AGRICULTURE ARCHIVES

OPEN ACCESS

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Original Research Article
ISSN: 3041-5322
Journal homepage: agriculture.researchfloor.org

Assessment of Nutrient Intake and Digestibility in West African Dwarf Bucks Fed Cassava Peel Residues Ensiled with Selected Three Tropical Browses as Mixed Diets

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ABSTRACT

Leguminous browse forages ensiled with cassava peel residues are increasingly used in ruminant feeding because of their high crude protein content, digestible energy, and overall nutritive value. Therefore, an 84-day feeding trial was carried out to investigate the effects of incorporating Gliricidia sepium (GS), Ficus thonningii (FT), and Gmelina arborea (GA) forages with cassava peel–maize residue (CPR) silage on nutrient intake and digestibility in West African Dwarf (WAD) bucks. A total of sixteen growing WAD bucks aged 6–9 months, with body weights ranging from 6.0 to 10.0 kg, were randomly assigned to four dietary treatments in a completely randomized design, with four animals per treatment and two animals per replicate. The experimental diets consisted of T1 (100% CPR), T2 (CPR70GS30), T3 (CPR70FT30), and T4 (CPR70GA30). Animals were fed the diets at 3% of their body weight and supplemented daily with 200 g concentrate. Results showed significant differences ($p < 0.05$) among treatments for both nutrient intake and digestibility parameters. The highest dry matter intake (363.28 g/day) was recorded in bucks fed T2, whereas the lowest value (342.81 g/day) occurred in animals receiving T4. Crude protein intake (132.14 g/day) was highest in bucks fed T3, while the lowest value (23.87 g/day) was observed in animals fed T1. Similarly, the greatest crude fibre intake (91.45 g/day) occurred in T1, whereas the lowest (74.08 g/day) was recorded in T2. Ash intake was highest in T4 (16.69 g/day) and lowest in T3 (14.42 g/day), while nitrogen-free extract intake was highest in T1 (168.42 g/day) and lowest in T2 (145.93 g/day). In terms of digestibility, bucks receiving the T3 diet showed the highest dry matter digestibility (46.89%), whereas the lowest value (41.78%) was observed in T4. Crude protein digestibility was lowest in T1 (39.75%) and highest in T3 (62.73%). The highest crude fibre digestibility (50.06%) was recorded in T4, while the lowest value (34.07%) occurred in T1. The results indicate that incorporating Ficus thonningii with cassava peel residues at a 70:30 ratio, alongside concentrate supplementation, can improve nutrient intake and digestibility in growing WAD bucks.

Keywords: *Cassava peel residues, browse fodders, WAD bucks, intake and digestibility of nutrients.*

Citation: Adebisi, I.A., Ajibike, A.B., Okunlola, O.O., Amoo, T.A., Adeniyi, O.A., Mustapha, T.B., Oladepo, O., Alalade, J.A., Akanmu, O.C., Adebisi, M.R., Ogungbenro, J.O., and Hassan, U.A (2026). Assessment of Nutrient Intake and Digestibility in West African Dwarf Bucks Fed Cassava Peel Residues Ensiled with Selected Three Tropical Browses as Mixed Diets. *Agriculture Archives: an International Journal.*
DOI: https://doi.org/10.51470/AGRI.2026.5.1.21

Received on: October 10, 2025
Revised on: November 09, 2025
Accepted on: December 12, 2025
Available Online: January 15, 2026

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Introduction

The conservation of alternative feed resources in the form of silage plays an important role in sustaining livestock production, particularly during the dry season when the availability of fresh forage is limited. Nevertheless, reliance on low-quality conserved feeds may lead to reduced animal performance, inferior carcass quality, and lower yields of meat cuts. The incorporation of agro-industrial by-products [32] and forage legumes [55] adapted to tropical environments and low rainfall conditions has been identified as a viable strategy for improving silage quality [55]. Ensiling therefore serves as an effective preservation technique that helps maintain both the quantity and nutritional value of forage, ensuring a consistent supply of energy and protein for animals during periods of feed scarcity [20; 16]. Under such conditions, browse leguminous trees are particularly valuable because they produce substantial forage biomass with high nutritional value, especially in regions where conventional forage resources are limited [7], browse fodders generally contain relatively low levels of tannins, with average leaf concentrations ranging from 6.0 to 9.0 g/kg DM [31; 58], which remain acceptable for ruminant diets when used as part of a balanced feed formulation.

