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Silage Characteristics and Preference of West Africa Dwarf Goat for Elephant Grass Ensiled with Cassava Peel and Brewer Dried Grain

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Abstract The silage characteristics and preferences of WAD goats for elephant grass (Pennisetum purpureum) ensiled with varying levels of brewer dried grain (BDG) and Cassava peel (CP) was investigated as follows: Treatment 1 (100% P. purpureum); Treatment 2 (60% P. purpureum + 40% B DG + 0% CP); Treatment 3 (60% P. purpureum + 30% BDG + 10% CP); Treatment 4 (60% P. purpureum + 20% BDG + 20% CP) + Treatment 5 (60% P. purpureum + 10% BDG + 30% CP); Treatment 6 (60% P. purpureum + 0% BDG + 40% CP). The silage was allowed to ferment for 56 days. Result revealed pH (3.95-5.27), Ammonia NH_3 (0.90-1.05) and water soluble carbohydrate WSC (1.08-1.24). Chemical composition showed that it contained 25.30% - 51.80% dry matter (DM), 10.95 – 21.80% crude protein (CP), 15.51 - 17.90% ash content, 3.50 – 3.85% ether extract (EE), 62.00 – 64.25% Neutral detergent fiber (NDF), 29.00 – 32.33% Acid detergent fiber (ADF), 12.75 – 13.90% Acid detergent lignin (ADL). There was no significant difference (P>0.05) in the ether extract (EE) across the silage mixtures. The order of preference of silage diet by WAD goat is T2, T3, T4, T6, T5 and T1. Elephant grass ensiled with cassava peels and brewer dried grain (BDG) holds potentials as silage feed for ruminants showing better quality and acceptability by WAD goat as BDG increased in the diets.

Keywords: *elephant grass, WAD goats, cassava peel, brewers dried grain, silage*

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1. Introduction

During the dry seasons, the main feed resources of ruminant animals are native grasses, legumes that occur naturally in grass lands, tree leaves and crop residues, feed intake declines and animal productivity is curtailed. There is a variation in the season and availability of natural pasture, tends to be more succulent, highly nutritious and more abundant in the rainy season (around May - November) as opposed to the dry season (around November - April) where they become fibrous, scarce and devoid of most essential nutrients such as protein, energy, minerals and vitamins which are required for increased rumen microbial fermentation that will results into production of volatile fatty acid and consequently performances of the host animal in the area of maintenance, production and reproduction [1,2]. The performance of ruminant animals which is dependent on the native pasture is seriously impaired; the quality is associated with the fibrous and lignified nature of the pasture which limits intake, digestibility and utilization [3].

Muhammad *et al.* [4] suggested the need for development of feed conservation strategies either as silage or haylage during the period of abundant supply so as to redistribute the feed supply over the year to meet the requirement of livestock. Ensiling is preservation method for most forage crops it is based on lactic acid under anaerobic conditions, as a result pH decreases and the moist forage is preserved from spoilage microorganism [5,6]. Grasses may be preserved as silage provided that they are ensiled at their optimum development stage or alongside the use of suitable additives [7]. Lactic fermentation must predominate in the anaerobic conditions so that forage plants can be conserved as silage. However, several factors may interfere with the quality of fermentation, including microorganisms that lead to secondary fermentation, soluble carbohydrates and DM contents, and compacting density [8].

Elephant grass (*Pennisetum purpureum*) is a high yielding tropical grass with great potentials for making silage because it have high productivity and it is usually rejected by ruminants while grazing but readily accepted when chopped and stall-fed. It is a valuable forage and very popular throughout the tropics, notably in cut-and-carry systems [9]. Characterized by a perennial vegetative cycle, rapid regrowth and high dry-matter (DM) yield, Elephant grass has been more used compared to other grasses [10]. Under good condition, its nutritional value is high having up to 12.5% crude protein, total digestible nutrient (TDN) of 10.2% and calcium phosphorus and magnesium [11]. Quality of this grass can improve with addition of a readily fermentable carbohydrate like cassava peel which is cheap and available in large quantities in Nigeria. The high starch content in cassava peel [12] will also improve energy concentration in the tropical grass silage. Ensiling elephant grass with cassava peels has been shown to improve its acceptability and feeding value to ruminants [13,14]. Cassava peels contains readily fermentable carbohydrates and have been used as additive [13] in grass silage fed to Red Sokoto goats.

