

## Physiochemical quality and nutritional value of ensiled fresh maize stover and groundnut haulms in wet season for sustainable ruminant production

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### Abstract

The study was conducted to evaluate the physiochemical quality and nutritional value of ensiled fresh maize stover and groundnut haulms for wet season sustainable ruminant production. Fresh maize stover and fresh groundnut haulms were collected, wilted for 3 – 4 days, chopped and ensiled in different proportions to make three (3) experimental treatments (T1: 100% maize stover; T2: 100 % groundnut haulms; T3: 50 % maize stover and 50 % groundnut haulms) and replicated four (4) times in glass Bamma® bottles for 30 days. Physical features, proximate composition, mineral profile, anti-nutritional factors, post in-vitro digestibility characteristics and nutritional values of the silages were examined. Results showed that the colour of the silage were cream, greenish brown and light brown for T1, T2 and T3, respectively. Texture was smooth for T1, coarse for T2 and slightly coarse for T3. All the silages were moist with pleasant aroma. The pH and temperature value ranges from 3 – 4.5, 30 – 31.5°C, respectively. There were significant differences ( $P < 0.05$ ) in the proximate composition, fiber fractions, minerals, anti-nutritional factors and the post in-vitro digestibility characteristics of the silages. Silage T3 (50 % maize stover and 50 % groundnut haulms) had highest ( $P < 0.05$ ) significant content for the parameters considered. Similar ( $P > 0.5$ ) nutritive value (Dry matter intake (DMI), digestible dry matter (DDM), and relative feed value (RFV)) were recorded for the experimental treatments. The values observed for DMI, DDM and RFV ranged from 2.44 – 2.45, 67.62 – 67.67 and 127.86 – 127.98, respectively. Conclusively, the silage exhibited good physiochemical quality and nutritional value that justified its potential in solving the challenges of dry season feeding. Treatment 3 (50% maize stover and 50% groundnut haulms) is recommended for ruminant farmers.

**Keywords:** Groundnut-haulms, maize-stover, physiochemical, qualities, ruminant, silage,

### La Qualité physiochimique et valeur nutritionnelle des tiges de maïs frais ensilées et des fanes d'arachide en saison humide pour une production durable de ruminants



### Résumé

L'étude a été menée pour évaluer la qualité physico-chimique et la valeur nutritionnelle des tiges de maïs frais ensilées et des fanes d'arachide pour la production durable de ruminants en saison humide. Les tiges de maïs frais et les fanes d'arachide fraîches ont été collectées, fanées pendant 3 à 4 jours, hachées et ensilées dans des proportions différentes pour faire trois (3) traitements expérimentaux (T1 : 100% de tiges de maïs ; T2 : 100% de fanes d'arachide ; T3 : 50% tiges de maïs et 50% de fanes d'arachide) et répliquées quatre (4) fois dans des bouteilles en verre Bamma® pendant 30 jours. Les caractéristiques physiques, la composition immédiate, le profil minéral, les facteurs anti-nutritionnels, les caractéristiques de digestibilité post-in vitro et les valeurs nutritionnelles des ensilages ont été examinés. Les

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*résultats ont montré que la couleur de l'ensilage était crème, brun verdâtre et brun clair pour T1, T2 et T3, respectivement. La texture était lisse pour T1, grossière pour T2 et légèrement grossière pour T3. Tous les ensilages étaient humides avec un arôme agréable. La valeur du pH et de la température varie respectivement de 3 à 4,5 et 30 à 31,5 ° C. Il y avait des différences significatives ( $P < 0,05$ ) dans la composition immédiate, les fractions de fibres, les minéraux, les facteurs anti-nutritionnels et les caractéristiques de digestibilité post-in-vitro des ensilages. L'ensilage T3 (50% de tiges de maïs et 50% de fanes d'arachide) avait la teneur significative la plus élevée ( $P < 0,05$ ) pour les paramètres considérés. Des valeurs nutritives similaires ( $P > 0,5$ ) (ingestion de matière sèche (DMI), matière sèche digestible (DDM) et valeur d'alimentation relative (RFV)) ont été enregistrées pour les traitements expérimentaux. Les valeurs observées pour le 'DMI', le 'DDM' et le 'RFV' allaient respectivement de 2,44 à 2,45, 67,62 à 67,67 et 127,86 à 127,98. En conclusion, l'ensilage présentait une bonne qualité physico-chimique et une valeur nutritionnelle qui justifiaient son potentiel à résoudre les défis de l'alimentation en saison sèche. Le traitement 3 (50% de tiges de maïs et 50% de fanes d'arachide) est recommandé pour les éleveurs de ruminants.*

**Mots clés :** arachide-fanes, tiges de maïs, physicochimiques, qualités, ruminant, ensilage,

### **Introduction**

Natural pasture is known to be the main source of feed for ruminant livestock production in Nigeria, as most farmers can hardly afford to keep their animals on concentrate rations (Lamidi *et al.*, 2019a). Lamidi *et al.* (2009) reported that available forage for most part of the year is low in crude protein, thus leads to marked decrease in voluntary intake and digestibility and consequent weight loss of animals, and poor economic return of the venture. The scarcity of forages during the dry seasons has also been reported to cause communal conflicts between the nomads and arable farmers (Lamidi and Ologbose, 2014).