In addition, crop residues and agricultural by-products, such as cassava peels, are often underutilized despite their potential value as livestock feed resources. Its potential value in enhancing ruminant nutrition and widespread availability have sparked interest in its inclusion in livestock feed [60]. However, due to its fibrous nature and high lignocellulose content, appropriate treatment or supplementation with browse plants and/or additional nutrients is necessary before feeding it to ruminants [19]. Browse plants such as, Gliricidia and Gmelina make up a significant portion of the available forage and provide livestock with supplemental nutrition during dry season because they are perennial and as such, they are resistant to abrupt weather changes, thus continue to produce higher quality and quantity of fodder even during the dry season [11]. Preserving surplus forage and agricultural by-products produced during the rainy season in the form of hay or silage can help mitigate the decline in livestock productivity commonly experienced during the dry season when forage resources become scarce [59]. Therefore, the present study investigated the effects of incorporating *Gliricidia sepium*, *Ficus thonningii*, and *Gmelina arborea* fodders into cassava peel residue silage on the nutrient intake and digestibility of growing West African Dwarf goats.

Materials and Methods

Experimental site and animal management

The study was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora. A total of sixteen growing West African Dwarf bucks, aged between 6 and 9 months and weighing 6.0–10.0 kg, were used for the experiment. Prior to the commencement of the trial, all animals were treated with Albendazole® to control internal parasites. As part of routine prophylactic management, oxytetracycline and multivitamin injections were administered intramuscularly at a rate of 1 mL per 10 kg body weight. In addition, the animals were vaccinated against Peste des Petits Ruminants (PPR) using a homologous vaccine. The experimental bucks were allowed a 28-day acclimatization period, during which they were fed guinea grass and cassava peels. Fresh drinking water was made available to the animals ad libitum throughout the experimental period.

Collection of Cassava peel residues and browse fodder plants.

Fresh forages of *Gliricidia sepium* (GS), *Ficus thonningii* (FT), and *Gmelina arborea* (GA) were sourced from mature woodlots located within the college farm. The plant materials, consisting of leaves and tender twigs, were harvested manually by hand-cutting. Cassava peel residues (CPR) used for the study were obtained from the garri processing unit of the Oyo State College of Agriculture and Technology (OYSCATECH) farm.

Silage production and experimental diets

The harvested forages were chopped into small pieces measuring approximately 2–3 cm using a sharp cutlass to facilitate proper compaction. The chopped materials were wilted for about 6 hours to reduce their moisture content before being thoroughly mixed with varying proportions of the selected browse fodder plants prior to the ensiling process. Molasses (200 g) was diluted in 4 litres of water and uniformly sprayed over the forage mixture to enhance fermentation. The treated material was then packed tightly into thick polythene bags, compacted carefully, and sealed to maintain anaerobic conditions necessary for effective fermentation. The silage was stored for 21 days, after which the bags were opened and the material was used for the feeding trial.

Experimental layout, design, and feeding method

The experimental animals were stratified according to body weight and randomly assigned to four dietary treatments, with four bucks per treatment. Two animals constituted a replicate in a completely randomized design (CRD). The experimental diets were provided at 3% of the individual animal's body weight. Cassava peel residue (CPR) silage mixed with browse fodders was offered in different proportions alongside a concentrate supplement. Each buck received approximately 350 g DM of silage at 8:00 am, followed by 200 g of concentrate per day at 2:00 pm. In addition, about 3 litres of clean drinking water were supplied daily. The experimental diets consisted of T1 (100% CPR silage + 200 g concentrate), T2 (CPR70GS30 silage + 200 g concentrate), T3 (CPR70FT30 silage + 200 g concentrate), and T4 (CPR70GA30 silage + 200 g concentrate). The proximate composition of the diets is presented in Table 2. Each group of animals was assigned to one of the experimental diets throughout the feeding trial.