The use of by-products as feedstuff for ruminant animals is becoming important in many parts of the world. Brewers' dried grain (BDG) is a solid waste from the brewery industries. It is available and cheap but difficult to dry to low moisture content for easy storage and use, especially during the wet seasons. BG has 230 to 290 g/kg CP (dry matter basis) and is high in digestible fiber [15]. BG is suitable for ruminants, particularly in dairy cows, to balance intake of large amounts of high starch diets, due to their fibrous nature and low energy content [15]. Wet brewers' grain can be ensiled and stored for long periods without altering its nutritive value for ruminant animals [16].

This study is to evaluate the silage quality and preference of West Africa Dwarf for elephant grass ensiled with brewer dried grain (BDG) and cassava peel.

2. Materials and Method

2.1. Experimental Site

The experiment was carried out at the Teaching and Research Farm, Ladoke Akinola University of Technology, Ogbomoso located in the derived Savanna zone of Nigeria. Ogbomoso lies at approximately 8° 7' North of the equator and 4° 15' East of Greenwich Meridian.

Elephant grass (*Pennisetum purpureum)* was harvested from the arable section of the Teaching and Research farm of the University and wilted in order to reduce the moisture content after which they were chopped to 2-3cm long length for ease of compaction and combination for silage. Brewer's Dried Grain were purchased from a reputable feed mill in Ogbomoso while cassava peel were gotten from the garri processing unit the Teaching and Research farm and crushed using a grinder. The chopped grasses with the Cassava peel and the Brewers Dried Grain (BDG) were mixed into six experimental proportions as follows:

Treatment 1 (100% P. purpureum);
Treatment 2 (60% P. purpureum + 40% B DG + 0% CP);
Treatment 3 (60% P. purpureum + 30% BDG + 10% CP);
Treatment 4 (60% P. purpureum + 20% BDG + 20% CP)
Treatment 5 (60% P. purpureum + 10% BDG + 30% CP);
Treatment 6 (60% P. purpureum + 0% BDG + 40% CP).

Each mixture were packed into the plastic drums (lined with 20mm thick nylon sheets) and compressed with heavy stones and sand bags to eliminate air and immediately, the plastic cover were placed, sealed and allowed to ferment for 56 days.

2.2. Determination of Silage Quality

After 56 days, the fermentation was terminated and the silage was opened for silage quality assessment. The assessed quality characteristics were colour, smell texture, taste, pH and temperature according to Babayemi and Igbekoyi [17]. Immediately the silage was opened laboratory thermometer was inserted to determine the temperature. Sub-samples of approximately 25 g were collected to analyse the pH and 100 mL of water was added following a two-hour rest period. The pH was read with a pH meter [18]. Colour assessment was ascertained using visual observation with the aids of colour charts. The odour or smell of the silage was relatively assessed as to whether nice or pleasant or fruity it was done also using the 0-5 scale as follows

Sub sample from different points and depth was taking and mixed together for dry matter determination by oven drying at 65°C until a constant weight is achieved. This sample was milled and stored in an air tight container ready for chemical analysis.

2.3. Preferential Study

Twelve (12) West African Dwarf (WAD) goats were used in a Cafeteria experiment to evaluate the acceptability of elephant grass ensiled with varying levels of cassava peels and BDG. The cafeteria experiment lasted seven days after initial seven day – adaptation period. About 1.5kg (3% body weight) of each diet was introduced for duration of six (6) hours per day in twelve (12) different plastic feeding troughs. Thus, each animal was allowed free access to each of the silage in the trough. The position of the feeding troughs was changed daily to prevent bias and conditioning of the animals in recognizing part of the pen for a particular diet. The amounts of feed consumed were monitored for four hours per day and quantity consumed was recorded. After then the animals were released to go for grazing. The feed preference was determined from the coefficient of preference (CoP) value calculated from the ratio between the intakes of each individual feed sample divided by the average intake of the six feed samples [19]. A diet was adjudged to be relatively preferred when the CoP value is greater than unity [19,20].

$$CoP = \frac{Intake\ of\ individual\ feed\ offered}{Mean\ intake\ of\ all\ the\ feed\ offered}$$

Preference (%) was calculated as the ratio of individual intake to total intake multiplied by 100. Silages were ranked based on percentage of preference [13].

