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NUTRITIONAL ASSAY AND GROWTH PERFORMANCE OF WEST AFRICAN DWARF GOATS FED WITH FRESH, WILTED AND ENSILED CASSAVA LEAVES-BASED DIET

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ABSTRACT

The study was carried out to evaluate the in vitro digestibility and growth performance of West African dwarf goats fed with fresh cassava leaves + concentrate mixture, wilted cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate mixture. Six goats were allotted to three treatment groups with two goats per treatment for eight weeks in a completely randomized design. Ensiling of the cassava leaves was done for 21 days and wilting of the leaves was done for 2 days on a concrete floor. There were significant differences (p < 0.05) amongst the values of the chemical composition of cassava leaves. Macro and micro mineral profile differed significantly across treatments (p < 0.05) and values were within the normal range for cassava leaves. The results obtained showed significant (p < 0.05) differences on total weight gain across the treatments. Goats fed wilted cassava leaves + concentrate mixture had the highest weight gain. The values for the post in vitro gas production parameters were significantly different (p < 0.05). Ensiled cassava leaves produced the highest methane gas volume (14.67±2.2 ml) during 24 h of incubation, while, wilted cassava leaves recorded the least gas volume (10.00±2.2 ml). Reduction in methane was highest in wilted cassava leaves (20.00±12.8%) and lowest in fresh cassava leaves (20.00±12.8%). The results showed that wilted and ensiled cassava leaves can promote growth performance and will ameliorate the negative impact of methane emission from West African dwarf goats for sustainable livestock production.

Key words: goats, cassava leaves, *in vitro* digestibility, body weight gain

INTRODUCTION

Goat farming is an economic activity that sustains both rural and peri-urban families in Nigeria and most West African countries. Despite this, the increase in the consumption of goat meat (chevon) in Nigeria is still poorly explored (Jiwuba and Jiwuba, 2020). This may be partly attributed to feeding. Feed cost is a very essential part of goat farming and may constitute the highest expense of any goat production. Hence, feed availability has been the major factor against the expansion of goat production in Nigeria and other parts of the world. This constraint has negatively affected ruminant production and created a wide gap between the demand and supply of animal protein in Nigeria (Lamidi and Akhigbe, 2018). Thus, the high cost of conventional feedstuffs and seasonal variation in Nigeria has necessitated the search for cheap and readily available feed ingredients to enhance goat production (Jiwuba and Udemba, 2019).

The incorporation of the underutilize crop residues commonly generated by cassava farmers may be a panacea to the reoccurring dry season problems and feed scarcity encountered by smallholder ruminant farmers in Nigeria. Cassava (*Manihot esculenta Crantz*) is a drought tolerant, staple food crop grown in tropical and subtropical areas; thus, it could be used as potentially valuable food source for humans and animals (Fasae and Yusuf, 2022). In Nigeria, this crop has been cultivated as an alternative food insecurity crop due to Federal Government of Nigeria January 2005 policy on adding 10 percent cassava flour in wheat flour for local industries. Nigeria is also the world highest producer of cassava (Jiwuba *et al.*, 2018). Therefore, a large quantity of cassava leaves is generated annually. There is seldom use of these leaves after the roots have been harvested. These materials are cheap and readily available all year round. The leaves have been reported as potential feed for ruminant (Ajayi *et al*., 2019).

However, the high concentration of cyanogenic glucosides and other anti-nutrients in cassava leaves poses a threat to its utilization by ruminants. Studies have shown that cassava leaves require processing via fermentation to detoxify the anti-nutrients for maximum utilization by ruminants. Using wilted and ensiled cassava leaves is an appropriate method to conserve cassava leaves and reduce the anti-nutritional content in cassava leaves and can help to

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achieve the sustainable development goals (SDGs) number 1 (No poverty), number 2 (Zero Hunger) and number 17 (Partnership for the goals). Therefore, this study was designed to determine the effects of feeding with fresh, wilted and ensiled cassava leaves-based diet on West African dwarf goat.

MATERIALS AND METHODS

Experimental Location

The study was carried out at the University of Port Harcourt Teaching, Research and Demonstration farm, Choba, Obio-Akpor Local Government Area of Rivers State in Niger Delta area of Nigeria. It is situated at latitude 4º44'49" North and longitude 7º2'23" East of the equator. It falls within the humid rain forest zone of West Africa with a long duration of rainfall (March-November) and a very quiet dry season. Temperature ranges from 25-28°C and a very high relative humidity above 80%.