Table 1: Composition of formulated concentrate for experimental West African Dwarf growing bucks

INGREDIENTS	LEVEL (%)
Palm kernel cake	60.00
Wheat offal	20.00
Corn bran	9.75
Groundnut cake	8.00
Bone meal	2.00
Salt	0.25
TOTAL	100.00

Data Collection and Analysis

At the end of the 84-day feeding trial, two bucks from each treatment were moved to individual metabolic cages designed for the separate collection of feces and urine. The animals were allowed a 7-day acclimatization period in the cages, followed by a 7-day collection phase. During the collection period, feces and urine from each animal were obtained daily. Total fecal output was collected every morning, weighed, and thoroughly mixed. The pooled fecal samples were oven-dried at 80 °C until a constant weight was achieved. To inhibit further microbial activity, 20% formaldehyde was added, and the samples were subsequently stored at −40 °C until analysis. Urine was collected over a 24-hour period using plastic containers placed beneath the metabolic cages, each containing 10 mL of 0.1 N H_2SO_4 to prevent nitrogen loss. Ten percent of the daily urine output from each buck was sampled and stored in a refrigerator at −20 °C for subsequent laboratory analysis. The fecal samples were chemically analyzed according to the procedure described by [8], while fiber fractions including neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL) were determined following the method of [57]. All data obtained for nutrient intake and digestibility were analyzed using one-way analysis of variance [52], and treatment means were compared using Duncan's multiple range test [13]. Nutrient intake was calculated using the following formula:

Dry matter intake = % dry matter of feed x daily feed intake

Crude protein intake = % crude protein of feed x daily feed intake etc.

Nutrient digestibility (%) = Nutrient in the feed – Nutrient in the feacal x 100
Nutrient in the feed 1

Chemical Composition Analysis

After 21 days of fermentation, the silage bags were opened and representative samples were obtained from each treatment silo. The samples were first evaluated for pH and then ground using a Wiley hammer mill equipped with a 3 mm screen. Proximate analyses for dry matter (DM), crude protein (CP), ether extract (EE), and ash were carried out according to the procedures described in [9]. Neutral detergent fibre (NDF) was determined following the method outlined by [57], while other chemical analyses were conducted in accordance with the protocols reported in [9].

Fermentative characteristics and Quality of silage determination

At the end of the fermentation period, the silage bags were opened to evaluate their quality. The parameters assessed included colour, aroma, taste, temperature, and pH, following the procedure described by [45]. Immediately after opening the silos, a laboratory thermometer was inserted into the silage mass to record the internal temperature, while pH was measured using a glass electrode pH meter. Colour evaluation was carried out visually with the aid of a standard colour chart. Representative sub-samples were collected from different depths and positions within each silo and thoroughly mixed to obtain a composite sample. These samples were then oven-dried at 65 °C until a constant weight was reached to determine dry matter content. The dried materials were subsequently ground and preserved in airtight containers for further chemical analysis.

Statistical Analysis

All data generated from the study were analyzed using one-way analysis of variance (ANOVA) as described by [52]. Where significant differences ($p < 0.05$) were observed among treatment means, Duncan's Multiple Range Test was applied to separate the means [13].

Results and Discussion

The chemical composition of the silages prepared from cassava peel residues combined with selected browse tree species in equal proportions is presented in Table 2. The dry matter (DM) content of the silages varied between 63.47% in T4 and 68.26% in T2, showing a slight increase with the inclusion of cassava peel residues in the silage mixtures. Similar observations have been reported by [44] and [43], who evaluated silages produced from legumes or elephant grass mixed with cassava peels and from moringa leaves ensiled with varying levels of cassava peels. The increase in DM content among the diets could be attributed to the relatively high dry matter level of cassava peels. Its shows that cassava peels enhanced DM retention. Cassava peel is a known absorbent and fermentable additive, improving silage dryness and sugar content. From the results of this finding, Crude protein (CP) was significantly higher in T_3 (24.65%), T_4 (21.77%) and T2 (20.48%) compared to T_1 (4.50%) that contained solely cassava peel residue silage, indicating that the combination of cassava peel residues and selected browse species fodders enhanced nitrogen retention which improved CP contents of the silages. The elevated crude protein content of the diets suggests that they provided sufficient dietary nitrogen and were therefore appropriate for feeding small ruminants. Crude fibre (CF) content ranged from T_2 (13.92%) to T_1 (17.24%), showing significant changes, a trend that reflects improved digestibility. Lower fibre values are desirable in ruminant diets as they enhance nutrient utilization. Lower CF values are desirable as they enhance energy availability (37). Ash content recorded in this finding also suggests better mineral preservation or concentration, potentially due to lower leaching losses. Browse fodders have been shown to improve fibre digestibility by promoting acid hydrolysis and enzymatic activities during ensiling (26). The fibre fractions showed remarkable variances, especially in ADF and NDF, which were significantly lower. Lower fibre fractions are favorable for ruminant intake and energy availability, as highlighted by (25), who emphasized the importance of reducing ADF and NDF in tropical forage silages to improve animal performance.