2.4. Chemical Analysis

Crude protein, crude fibre, ether extract and ash contents of the silage were carried out as described by AOAC [21] and the amount of CP was calculated (N x 6.25). The fiber components including neutral detergent fiber, acid detergent fiber and acid detergent lignin were determined according to Van Soest *et al*. [22]. Mineral contents such as calcium and phosphorus were also determined.

2.5. Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) using General Linear Model Procedure of SAS [23]. Significant differences between the means were separated using the Duncan's multiple range test of the same package at 5% probability level.

3. Results and Discussion

The colour, smell and texture of elephant grass ensiled with cassava peel and brewers dried grain are shown in Table 1. Organoleptic characteristics can be used to assess silage quality because the volatile nature of many fermentation end products produces a variety of distinct odors. The experimental silages' color ranged from Green to Olive Green with T1 and T5 which were Green while T2, T3, T4 and T6 were Olive Green. The Smell ranged from Pleasant to Very Pleasant with T1, T2, T3 and T5 having a Pleasant smell while T4 and T6 were having a very pleasant smell. The experimental silages were observed to have a Green to Olive Green colour similar to the report of Olorunisomo [13] that ensiled *P. purpureum* with cassava peel.

All the silages prepared had a pleasant and acceptable smell; however, it appears that the smell improved with increasing level of cassava peel in the mixture. All the silages were firm in texture although those with little or no BDG were slightly wet when touched. The firm texture of the experimental silages, which was expected to be the best texture of good silage [24].

Table 1. Colour, Smell And Texture Of Elephant Grass (*Pennisetum purpureum*) Ensiled With Brewers Dried Grain And Cassava Peel

Parameters	COLOUR	SMELL	TEXTURE
T1	GREEN	PLEASANT	VERY FIRM
T2	OLIVE GREEN	PLEASANT	FIRM
T3	OLIVE GREEN	PLEASANT	FIRM
T4	OLIVE GREEN	VERY PLEASANT	FIRM
T5	GREEN	PLEASANT	FIRM
T6	OLIVE GREEN	VERY PLEASANT	VERY FIRM

Treatment 1: 100% *P. purpureum; Treatment* 2: 60% *P. purpureum* + 40% BDG + 0% CP
Treatment 3: 60% *P. purpureum* + 30% BDG + 10% CP; Treatment 4: 60% *P. purpureum* + 20% BDG + 20% CP; Treatment 5: 60% *P. purpureum* + 10% BDG + 30% CP; Treatment 6: 60% *P. purpureum* + 0% BDG + 40% CP
BDG – Brewers Dried Grain; CP – Cassava Peel.

Table 2 shows the microbial content of elephant grass ensiled with BFG and cassava peels. Silage micro flora fermented carbohydrates to obtain energy for growth and survival and produce organic acids and other metabolites as end products. Total Aerobic Bacteria ranged from 12.59 Log_{10} (cfu/g) to 12.79 Log_{10} (cfu/g) higher than results (8.86 Log_{10} (cfu/g)) of Zhang *et al*., [25] on corn silage. The levels of lactic Acid Bacteria ranged from 7.21 Log_{10} (cfu/g) in T4 to 7.36 Log_{10} (cfu/g) in T2. It is a well-known fact that lactic acid bacteria play a very crucial role in silage fermentation [26]. Normal fermentation process will provide a growth opportunity for lactic acid bacteria [27] and will increase in number if sufficient media and energy are added [28], and can inhibit other pathogenic bacteria. LAB utilized water-soluble carbohydrates (WSC) and converted them into mixtures of organic acids. Also, the LAB suppresses the growth of undesirable microorganisms and thus reduces proteolysis and DM loss in early fermentation [29]. The principle of ensiling involves the conversion of water-soluble carbohydrates (WSCs) into organic acids (mainly lactic acid) by lactic acid bacteria (LAB) [25]. The levels of Acetic Acid Bacteria ranged from 2.53 Log_{10} (cfu/g) in T6 to 2.75 Log_{10} (cfu/g) in T4. Acetic acid bacteria are aerobic bacteria that are capable of growing at low pH. They grow on ethanol, producing Acetic acid. However, once ethanol has been exhausted, they can grow on acetic acid, producing carbon dioxide and water. This will raise pH and permit other aerobic microorganisms to grow. Consequently, Acetic acid bacteria can be initiators of aerobic deterioration [30]. Propionic Acid Bacteria ranged from 1.25% to 1.56%. The reduction in the pH of the medium may have inhibited the development of enterobacteria and clostridia bacteria that produce these acids, reducing their concentration in the silage.