Experimental Animals and Management

Six West African dwarf goats (bucks) aged 5-6 months weighing appropriately 6-8 kg were used for the experiment. These animals were purchased from a reputable farm within Port Harcourt metropolis and housed individually in separate pens. The pens were washed using disinfectant before the commencement of the experiment. The animals were dewormed against endoparasites and vaccinated against ectoparasites before introduction to the pens. The growth trial lasted for 8 weeks with 14 days adjustment period.

Experimental Diet and Design

Cassava leaves were obtained from farms within and around the University environment after root harvesting. Ensiling of the cassava leaves was done for 21 days and wilting of the leaves was done for 2 days on a concrete floor. The concentrate mixture consisted of bone meal, salt, maize offal, groundnut cake, wheat offal and vitamin premix as shown in Table 1. Water was given *ad libitum* throughout the period of the experiment. The six West African dwarf goats were randomly assigned to the three experimental diets with two bucks per treatment. The treatments were:

Treatment 1 (Control) - fresh cassava leaves + concentrate mixture; Treatment 2 - wilted cassava leaves + concentrate mixture; and Treatment 3: Ensiled cassava leaves + concentrate mixture.

Table 1: Ingredient composition of concentrate mixture

Ingredients	Percentage (%)
Maize	30.00
Wheat bran	22.75
Palm kernel cake	25.00
Groundnut cake	18.00
Bone meal	3.00
Salt	1.00
Vitamin premix	0.25
Total	100
Calculated analysis	
Crude protein	17.39
Metabolisable energy (kCal/kg)	2475

Body Weight Changes

The initial body weight of the animal was taken at the start of the experiment and was progressively taken on weekly basis to determine the live weight gain. The feed intake was determined by weighing the amount of feed fed to the animals and measuring the left over.

Feeding Rate and Frequency

The animals were fed the experimental diets daily at the rate of 4% of their body weight. The animals were offered the concentrate ration first, while, cassava leaves were given *ad libitum* throughout the period of the experiment.

Chemical Analysis

The composition of the experimental diets was analyzed for dry matter content, ash, crude protein (Kjeldahl process), ether extract, fiber fractions and nitrogen free extract (AOAC, 2005).

Mineral Analysis

Mineral composition after wet digestion with a mixture of sulphuric acid, nitric and perchloric acid was determined using the atomic absorption spectrometer (AAS) (Buch Scientific, East Norwalk, CT 06855, USA) for calcium (Ca), magnesium (Mg), manganese (Mn), iron (Fe) and zinc (Zn), while potassium (K) and sodium (Na) were determined using flame photometry.

In Vitro Gas Production

The *in vitro* incubation was carried out using 120 mL calibrated syringes containing the inoculums (Rumen liquor: buffer, 1:2). 200 mg of feed samples was weighed into Ankom bags for the incubation at 39ºC with 30 mL of inoculums. The bags were placed inside the syringes before the inoculum was introduced into the syringes. The syringes were fitted with silicon tube and clipped before placing them in the incubator at 39°C. The syringes containing only inoculum served as the blank while the bags containing only the substrate served as the control (i.e., 0% plant extract). The time for the commencement of incubation was noted and the syringes were monitored at three-hour intervals for the next 24 h. For each incubation time, the head space of the syringes was measured and recorded. At 24 h of incubation, the final readings were taken and the syringes put on ice to stop further gas production.

Determination of Post In Vitro Fermentation Parameters

The sealed Ankom bags containing the feed samples were taken out from the syringes, washed with water until the water becomes clear and oven dried at 100°C to constant weight and the dry matter determined expressed as the percentage of the original sample weight to calculate dry matter degradability (DMD), fermentation efficiency (FE), metabolisable energy (ME), organic matter digestibility (OMD), gas volume and short chain fatty acids (SCFA).

Statistical Analysis

Data collected (nutrient profile, body weight, *in vitro* digestibility and cost-benefit analysis) were subjected to analysis of variance using the General Linear Model procedure of Statistical Package for the Social Sciences (SPSS) (Version 16.0). Means with differences were separated using Duncan multiple range at 5% level of significance.