Results

Table 2. Proximate composition (%) of cassava peel residues ensiled with varying levels of selected browse fodder plants and the concentrate diets fed to bucks.

Parameters (%)	T1 100CPRS	T2 CPR70GS30	T3 CPR70FT30	T4 CPR70GA30	Concentrate
DM	65.12	68.26	67.71	63.47	94.48
CP	4.50	20.48	24.65	21.77	17.57
CF	17.24	13.92	14.25	14.20	8.75
EE	1.57	2.18	1.92	2.04	10.39
Ash	2.86	2.93	2.69	3.09	5.85
NFE	31.75	27.42	28.14	27.80	50.21
NDF	60.38	52.86	47.73	53.16	30.34
ADF	32.51	31.63	30.45	31.82	16.05
ADL	13.43	13.02	12.32	13.05	5.65
*ME(Kcal/Kg)	1422.06	1909.49	2068.07	1959.26	3282.45

*DM= Dry Matter, CP= Crude Protein, CF= Crude Fibre, EE= Ether Extract, NFE=Nitrogen Free Extract, NDF= Neutral detergent fibre, ADF= Acid detergent fibre, ADL= Acid detergent lignin, *ME= Calculated Metabolizable energy,* CPRS=*Cassava peel residue silage, GS= Gliricidia sepium, FT=Ficus thonningii, GA=Gmelina arborea*

Table 3 indicates the Fermentative characteristics, P^H and temperature of cassava peel residues ensiled with selected three tropical browses mixture. The variation in colour, light brown in T1, olive-green in T2, yellow-green in T3, and brownish-green in T4, suggests differences in fermentation quality, possibly linked to microbial activity and the additive (molasses) used for the silage production. A brownish-green colour, as seen in T4, is often considered an indicator of optimal fermentation, indicating better preservation of the original forage material. This aligns with reports by [41], who noted that greenish coloration in silage implies minimal oxidative degradation and more efficient fermentation. Brownish green colour in T4 silage may indicate better preservation of chlorophyll and less oxidation, which often correlates with enhanced fermentation [28]. In terms of smell, all treatments except T1 exhibited a pleasant smell, indicating successful fermentation. T1 had only a slightly pleasant smell, which, coupled with the presence of surface mould, suggests sub-optimal fermentation. According to (61), a pleasant silage smell often corresponds with the dominance of *Lactobacillus plantarum* or *Lactobacillus acidophilus*, which rapidly reduces pH and inhibits undesirable microbes. The slightly pleasant odor in T_1 might reflect slower fermentation activity. The pH of the silage ranged from 4.30 – 4.70 with the highest (4.70) in T3 and the lowest in T1 (4.30). The pH of silage was within the acceptable range of 3.5 - 5.5 for good silage [27; 40; 33]. The acidity (pH) fluctuates from 4.30 to 4.70 as the proportion of cassava peels and selected tropical browse species were ensiled, showing that cassava peel residues improved the fermentation of selected browse silage. This trend was also observed when cassava peel was ensiled with elephant grass and legume forages [42; 44].

Elevated temperatures during the ensiling process do not necessarily enhance fermentation quality. Excessive heat may reduce silage quality by accelerating protein degradation and hindering the rapid decline in pH required for effective preservation [50]. In the present study, the silage temperature ranged from 36.10 to 38.50 °C in cassava peel residue silage (T1) as well as in cassava peel residue–browse fodder mixture silages (T2, T3, and T4). These values are considerably higher than the temperatures of 16.62–19.52 °C reported for maize stover silage produced from the Arganie variety [2]. However, earlier studies have documented silage temperatures ranging between 29 and 40 °C [38], which are comparable to the values observed in the current experiment. The differences in temperature among studies may be attributed to variations in environmental and climatic conditions during the ensiling process.