Table 2. Microbial Composition Of Ensiled Elephant Grass (*Pennisetum purpureum*) With Cassava Peel And Brewers Dried Grain

Parameters Log_{10}(cfu/g)	T1	T2	T3	T4	T5	T6	SEM
TAB	12.79	12.70	12.59	12.74	12.74	12.65	5.95
LAB	7.23	7.36	7.23	7.21	7.25	7.26	0.08
AAB	2.57	2.63	2.62	2.75	2.45	2.53	0.13
PAB	1.40^{a}	1.25^{c}	1.56^{a}	1.37^{ab}	1.33^{bc}	1.29^{bc}	0.02
BAB	9.40	9.37	9.40	9.42	9.35	9.31	8.11

$^{a, b, c, d}$ means with different superscripts on the same row are significantly different.
Treatment 1: 100% *P. purpureum;* Treatment 2: 60% *P. purpureum* + 40% BDG + 0% CP; Treatment 3: 60% *P. purpureum* + 30% BDG + 10% CP; Treatment 4: 60% *P. purpureum* + 20% BDG + 20% CP; Treatment 5: 60% *P. purpureum* + 10% BDG + 30% CP; Treatment 6: 60% *P. purpureum* + 0% BDG + 40% CP
SEM: Standard Error of Mean
TAB: Total Aerobic Bacteria; LAB: Lactic Acid Bacteria; PAB: Propionic Acid Bacteria; AAB: Acetic Acid Bacteria; BAB: Butyric Acid Bacteria; BDG: Brewer Dry Grain; CP: Cassava Peel.

Table 3 shows the Volatile Fatty Acids, pH, Ammonia and water soluble carbohydrate contents of the experimental silages. Lactic Acid ranged from 7.64% to 8.13% with no significant difference between the experimental silages. According to Kung and Shaver, [24] Lactic acid should be at least 65% to 70% of the total silage acids and the primary acid in good silage. This acid is stronger than the other acids in silage (Acetic, Propionic, and Butyric acid). The level of Lactic Acid in the experimental silage ranged from 62% to 67% close to the 65% to 70% minimum level stated by Kung and Shaver [24]. Lactic Acid in this study exceeds the 4-7% reported by Ward [31] for general silage and the 3.5 to 4.4 reported by Abegunde *et al*. [32] on dry banana leaves ensiled with cassava peels and urea. Lactic Acid and Acetic Acid were not affected by varying levels of cassava peel and brewers dried grain. The pH of silage is related to the production of lactic acid during the ensilage process, a low pH reflects a high production of lactic acid [33,34].

Acetic Acid also ranged between 3.11% and 3.55% in the experimental silages. Acetic Acid acts as an inhibitor of the growth of spoilage, resulting in increases of the aerobic stability exponentially [35]. Extremely wet silages (<25% DM), prolonged fermentations (due to high buffering capacity), loose packing, or slow silo filling can result in silages with high concentrations of acetic acid [24]. The levels of Acetic Acid recorded from the experimental silage were similar to 3.22% in Corn Silage by Baytok *et.al.* [36]. Higher values of propionic and acetic acids reported for T2 silage imply that this diet had the highest energy contents, which might have been due to cassava peels' addition as an additive.

Propionic and butyric Acid on the other hand differed significantly ($p<0.05$) among the silage. Propionic acid ranged from 0.37% to 0.71%, with T5 significantly highest (0.71%) and others were similar. Butyric Acid followed the same trend. Most silage contains very low concentrations of propionic acid (<0.2 to 0.3%) unless the silage is very wet (<25% DM). In silages with more typical concentrations of DM (35 to 45% DM), concentrations of propionic acid may be undetectable [24]. According to Kung and Shaver (2001) the expected level of propionic acid in grass silage is < 0.2 to 0.3. The level of Propionic Acid in the experimental silages with the exception of T5 which was 0.71% can be regarded as being in order. According to reports from [24], a high level of Propionic Acid could be as a result of high moisture in the silage. The level of Butyric Acid in the experimental silages ranged from 0.34 % to 0.79% exceeding the expected level of < 0.1 according Selgar, [37]. Elevated levels of Butyric acid indicate silage deterioration from secondary fermentation, which in the presence of unpalatable nitrogenous end products such as amines and amides, may lead to significant reduction in dry matter intake and energy level of the forage [37].