RESULTS

Chemical composition of fresh, wilted and ensiled cassava leaves is showed in Table 2. Dry matter content was similar between wilted cassava leaves (98.84) and ensiled cassava leaves (94.66), but, was significantly lower ($p < 0.05$) in fresh cassava leaves (93.78). Crude protein was lowest in ensiled cassava leaves (21.00), whilst, the highest crude protein was obtained in wilted cassava leaves (23.86). Ether extract content was significantly different ($p < 0.05$) across treatments, the values were significantly higher in ensiled cassava leaves (1.70) than wilted cassava leaves (1.50) and fresh cassava leaves (1.50). The NDF content was significantly different ($p < 0.05$) across treatments, the values were signifi-cantly higher in ensiled cassava leaves (67.00) compared to fresh cassava leaves (38.50) and wilted cassava leaves (29.50). The ADF content was significantly different ($p < 0.05$) across treatments, the values were significantly higher in fresh cassava leaves (33.00) than wilted cassava leaves (14.00) and ensiled cassava leaves (13.25). Hemicellulose content was significantly different ($p < 0.05$) across treatments, the values were higher in ensiled cassava leaves (53.75) than fresh cassava leaves (5.75) and wilted cassava leaves (15.50).

Mineral profile of fresh, wilted and ensiled cassava leaves is displayed in Table 3. Calcium content was significantly different ($p < 0.05$) across treatments; the values were higher in wilted cassava leaves (0.42) compared to fresh cassava leaves (0.36%) and ensiled cassava leaves (0.41%). Magnesium content was significantly different ($p < 0.05$) across treatments, with higher values in ensiled cassava leaves (0.20%) than fresh cassava leaves (0.17%) and wilted cassava leaves (0.19%). Sodium content was signifi-cantly different ($p < 0.05$) across treatments, with higher values in fresh cassava leaves (32.20 ppm). Potassium content was significantly different ($p < 0.05$) across treatments, with higher values in ensiled cassava leaves (0.15 mg DM^{-1}) compared to fresh cassava leaves (0.12 mg DM^{-1}) and wilted cassava leaves (0.11 mg DM^{-1}). Zinc content was significantly different ($p < 0.05$) across treatments, with higher values in wilted cassava leaves (150.00 ppm) compared to fresh cassava leaves (130.00 ppm) and ensiled cassava leaves (125.00 ppm). Iron content was significantly different ($p < 0.05$) across treatments, with higher values in ensiled cassava leaves (120.00) than fresh cassava leaves (90.00) and wilted cassava leaves (85.00). Manganese content was significantly different ($p < 0.05$) across treatments, the values were higher in ensiled cassava leaves (97.00 ppm) than fresh cassava leaves (86.00 ppm) and wilted cassava leaves (78.00 ppm).

Gas Production

Volume of gas production at different hours of incubation for fresh, wilted and ensiled cassava leaves is showed in Table 4. The gas produced by the cassava leaves as reflected on Table 4 increased and differed significantly ($p < 0.05$) from the 3rd h to the 24th h of incubation. Ensiled cassava leaves produced the highest gas volume (11.33±0.6 ml 200 mg DM^{-1}) during 12[th] h of incubation, while wilted cassava leaves recorded the least gas volume (7.33±0.6 ml 200 mg DM^{-1}) at the 12[th] h of incubation. Ensiled cassava leaves produced the highest gas volume (14.67±2.2 ml 200 mg DM^{-1}) during 24[th] h of incubation, while wilted cassava leaves recorded the least gas volume (10.00±2.2 ml 200 mg DM^{-1}) at the 24[th] h of incubation.

Table 2: Chemical composition of fresh, wilted and ensiled cassava leaves

Parameters (%)	Fresh cassava leaves	Wilted cassava leaves	Ensiled cassava leaves
Dry matter	93.78^{b}	94.84^{a}	94.66^{a}
Crude protein	22.09^{b}	23.86^{a}	21.00^{c}
Neutral detergent fibre	38.50^{b}	29.50^{c}	67.00^{a}
Acid detergent fibre	33.00^{a}	14.00^{b}	13.25^{b}
Hemicellulose	5.75^{c}	15.50^{b}	53.75^{a}
Ether extract	1.50^{b}	1.50^{b}	1.70^{a}
Ash	6.14^{a}	5.14^{b}	5.36^{b}
Nitrogen free extract	45.94^{ab}	45.16^{b}	46.30^{a}

abc - means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 3: Mineral profile of fresh, wilted and ensiled cassava leaves