Table 3: Fermentative characteristics, PH and temperature of cassava peel residues ensiled with selected three tropical browses mixture

Parameters	T1 100CPRS	T2 CPR70GS30	T3 CPR70FT30	T4 CPR70GA30
Colour	Light-brown	Olive-green	Yellow-green	Brownish-green
Smell	Slightly-Pleasant	Very-pleasant	Pleasant	Sweet-sour
Taste	Sour	Vinegar	Vinegar	Sour
P^H	4.30	4.60	4.70	4.50
Tempt(^{0}C)	36.10	38.40	37.60	38.50

CPRS=Cassava peel residue silage, GS= Gliricidia sepium, FT=Ficus thonningii, GA=Gmelina arborea Tempt=Temperature

Table 4 presents the nutrient intake of West African Dwarf (WAD) bucks fed cassava peel residues ensiled with three selected browse fodder mixtures and supplemented with concentrate diets. Significant differences ($p < 0.05$) were observed in dry matter intake (DMI) among the dietary treatments, with values ranging from 342.81 to 363.28 g/day. Similarly, crude protein (CP) intake varied significantly ($p < 0.05$) across the treatments. The lowest CP intake (23.87 g/day) was recorded in bucks fed diet T1. Neutral detergent fibre (NDF) intake also differed significantly ($p < 0.05$) among the treatments, with values ranging from 255.86 to 320.91 g/day. Likewise, acid detergent fibre (ADF) intake showed significant ($p < 0.05$) variation among the diets, with values ranging between 163.23 and 172.45 g/day.

Feed intake is a major determinant of ruminant productivity, as it influences nutrient availability and utilization by the animal. The dry matter intake observed in this study ranged from 342.81 to 363.28 g/day, with the highest value recorded in bucks fed diet T2 (363.28 g/day), suggesting that this diet may have been more palatable to the animals. However, these values are lower than the range of 484.47–742.96 g/day reported by [15] for WAD bucks fed different forms of processed guinea grass.

The average crude protein intake from diets containing browse species silage mixed with cassava peel residues ranged from 108.99 g/day (T2) to 132.14 g/day (T3). These values are lower than the recommended intake of 156 g/day for crossbred lambs as suggested by [39]. Nevertheless, the CP intake values recorded in this study are comparable to those reported by other researchers. For example, [35] documented CP intake values ranging from 95.12 to 149.78 g/day in Yankasa rams fed untreated and treated sorghum stover with supplements. Similarly, values of 86.00–133.10 g/day were reported by [4] for West African Dwarf sheep fed sugarcane tops treated with different nitrogen sources. A comparable range of 80.5–133.4 g/day was also reported by [1] for sheep fed maize cobs treated with urea and wood ash.

However, the CP intake for bucks fed the control diet (T1), which consisted solely of cassava peel residue silage, was considerably lower at 23.87 g/day.

Ash intake values in the present study ranged from 14.42 to 16.69 g/day, which is consistent with the values of 15.83–27.01 g/day reported by [51] for West African Dwarf goats fed diets containing graded levels of alkaline-treated malted sorghum sprout. The ADF intake values observed in this study (163.23–172.45 g/day) were also lower than the values of 484.47–742.96 g/day reported by [15] for WAD bucks fed processed guinea grass. The relatively higher ADF intake recorded for the T1 silage diet compared with the other treatments may be attributed to its higher dry matter content, as the diet contained cassava peels as a major component. A similar observation was reported by [21], who evaluated graded levels of toasted *Enterolobium cyclocarpum* seeds as a supplement to guinea grass for WAD sheep and suggested that inclusion of about 10% *E. cyclocarpum* seeds provided a more synchronized release of nitrogen and carbohydrates in the rumen, thereby enhancing microbial protein synthesis.

Table 4: Nutrient intake of WAD growing bucks fed cassava peel residues ensiled with selected three tropical browses mixture and concentrate diets (g/day)

Parameters(g/day)	T_1 100CPRS	T_2 CPR70GS30	T_3 CPR70FT30	T_4 CPR70GA30	SEM (±)
DFI	530.46^{cd}	532.20^{bc}	536.05^{b}	540.12^{a}	10.04
DMI	345.44^{c}	363.28^{a}	362.96^{ab}	342.81^{b}	9.27
CPI	23.87^{d}	108.99^{c}	132.14^{a}	117.58^{b}	6.70
CFI	91.45^{a}	74.08^{c}	76.39^{bc}	76.70^{b}	4.11
EE intake	8.33^{d}	11.60^{a}	10.29^{c}	11.02^{b}	0.86
Ash intake	15.17^{bc}	15.59^{b}	14.42^{c}	16.69^{a}	2.24
NFE intake	168.42^{a}	145.93^{c}	150.84^{b}	150.15^{bc}	6.22
NDF intake	320.91^{a}	281.32^{c}	255.86^{d}	287.13^{b}	1.91
ADF intake	172.45^{a}	168.33^{b}	163.23^{c}	171.87^{ab}	3.34
ADL intake	71.24^{a}	69.29^{b}	66.04^{c}	70.49^{ab}	1.17

