the crude protein in the diets was adequate. The basal diet did not meet the minimum protein requirement for microbial growth, which is a justification for supplementation of the basal diet. During this study, supplements were fed to make up for the crude protein requirement lapse.

Lactating does with 75% replacement of diet with CPM and CLM had the best feed conversion ratio, although it was not significant. This shows that milk yield or the milk producing ability of the experimental animals was not affected by the varying replacement levels of CPM and CLM in the respective dietary treatments.

Milk yield: The results of the study showed that the average daily milk yield (265.76-332.18 g/day) was higher than those reported by Ahamefule[4] (139.70-233.00 g/day) who evaluated the effects of pigeon pea-cassava peel-based diets on goat production for 14 weeks. Non-concurrent values might be due to differences in the inclusion level of cassava peel and leaf in the experimental diets. Also, the method of milk collection during the experiments might be responsible for the variation in milk yield of the does. According to Ochepo *et al.*[5] and Banda *et al.*[21] the suckling method when compared with the oxytocin and hand milking methods, resulted in higher milk yield when the WAD, Yankassa and Malawi ewes were subjected to the methods listed. Ochepo *et al.*[5] and Banda *et al.*[21] reported that the suckling method, compared to oxytocin and hand milking, resulted in higher milk yields in WAD, Yankassa and Malawi ewes.

Also, milk yield could vary due to differences in lactation lengths used during this study and those used by Ahamefule[4]. Furthermore, lactating does fed respective dietary treatments during this study may also be responsible for the variations in their individual daily milk yields due to varying litter sizes. This result agrees with the findings of Akpa *et al.*[22] where litter size significantly influenced the milk yield and composition in lactating animals. The average daily milk yield increased non-significantly from the control to T4 (75% replacement with CPM and CLM).

Results showed that cassava leaf meal (CLM) and cassava peel meal (CPM) inclusion in different experimental diets increased early lactation milk yield. This is in line with the findings of Ukanwoko and Ibeawuchi[23] who reported that an increase in dietary CPM and CLM resulted in a corresponding non-significant increase in milk yield when cassava peel – cassava leaf meal-based diets was fed to West African dwarf goats in South Eastern Nigeria.

However, during the mid lactation period (peak), there was a decrease in the milk yield of lactating WAD does in TI, T2 and T3 with increasing level of CLM and CPM, this is as opposed to an expected peak in milk yield mostly due to disease (mastitis and diarrhea) in this experiment. This is in accordance with the findings of Zeng *et al.*[24] who reported that the decrease in milk production depends on the severity and type of disease. There was an exception to this decrease in milk yield during mid lactation in lactating WAD does in T4, mainly due to the high fibrous content of the experimental diet (75% inclusion level of cassava peel and cassava leaf).

Generally, there was a decline in milk yield during the late lactation period. This corroborates the findings of Tovar-Luna *et al.*[25], who reported that the lactating doe has the tendency to mobilize body tissues for maintaining, repairing and building up of the body rather than for milk production. This result also in accordance with Rai[26], who stated that in raising ruminant livestock either for meat or milk production, there is a fundamental antagonism between milk synthesis and fattening, thus diets that would promote efficient weight, would most times naturally lead to poor milk synthesis and vice versa. However, in all stages of lactation, there was no significant difference in the milk yield of all lactating animals fed experimental diet. This is in line with the findings of Ukanwoko and Ibeawuchi[23] who reported that diet had no significant effect on milk yield of lactating WAD goats fed cassava peel and leaf meal-based diets.

CONCLUSION

Performance of West African dwarf goats in treatments 2, 3 and 4 where wheat offal and PKC were replaced with cassava peel meal and cassava leaf meal was significantly different and better than those of treatment 1 (control) which is a more expensive diet to formulate. Thus, for optimum performance, up to 50% replacement of wheat offal and PKC with CPM and CLM is recommended.