Parameter	Fresh cassava leaves	Wilted cassava leaves	Ensiled cassava leaves	SEM
Calcium (%)	0.36^{b}	0.42^{a}	0.41^{ab}	0.70
Magnesium (%)	0.17^{b}	0.19^{ab}	0.20^{a}	0.00
Sodium (ppm)	32.20^{a}	26.20^{bc}	28.20^{b}	0.10
Potassium (%)	0.12^{b}	0.11^{c}	0.15^{a}	0.12
Zinc (ppm)	130.00^{b}	150.00^{a}	125.00^{c}	0.23
Iron (mg DM^{-1})	90.00^{ab}	85.00^{b}	120.00^{a}	0.20
Manganese (ppm)	86.00^{ab}	78.00^{b}	97.00^{a}	0.20

abc - means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 4: Volume (ml 200 mg DM^{-1}) of gas production of fresh, wilted and ensiled cassava leaves at different hours of incubation.

Incubation periods (hours)	Fresh cassava leaves	Wilted cassava leaves	Ensiled cassava leaves
3	$2.00±0.4^{b}$	$2.00±0.4^{b}$	$2.67±0.4^{a}$
6	$6.00±1.0^{ab}$	$6.67±1.0^{a}$	$6.00±1.0^{ab}$
9	$8.00±1.0^{a}$	$7.33±1.0^{b}$	$8.00±1.0^{a}$
12	$9.33±0.6^{b}$	$7.33±0.6^{b}$	$11.33±0.6^{a}$
15	$10.00±0.1^{b}$	$8.00±0.7^{c}$	$12.67±0.7^{a}$
18	$12.67±1.7^{ab}$	$9.33±1.7^{bc}$	$13.33±1.7^{a}$
21	$12.67±1.7^{ab}$	$9.33±1.7^{bc}$	$13.33±1.7^{a}$
24	$12.67±2.2^{ab}$	$10.00±2.2^{bc}$	$14.67±2.2^{a}$

abc - means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 5 shows significant differences ($p < 0.05$) in methane percentage production (%), methane gas volume (ml), methane reduction percentage (%) and short chain fatty acids (SCFAs) production from the leaves. The table shows that, fresh cassava leaves (8.00±1.3%) and ensiled cassava leaves (7.3±1.3%) were the highest producers of methane gas, while, wilted cassava leaves (5.33±1.3%) was the lowest producer of methane gas. Fresh cassava leaves (0.60±0.1 ml) gave the highest methane gas volume, while ensiled cassava leaves (0.50±0.1%) was the least. Reduction in methane was highest in wilted cassava leaves (20.00±12.8%) and lowest value in fresh cassava leaves (20.00±12.8%). Fresh cassava leaves (0.24±0.1 µml) gave the highest short chain fatty acids, while wilted cassava leaves (0.18±0.1 µml) recorded the lowest SCFA.

Growth Performance

Concentrate intake was significantly lower ($p < 0.05$) in goats fed fresh cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate mixture than those on wilted cassava leaves + concentrate mixture diet. Cassava leave intake differed significantly ($p < 0.05$) between the dietary treatments; the values were, however, higher in goats fed wilted cassava leaves + concentrate mixture diet. Total feed intake was significantly lower ($p < 0.05$) in ensiled cassava leaves + concentrate mixture compared to wilted cassava leaves + concentrate mixture and fresh cassava leaves + concentrate mixture. Final weight (FWT), total weight gain (TWG) and daily weight gain significantly differed ($p < 0.05$) across dietary treatments (Table 6).

Economic Efficiency

The cost of cassava leaves was significantly higher ($p < 0.05$) in fresh cassava leaves + concentrate mixture than wilted cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate mixture. Total cost of feed was significantly higher ($p < 0.05$) in goats fed fresh cassava leaves + concentrate mixture, than wilted cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate mixture rations. Total cost of feed consumed was significantly different ($p < 0.05$) among treatment means. The values were higher for goats fed wilted cassava leaves + concentrate mixture ration compared to those fed fresh cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate rations. Cost of feed consumed/kg gain was lower in goats fed wilted cassava leaves + concentrate mixture ration, than those fed ensiled cassava leaves + concentrate mixture and fresh cassava leaves + concentrate mixture rations (Table 7).