[abcd]Means on the same row with different superscript are significantly different (P< 0.05). DMI= Dry Matter intake, CPI= Crude Protein intake, CFI= Crude Fibre intake, EEI= Ether Extract intake, NFEI=Nitrogen Free Extract intake, NDFI= Neutral detergent fibre intake, ADFI= Acid detergent fibre intake, ADLI= Acid detergent lignin intake, CPRS=Cassava peel residue silage, GS= Gliricidia sepium, FT=Ficus thonningii, GA=Gmelina arborea

Digestibility values for dietary dry matter (DM), crude protein (CP), crude fibre (CF), neutral detergent fibre (NDF), acid detergent fibre (ADF), ether extract (EE), and nitrogen-free extract (NFE) were generally high in the present study. Significant differences ($P < 0.05$) were observed among the treatments for dry matter digestibility (DMD) and nitrogen-free extract digestibility (NFED). Nutrient digestibility is an important indicator used to evaluate the availability of nutrients for ruminant utilization. The relatively high digestibility values obtained in this study suggest favourable rumen conditions that may have enhanced fermentation efficiency [49]. This improvement may be attributed to the nature of the diets, their palatability, and the adequate levels of protein and energy supplied by the supplements, which could have supported increased microbial activity and improved digesta passage rate. Efficient nutrient digestibility is essential for improved ruminant productivity because it enhances the utilization of dietary nutrients [53].

High digestibility values also reflect the contribution of specific nutrients to livestock performance, whereas low digestibility often indicates that the feed is unable to adequately meet the maintenance and production requirements of animals [36]. Consequently, the relatively high dry matter digestibility observed in this study may also indicate good palatability and acceptability of the diets. Previous studies have also reported that higher nutrient digestibility is often associated with improved feed palatability [17].

The increased digestibility values observed may therefore reflect the beneficial effects of supplementing cassava peel residue silage with browse fodders in the diets of growing bucks. Furthermore, the fibre content of the supplements did not appear to negatively affect nutrient intake or utilization. According to [3], rumen microorganisms are capable of rapidly hydrolysing cellulose present in dietary fibre, converting it into volatile fatty acids that serve as a major energy source for ruminants.

Dry matter digestibility in the present study ranged from 41.78% to 46.89%, which is lower than the values of 89.01–93.95% reported by [5] for West African Dwarf goats fed grass silage. This discrepancy may be associated with differences in the stage of forage maturity, harvesting period, preservation techniques, and the additives used during the ensiling process. Junior et al. [23] also reported that the digestibility of dry matter can be influenced by factors such as the type of feed material used, the method of diet preparation, and the animal species involved. Similarly, [12] noted that high digestibility values generally indicate that the diet is both palatable and easily digested by the animals.

Crude protein digestibility (CPD), which reflects the extent to which microbial protein becomes available for utilization by animals [42], was significantly higher in bucks fed the T3 silage diet compared with the other treatments. This observation agrees with the findings of [30], who reported that increased CP intake is often associated with improved CP digestibility. The lower CP digestibility recorded for bucks fed the T4 silage diet may be attributed to the interaction of additives during the ensiling process or to relatively lower protein levels in the browse fodder used. Earlier studies by [42] also reported improved DM and CP digestibility in Red Sokoto goats fed elephant grass and cassava peel silage compared with diets without cassava peel inclusion, apparent digestibility results suggest that crude protein and crude fibre play important roles in stimulating microbial activity in the rumen [47]. Significant differences ($P < 0.05$) were also observed among treatments for CP digestibility. The CP digestibility values obtained in this study ranged from 39.75% to 62.73%, which are comparable to the values of 47.5–61.9% reported by [56] for Arsi-Bale sheep fed different varieties of faba bean (*Vicia faba* L.) straw supplemented with a concentrate mixture. Variations in CP digestibility among studies may be attributed to differences in feed processing methods, diet formulation, and the breed of animals used in the respective experiments.