The pH of an ensiled sample is a measure of its acidity [24]. The pH of the silages ranged from 3.95- 5.27and were within the recommended values of 3.5-5.5 classified to be pH for good silages [24,38]. The pH of the ensiled mixtures reduced with increasing level of cassava peel inclusion, showing that addition of cassava peel was effective in improving fermentation characteristics of the tropical grass silage. Lower pH values have been indicated to preserve silages better and elicit longer stability during feeding out process. The concentration of lactic acid and buffering capacity of the silage are two of many factors affecting the final pH of silage [39]. T6 silage had the lowest pH. This low pH is an indicative of the efficiency of cassava peel as an additive that acts as a substrate for LAB known to increase the lactic acid content of silage [40]. The importance of lactic acid in the silage reduces the pH, which helps to stabilize the fermentation of the silage through the inhibition of growth or outright killing of microbe intolerant to low pH.

Ammonia ranged from 0.9 to 1.05%. Well-preserved silages should contain less than 100 g NH_3-N/kg total N [11]. The silage is well conserved, presenting good fermentation profile with ideal N-NH_3 values according to McDonald *et al.* [5]. On average, silage fermentation quality was good, as indicated by the relatively low proportion of ammonia.

There were significant differences in Water Soluble Carbohydrate between the silages. Water-soluble carbohydrates range from 1.08 to 1.24%. The soluble carbohydrate content is critical for the production of good quality silage because it is the main source of nutrients for the growth of microorganism that produce lactic acid. McDonald *et al.* [5] suggested that the potential of a plant for silage depends on the content of Water Soluble Carbohydrate.

Table 4 presents the chemical composition of ensiled Elephant grass ensiled with varying proportions of cassava peel and brewery dried grain. The dry matter (DM) (%) content of the silages ranged from 25.30% (diet 1) to 51.80% (Diet 2). DM content of the silage increased as the proportion of BDG in the mixture increased. The Dry Matter (DM) content of forages influences fermentation quality of the silages; and optimal DM content ranges from 30% - 40% for good quality silage making [5]. The DM content recorded across the experimental silages (25.30% to 51.80%) were similar reports from Binuomote *et al.* [41] on Elephant Grass with varying levels of Poultry dropping and cassava peels whose DM content ranged from 27.00 to 54.00% and 30% DM reported by Oliveria *et al* (42) on Elephant Grass silage.

Table 3. Volatile Fatty Acids, pH, Ammonia and water-soluble carbohydrate of Elephant Grass (*Pennisetum purpureum*) Ensiled With Cassava Peel And Brewers Dried Grain

Parameters	T1	T2	T3	T4	T5	T6	SEM
LATIC ACID	7.95	7.73	7.89	7.64	7.78	8.13	0.16
ACETIC ACID	3.54	3.55	3.29	3.12	3.18	3.19	0.13
PROPANOIC ACID	0.43^{b}	0.41^{b}	0.39^{b}	0.37^{b}	0.71^{a}	0.39^{b}	0.07
BUTYRIC ACID	0.41^{b}	0.38^{b}	0.37^{b}	0.34^{b}	0.79^{a}	0.36^{b}	0.09
pH	5.27^{a}	4.45^{b}	4.17^{bc}	4.07^{bc}	3.98^{c}	3.95^{c}	0.14
NH3	0.91^{c}	1.05^{a}	0.99^{b}	0.92^{c}	0.90^{c}	0.90^{c}	0.01
WSC	1.08^{b}	1.17^{ab}	1.17^{ab}	1.21^{a}	1.20^{a}	1.24^{a}	0.03

a, b, c, d means with different superscripts on the same row are significantly different.
SEM: Standard Error of Mean
Treatment 1: 100% *P. purpureum;* Treatment 2: 60% *P. purpureum* + 40% BDG + 0% CP
Treatment 3: 60% *P. purpureum* + 30% BDG + 10% CP; Treatment 4: 60% *P. purpureum* + 20% BDG + 20% CP; Treatment 5: 60% *P. purpureum* + 10% BDG + 30% CP; Treatment 6: 60% *P. purpureum* + 0% BDG + 40% CP
BDG – Brewers Dried Grain, CP – Cassava Peel.