Table 5: Post *in vitro* parameters for fresh, wilted and ensiled cassava leaves

Parameters	Fresh cassava leaves	Wilted cassava Leaves	Ensiled cassava leaves
Methane percentage (%)	8.00±1.3^{a}	5.33±1.3^{c}	7.3±1.3^{b}
Methane gas volume (ml)	0.60±0.1^{a}	0.53±0.1^{ab}	0.50±0.1^{ab}
Methane reduction percentage (%)	20.00±12.8^{c}	46.67±12.8^{a}	26.67±12.8^{b}
Fermentation efficiency (µml)	1.06±0.2	1.16±0.2	1.16±0.2
Short chain fatty acid (µml)	0.24±0.1^{a}	0.18±0.1^{c}	0.23±0.1^{ab}
Metabolisable energy (MJ Kg DM^{-1})	5.18±0.3^{ab}	4.92±0.3^{c}	5.39±0.3^{a}
Organic matter digestibility (%)	39.92±1.9^{ab}	37.76±1.9^{b}	40.73±1.9^{a}

abc - means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 6: Growth performance of West African dwarf goat fed fresh, wilted and ensiled cassava leaves

Parameters	Fresh cassava leaves + concentrate mixture	Wilted cassava leaves + concentrate mixture	Ensiled cassava leaves + concentrate mixture
Concentrate intake (kg)	6.54±1.4^{b}	7.68±1.4^{a}	6.56±1.4^{b}
Cassava leaves intake (kg)	15.50±3.4^{b}	18.90±3.4^{a}	15.16±3.4^{bc}
Total feed intake (kg)	22.05±4.8^{b}	26.58±4.8^{a}	21.73±4.8^{bc}
Feed intake (g day^{-1})	393.6±85.86^{b}	474.61±85.86^{a}	388.09±85.86^{c}
Initial weight (kg)	6.55±0.8	6.95±0.8	6.3±0.8
Final weight (kg)	7.65±1.3^{ab}	8.40±1.3^{a}	7.20±1.3^{b}
Total weight gain (kg)	1.10±0.6^{ab}	1.45±0.6^{a}	0.9±0.6^{b}
ADG (kg day^{-1})	0.02±0.01^{b}	0.03±0.01^{a}	0.02±0.01^{b}

abc - means within the same row with different superscripts are significantly different ($p < 0.05$). ADG - average daily gain

Table 7: Economic evaluation of feeds fed to West African dwarf goats

Parameters	Fresh cassava leaves + concentrate mixture	Wilted cassava leaves + concentrate mixture	Ensiled cassava leaves + concentrate mixture
Concentrate intake (kg)	6.54±1.4^{b}	7.68±1.4^{a}	6.56±1.4^{b}
Cassava leaves intake (kg)	15.51±3.4^{b}	18.90±3.4^{a}	15.16±3.4^{b}
Total feed intake (kg)	22.05±4.8^{b}	26.58±4.8^{a}	21.73±4.8^{b}
Total weight gain (kg)	1.10±0.6^{b}	1.45±0.6^{a}	0.90±0.65^{b}
Concentrate cost (₦)	112.19±0.00	112.19±0.00	112.19±0.00
Cost of cassava leaves (₦)	48.00±0.00^{a}	32.00±0.00^{b}	20.00±0.00^{c}
Total cost of feed (₦)	160.19±0.00^{a}	144.19±0.00^{b}	132.19±0.00^{c}
Total cost of feed consumed (₦)	3532.18±744.03^{b}	4012.56±744.03^{a}	2872.49±744.03^{c}
Cost per kg gain (₦)	4153.59±2471.93^{b}	3175.09±2471.93^{c}	5750.26±2471.93^{a}

₦ - Naira, abc - means within the same row with different superscripts are significantly different ($p < 0.05$).

DISCUSSION

The dry matter, ether extract and nitrogen free extract obtained in this study are similar to those in Akindahunsi and Oboh (2003). Cassava leaves are high in protein and can be used to supplement low-quality forages fed to ruminants (Marjuki *et al*., 2008). The results of the fibre fraction analysis of cassava leaves indicate that various processing methods may either increase or decrease some nutritive components of cassava leaves (Fasae *et al.,* 2017). This variation could be due to the action of endogenous linamarase on glucosides following wilting, ensiling or tissue damage due to processing methods (Fasae *et al.,* 2017). The ash content obtained in this study is similar to 5.7-12.7% reported by Ravindran (1992).