Neutral detergent fibre (NDF) and acid detergent fibre (ADF) digestibility were highest in bucks fed the T3 diet, with values of 61.36% and 52.27%, respectively, compared with the other treatments. The differences observed in NDF and ADF digestibility among the diets may be attributed to variations in rumen microbial activity as well as the chemical composition of the feeds [18]. The NDF digestibility values recorded in the present study (52.62–61.36%) and ADF digestibility values (45.25–52.27%) were lower than those reported by [6], who observed NDF and ADF digestibility ranges of 74.48–81.36% and 83.41–84.35%, respectively, in Abergelle goats supplemented with cowpea hay. Such differences may be related to variations in feed type, processing methods, feeding management, as well as differences in animal species and breeds used across studies.

The relatively higher NDF and ADF digestibility observed in the supplemented treatment groups in this study may be associated with increased feed intake and the nitrogen-rich nature of the diets, which can enhance microbial fermentation of fibrous feeds in the rumen. Higher NDF content may also prolong rumination time in ruminants, thereby improving fibre breakdown and digestion [48]. The improved performance of the bucks and the overall increase in digestibility observed in the present study may therefore be attributed to the nutritional contribution of the dietary supplements [18]. In addition, [34] reported that dry matter intake is positively correlated with organic matter, crude protein, and ADF intake and digestibility. Similarly, [14] noted that supplementation in different sheep breeds improved crude protein digestibility without significantly affecting the digestibility of dry matter, organic matter, NDF, or ADF.

Table 5: Nutrient digestibility of WAD growing bucks fed Cassava peel residues ensiled with selected three tropical browse fodders mixture and concentrate diets (%)

Parameters(g/day)	T_1 100CPRS	T_2 CPR70GS30	T_3 CPR70FT30	T_4 CPR70GA30	SEM (±)
DMD	42.54^{b}	44.32^{ab}	46.89^{a}	41.78^{c}	1.15
CPD	39.75^{c}	58.90^{b}	62.73^{a}	60.82^{ab}	1.34
CFD	34.07^{d}	37.32^{c}	43.91^{b}	50.06^{a}	6.02
EED	45.51^{c}	41.23^{d}	55.30^{a}	53.48^{b}	3.35
Ash D	44.60^{d}	51.30^{c}	61.33^{b}	65.04^{a}	6.54
NFED	34.06^{d}	58.10^{b}	62.47^{a}	51.66^{c}	4.21
NDFD	52.62^{c}	59.52^{b}	61.36^{a}	58.80^{bc}	6.82
ADFD	45.25^{d}	46.16^{c}	52.27^{a}	50.61^{b}	3.46
ADLD	44.68^{d}	52.47^{b}	53.01^{a}	47.83^{c}	3.92

[abcd] means on the same row with different superscript are significantly different (P< 0.05). DMD= Dry Matter Digestibility, CPD= Crude Protein Digestibility, CFD= Crude Fibre Digestibility, EED= Ether Extract Digestibility, NFED=Nitrogen Free Extract Digestibility, Neutral detergent fibre Digestibility, Acid detergent fibre digestibility, Acid detergent lignin digestibility, CPRS=Cassava peel residue silage, GS= Gliricidia sepium, FT=Ficus thonningii, GA=Gmelina arborea

Conclusion

The results of this study indicate that the T3 diet, consisting of 70% cassava peel residues and 30% *Ficus thonningii* silage supplemented with 200 g of concentrate, provided the most favourable nutritional outcomes for West African Dwarf (WAD) bucks. This dietary combination, characterized by relatively higher crude protein and lower crude fibre content, improved silage quality and consequently enhanced feed intake, nutrient consumption, and nutrient digestibility in the animals.

Recommendation

Based on the findings, it is recommended that underutilized crop residues, such as cassava peel, can be effectively supplemented with browse fodder species in silage production to improve the nutrient intake and digestibility of growing bucks. The optimal mixing ratio may vary depending on the physiological status of the animals and the nutritional quality of both the cassava peel and the selected browse species. Further research is warranted to determine the most effective cassava peel-to-browse fodder ratio for silage formulation across different production stages and animal requirements.

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