Ensiling with BDG significantly (P<0.05) increased CP level of diets which ranged from 10.95 to 21.80%. This agrees with the findings of Jolaosho *et al*., [43] who observed increase in CP content of the silage ensiled with 25% guinea grass+ 25% cassava peel+50% BDG. The higher CP obtained could be attributed to the high inclusion level of BDG in the silage because BDG contain 25.3% CP [44]. The CP values (10.50-21.80%) obtained in this study are higher than that of 8.46-10.72% obtained by Binuomote *et al*. [41] for elephant grass ensiled with poultry droppings and cassava peels and 4.52 -5.50% reported by of Olorunnisomo and Dada [45] for Elephant Grass ensiled with cassava peel.The CP were above the minimum level necessary to provide sufficient nitrogen required by rumen microorganisms to support optimum activity [11,46] and for adequate intake of forages.

Ash is simply the total mineral content of a forage or diet. Ash Content which were between 15.51% - 17.90 %, indicating that there was an appreciable amount of minerals in the silage. Ash content was significantly highest in T3 (17.90%) while the lowest value of 15.51% was recorded in T4 (60% Elephant grass + 20% Cassava peel + 20% BDG). The ash content of silage with relatively high proportion of BDG was higher compared to those with high cassava peel content and the sole grass silage. This may be as a result of higher ash content of BGD and cassava peels as compared to Elephant grass. The ash values reported in this study are higher than 7.25 – 11.05 % reported by Abegund *et. al.* [32]. The ash content is an indication that the silage diets ensiled with cassava peels will be a good source of minerals. Ether Extract ranged from 3.50% to 3.85% higher than reports of Binuomote *et al*., [41] for elephant grass ensiled with poultry droppings and cassava peels but similar to 3.44 – 4.36% by of Oliviera *et al*., [42] on Elephant Grass silage.

Neutral detergent fiber (NDF) content of the silage ranged from 62.29 to 64.25%, the highest value is obtained in the T1 while the least value is recorded in T6. The NDF in the present study were higher than results from Binuomote *et al*., [41] who reported 28.52 to 60.52% CF for elephant grass ensiled with poultry droppings and cassava peels and report of Olorunnisomo and Dada [45] who reported 29.50 to 35.00 for Elephant Grass ensiled with cassava peel

The NDF content in this study is lower than the NDF content of 74.50% reported by Ansah *et al* [46] for fresh *P. purpureum.* The reduction in fiber content may have resulted from increased cell wall degradation due to increased silage fermentation caused by the addition of cassava peels and BDG. This statement agrees with the report of Zanine *et al.* [6] who reported a reduction in fiber fractions of elephant grass silage with the addition of cassava scrapings and Oliveira [47] who reported a decrease in NDF and ADF content of elephant grass ensiled with cassava meal. The NDF recorded were within the range of 600-650 g.kg DM-1 suggested as the limit above which intake of tropical feeds by ruminant animals would be limited [22].

Acid detergent fiber (ADF) values ranged between 29.00% and 32.33%. ADF represents the least digestible fiber portion of forage. The higher the ADF concentration is, the lower the energy concentration. The ADF content ranged from 20.81 % to 32.33%. According to Guerra *et al*., [48] Elephant Grass contains 47.45 % Dry matter of ADF. Acid detergent lignin (ADL) values fell between 12.75 to 13.60%. The Hemicellulose content ranged from 31.50% to 33.00% while the Cellulose content ranged from 16.25% to 18.83%.

The values of Calcium (Ca) of the silages (0.25-0.26%) were below the critical level of 3 g.kg DM-1 as recommended for ruminants in the warm wet climates [49]. Phosphorus on the other hand range (0.26-0.38%) found to be higher than the recommended critical value of 0.25% for ruminant animals as reported by Mc Dowell *et al* [49].

The result of the preference of West African dwarf goat to Elephant grass (*Pennisetum purpureum*) ensiled with brewery dried gran (BDG) and cassava peel (CP) is shown in Table 3. There was significant (P<0.05) differences between the Coefficient of preference (CoP), Dry matter intake (DMI) and percentage preference (PP). Silage preference on cafeteria basis showed that T4 was most preferred while T1 was least preferred. When the CoP is equal to or greater than 1, the diet is considered to be acceptable and when CoP is less than 1, the diet is assumed to be unacceptable to livestock [20,50]. Accordingly, silage diets T1 (sole elephant grass silage) and T5 were rejected by sheep, while T2, T3, T4 and T6 were preferred. The result on the preference of silage diets is supported by the observations from the physico-chemical parameters where the accepted silages had the most desirable pH and chemical composition for well-preserved silage. This could be attributed to the presence of cassava peels and brewers' grain in the mixture as ruminants are used to these feed resources and relish them especially when fermented. This results conforms with the findings of Olorunnisomo [13] that the addition of cassava peel enhances the acceptability of elephant grass silage among goats and Ikhimioya [51] that goats more readily accept diets with which they have had previous experience.