Cassava leaves are a good source of macro- and micro-minerals. The calcium range of 0.36-0.42% in this study is within the range of 0.04-1.63% obtained by other authors (Ravindran *et al.,* 1992; Aletor and Adeogun, 1995; Oresegun *et al.,* 2016). The potassium range of 0.11-0.15% is within the range of 0.07-0.35% reported by other authors (Chavez *et al.,* 2000; Madruga and Camara, 2000; Oresegun *et al.,* 2016). The sodium range of 28.0-32.0 ppm obtained is similar to that observed by Oresegun *et al.* (2016). The magnesium range of 0.17-0.20% is within the range of 0.12-0.42% reported by Bradbury and Holloway (1988), but was higher than 0.02- 0.07% by Oresegun *et al.* (2016). The zinc range of 125-130 ppm is within the range of 3-140 ppm reported by Burns *et al.* (2012). The manganese range of 78-97 ppm is within the range of 72.0-252.0 ppm obtained by other authors (Bradbury and Holloway, 1988; Oresegun *et al.,* 2016). The iron range of 85-120 mg DM^{-1} falls within the range of 61.5-270 mg iron kg^{-1} DM reported by Madruga and Câmara (2000). The trends of the results of this study agree with those reported by Ravindran and Ravindran (1988) who sampled cassava leaves at different ages. The differences in mineral levels are attributed to the rapid uptake of minerals by plants during early growth and their gradual dilution as the plant matures (Lanyasunya *et al*., 2007). The variations in the mineral profile between wilted and ensiled cassava leaves could be caused by differences in the process of fermentation to detoxify the concentration of cyanogenic glucosides. These observed variations when compared with similar studies could probably be due to the genetic differences among the cultivars, soil fertility or the levels of these minerals in the soils (Ravindran, 1992; Wobeto *et al*., 2006; Simão *et al.,* 2013). Cassava leaves can, therefore, be utilized as a rich source of dietary minerals in ruminant diet because of its mineral composition.

The presence of secondary metabolites, nature of fiber and potency of rumen liquor for incubation are factors that affect the amount of gas produced during fermentation (Babayemi *et al*., 2004). The highest gas production was observed in ensiled cassava leaves. The gas production is an indication of microbial degradation of the samples (Babayemi *et al*., 2004; Fievez *et al*., 2005). Methane production in ruminants is a wasteful process and accounts for energy loss of about 10-11% of the total energy meant for the animal from the feed. It is one of the gases contributing to global warming (Ajayi and Babayemi, 2008). The OMD and ME of ensiled cassava leaves were the highest while that of wilted cassava leaves was the lowest. These findings agree with the reports of Binuomote *et al.* (2010) and Ajayi and Joseph (2019). The higher fiber content in wilted cassava leaves could have resulted in low OMD and ME. The gas volume of methane is low for cassava leaves and methane reduction is high for cassava leaves (Chagunda *et al*., 2010). This implies that processing of cassava leaves can mitigate methane emission in a way acceptable for the environment and animals.

The higher total feed intake observed in goats fed wilted cassava leaves + concentrate mixture ration compared to fresh cassava leaves + concentrate mixture and ensiled cassava leaves + concentrate mixture ration could be as a result of interaction of the different forms of the cassava leaves with concentrate ration. Also, Forbes (1995) reported that ruminants eat the amounts of feed which leave them with the most comfortable feelings; this could be the reason for the higher intake recorded in wilted cassava leaves + concentrate mixture. The difference in daily gain in weight (g day^{-1}) of the goats could be attributed to the variation in the nutrient utilization of the diets by each animal (Fasae *et al.,* 2012). The observed weight gain of the experimental animals across the treatments could suggest the efficiency of the cassava leaves coupled with the concentrate supplement to provide microbial growth in the rumen (Njidda, 2008). The significant difference observed for feed conversion ratio across the treatments implies variation in nutrient utilisation of the goats in body tissue formation (Fasea *et al.,* 2012). The results of this study showed that cost of feed consumed differed, which may be due to differences in the quantity of feed consumed. Cost per kg gain in Naira, was higher in fresh cassava leaves + concentrate mixture treatment and lowest in goats fed wilted cassava leaves + concentrate mixture ration indicating it was beneficial to incorporate cassava leaves in the diets of goats. Availability of feed stuff is important when considering its use in farm enterprises. The result shows that the other treatments compared favorably with the control.

CONCLUSION

The incorporation of wilted cassava leaves as basal diet in concentrate rations fed to West African dwarf bucks positively influenced better body weight gain, reduced methane gas production and lower cost of feeding. The use of wilted cassava leaves + concentrate mixture is, therefore, recommended for enhanced goat production as a valuable feed resource and would discourage the burning of these leaves after the roots have been harvested.

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