REFERENCES

1. Malau-Aduli, B.S., L.O. Eduvie, C.A.M. Lakpini and A.E.O. Malau-Aduli, 2001. Effect of supplementation on the milk yield and composition of Red Sokoto does. Proceedings of the 26th Annual Conference of the Nigerian Society for Animal Production, March 18, 2001 Nigerian Society for Animal Production 353-356.
2. Lebbie, S.H.B., 2004. Goats under household conditions. Small Rumin. Res., 51: 131-136.
3. Makun, H., S.M. Otaru and D. Dung. 2013. Effect of management practices on milk yield and live weight changes of indigenous breeds of goats supplemented with groundnut haulms and concentrate in sub humid zone of Nigeria. Sokoto J. Veterinary Sci., 11: 40-50.
4. Ahamefule, F.O., 2005. Evaluation of pigeon pea-cassava peel based diets for goat production in South-Eastern Nigeria. Ph.D. Thesis, Michael Okpara University of Agriculture, Umudike.
5. Ochepo, G.O., J.A. Ayoade, S. Attah and A.Y. Adenkola, 2015. Effect of breed and method of milking on yield and composition of sheep milk. Sch. J. Agric. Sci., 5: 232-235.
6. AOAC, 1990. Official Methods of Analysis of the Association of Official Analytical Chemists. 15th Edn., AOAC, Arlington, Virginia, ISBN: 9780935584424, Pages: 684.
7. van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.
8. SAS, 2001. User's Guide: Statistics. SAS Inst. Inc., Cary, NC, USA.
9. Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.
10. Khajarern, S. and J.M. Khajarern, 1992. Use of cassava products in poultry feeding. In: Roots, tubers, plantains and bananas in animal feeding, Machin, D. and S. Nyvold, (Eds.). FAO, Rome, Pages: 289.
11. Iheukwumere, F.C., E.C. Ndubuisi, E.A. Mazi and M.U. Onyekwere, 2008. Performance, nutrient utilization and organ characteristics of broilers fed cassava leaf meal (*Manihot esculenta* Crantz). Pak. J. Nutr., 7: 13-16.
12. NRC., 2007. Nutrient Requirements of Small Ruminants. National Academies Press, Washington, DC., USA.
13. Oboh, G., 2006. Nutrient enrichment of cassava peels using a mixed culture of *Saccharomyces cerevisae* and *Lactobacillus* sp. solid media fermentation techniques. Electron. J. Biotechnol., 9: 46-49.
14. McDonald, P., R.A. Edwards, J.F.D Greenhalgh, C.A. Morgan, L.A. Sinclair and R.G. Wilkinson, 2011. Animal Nutrition. 7th Edn., Prentice Hall, USA, Pages: 714.
15. Adebayo, A.O., 2008. Using cassava waste to raise goats. Project 2008-4345. World Bank Development Marketplace. https://www.feedipedia.org/node/8149.
16. NRC, 1981. National Research Council, Nutrient requirements of Goats, Committee on Animal Nutrition. National Academy Press, Washington, DC., ISBN: 0-309-58826-x.
17. Eknaes, M., K. Kolstad, H. Volden and K. Hove, 2006. Changes in body reserves and milk quality throughout lactation in dairy goats. Small Rumin. Res., 63: 1-11.
18. Eniolorunda, O.O., B.B.A. Taiwo, O.O. Oyewumi and O.A. Adeyemi, 2008. Performance of laying hens fed graded levels of Indomie® waste as replacement for maize in a humid tropical environment. Res. J. Anim. Sci., 2: 135-138.
19. Devendra, C., 1981. Meat Production from Goats in Developing Countries. In: Intensive Animal Production in Developing Countries BSAP, Smith, A.J. and R.G. Gunn (Eds.). British Society of Animal Production, Occasional Publication 4 BSAP, Edinburgh, UK., pp: 395-406.

20. Mtenga, L.A. and R.A. Shoo, 1990. Growth rate, feed intake and feed utilization of small East African goats supplemented with *Leucaena leucocephala*. Small Ruminant Res., 3: 9-18.
21. Banda, J.W., J. Steinbach and H.P. Zerfas, 1992. Composition and yield of milk from non-dairy goats and sheep in Malawi. Consultative Group on International Agricultural Research. https://cgspace.cgiar.org/handle/10568/70827
22. Akpa, G.N., E.O. Asiribo, O.O. Oni and J.P. Alawa, 2001. The influence of non-genetic factors on the shape of lactation curves in Red Sokoto goats. Anim. Sci., 72: 233-239.
23. Ukanwoko, A.I. and J.A. Ibeawuchi, 2014. Evaluation of cassava peel-cassava leaf meal based diets for milk production by the West African Dwarf goats in South Eastern Nigeria. IOSR J. Agric. Vet. Sci., 7: 27-30.
24. Zeng, S.S., E.N. Escobar and T. Popham, 1997. Daily variations in somatic cell count, composition, and production of alpine goat milk. Small Ruminant Res., 26: 253-260.
25. Tovar-Luna, I., R. Puchala, T. Sahlu, H.C. Freetly and A.L. Goetsch, 2010. Effects of stage of lactation and level of feed intake on energy utilization by alpine dairy goats. J. Dairy Sci., 93: 4829-4837.
26. Rai, M.M., 1980. Dairy Chemistry and Animal Nutrition. 3rd Edn., Kalyani Publishers, New Delhi, India, Pages: 178.