Table 4. Chemical composition (%) of Elephant grass (*Pennisetum purpureum*) ensiled with cassava peel and BDG

Parameters	T1	T2	T3	T4	T5	T6	SEM
Dry Matter	25.30^{d}	51.80^{a}	43.10^{b}	40.00^{c}	33.10^{cd}	29.00^{d}	2.45
Crude Protein	10.95^{d}	21.80^{a}	15.40^{b}	12.65^{c}	12.08^{c}	11.35^{cd}	0.96
Ash	15.51^{c}	17.90^{a}	16.90^{b}	16.66^{b}	16.49^{b}	15.90^{bc}	0.39
Ether Extract	3.50	3.85	3.55	3.48	3.65	3.60	0.18
NDF	64.25^{a}	62.90^{bc}	62.00^{c}	63.90^{b}	62.88^{b}	62.29^{d}	0.10
ADF	32.33^{a}	30.81^{b}	29.00^{c}	31.70^{ab}	30.23^{b}	30.79^{b}	0.52
ADL	13.90^{a}	13.35^{c}	12.75^{d}	13.50^{bc}	13.60^{b}	13.60^{b}	0.31
Ca	0.25	0.26	0.25	0.25	0.25	0.26	0.00
P	0.36	0.38	0.36	0.37	0.37	0.37	0.00

a, b, c, d: Means in the same row with different superscript are significantly different (P < 0.05).
SEM- Standard error of mean, NDF- neutral detergent fiber, ADF- acid detergent fiber, ADL- acid detergent lignin Ca- Calcium, P- phosphorus.
Treatment 1 (100% *P. purpureum*); Treatment 2 (60% *P. purpureum + 40% BDG + 0% CP);*
Treatment 3 (60% P. purpureum + 30% BDG + 10% CP)*; Treatment 4 (60% P. purpureum + 20% BDG + 20% CP)*
Treatment 5 (60% P. purpureum + 10% BDG + 30% CP); Treatment 6 (60% P. purpureum + 0% BDG + 40% CP).

Table 5. Preferential Study of Elephant Grass (*Pennisetum purpureum*) Ensiled with Cassava peel and Brewery Dried grain Fed to West African dwarf goat

Parameters	T1	T2	T3	T4	T5	T6	SEM
COP	0.76e	1.20a	1.12b	1.02c	0.89d	1.01c	0.01
DMI	211.17e	333.34a	310.30b	283.75c	247.25d	281.75c	1.84
PP	12.66e	19.99a	18.61b	17.02c	14.83d	16.90c	0.10
Raking	6th	1st	2nd	3rd	5th	4th	

a, b, c, d, e: Means in the same row with different superscript are significantly different ($P < 0.05$).
SEM- Standard error of mean, COP- Coefficient of preference, DMI- Dry matter intake, PP- percentage preference
Treatment 1: 100% *P. purpureum;* Treatment 2: 60% *P. purpureum* + 40% BDG + 0% CP; Treatment 3: 60% *P. purpureum* + 30% BDG + 10% CP; Treatment 4: 60% *P. purpureum* + 20% BDG + 20% CP; Treatment 5: 60% *P. purpureum* + 10% BDG + 30% CP;
Treatment 6: 60% *P. purpureum* + 0% BDG + 40% CP.

4. Conclusions

Various microorganisms interact during the ensiling process which may affect the nutritive value of silage for ruminants. Microbial activities showed that the environment were favorable to desirable microbes (Lactic Acid Bacteria and Acetic Acid Bacteria). Lactic Acid Bacteria dominated fermentation once anaerobic conditions were established. The microbial load and the Volatile Fatty Acid composition show that there will be no health risk when fed to the animals.

Addition of Cassava peel and BDG to elephant grass silage improved physical characteristics and dry matter content of the silage compared to the sole grass. Protein content of silage increased as proportion of BDG in the silage increased while fiber components decreased. Goats preferred Elephant grass ensiled with varying proportion of BDG and cassava peels to the sole grass.

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