Crop-livestock farming is an integrated agricultural production system in which crop products especially wastes can be used as feed resources for the animals. Meanwhile, the dung and urine of the animals can also be used to improve the soil fertility. Increase in crop production will consequently lead to increase in the production of crop waste which can be harnessed or transformed to feed resources for animal production. The best way to maximally utilize crop wastes is to convert them to useful materials such as feed

resources for animals, especially ruminant animals. Silage production has been used as a means of adding value to different crops waste. Silage production has been used as sustainable measures and strategies to ameliorate the dry season feeding challenges. Silage is defined as any plant material that has undergone fermentation or “pickling” in a silo, while silo is any storage structure in which green, moist forage is preserved (Amuda *et al.*, 2019). The primary goal of making silage is to maximize the preservation of original nutrients in the forage crop for feeding of livestock at a later date in livestock feeding programs.

Fortunately, apart from the conventional forage crops, materials that can be ensiled include fodder crops and crop residues or by-products ('t Mannetje, 2000). Silage production has been used as a means of adding value to different crops waste.

Maize stover is the left over material when maize cob has been harvested by the farmers. It can be a waste if left on the farm to dry off, it can also be ploughed back into the soil or destroyed by rodents or insect especially termites. Groundnut haulms is the entire groundnut plant after groundnut were removed after harvesting, it is made

up of the leaves, stem and root. It is also crop wastes which were left on the farm. Sometimes it may be used as hay; and where weather is not favorable, it is left on the farm and wasted. Groundnut haulms have a higher crude protein content (11-17%) compared to 2 - 8% in cereal residues. Adass *et al.* (2011) reported 91% DM, 8.30% ash, 10.90% CP, 31.80 CF and 1.31% EE for groundnut haulms. This study assessed the physical quality, nutritional value of ensiled fresh maize stover and fresh groundnut haulms for sustainable ruminant production.

## **Materials and methods**

### ***Experimental site***

The study was carried out at Forage Science Laboratory, Department of Animal science, Faculty of Agriculture, University of Port Harcourt, Rivers State. Port Harcourt is a coastal city located in the Niger Delta region of Nigeria within latitudes 6° 58' – 7° 60'E and longitudes 4° 40' – 4°55'N. The monthly rainfall in Port Harcourt follows a sequence of increase from March to October before decreasing in the dry season months of November to February (Uko and Tamunobereton, 2013; Lamidi and Ogunkunle, 2016).

### ***Collection of experimental materials and silage production***

Fresh maize stover was collected from the Faculty of Agriculture Demonstration Farm immediately after maize cobs were harvested, also fresh groundnut haulms were gathered after groundnut seeds were harvested from the groundnut plant, the haulms cleaned of soil from the root. Both the fresh crop wastes (maize stover and groundnut haulms) were allowed to wilt for 2-3 days.

The wilted maize stover and groundnut haulms were chopped to 3 - 5 cm with forage chopper machine separately and later weighed on percentage bases as

follows:

T1 = 100% of Maize stover

T2 = 100% of Groundnut haulm

T3 = 50% of Maize stover: 50% of Groundnut haulm.

The experimental materials were ensiled in laboratory bottles (Bamma® 960 ml) as laboratory silos and plastic drum for preferential trial. The silos were tightly tied and covered to avoid air penetration. Each treatment had four replicates and the ensiled materials were kept at room temperature of 28 to 32 °C for 30 days.

### ***Data collection***

Physical characteristics as well as temperature (°C) and pH of the silage were determined immediately the silos were opened. Physical characteristics of silage for ensiled fresh maize stover and groundnut haulms were carried out according to the procedures of Lamidi and Akhigbe (2018), while pH and temperature were determined using Digital pH Meter. Sub-samples of the silage were oven-dried, ground with a Thomas Willey Laboratory Mill-Model 4 to pass through 1 mm sieve.

### ***Chemical analysis***

#### ***Proximate composition***

The dry matter, crude protein, ether extract and Ash contents of the milled silage sample were determined according to A.O.A.C. (2000). Non-fibre carbohydrate was calculated as  $NFC = 100 - (CP + Ash + EE + NDF)$ .

#### ***Fibre fraction analysis***

Neutral detergent fibre (NDF), Acid detergent fibre (ADF) and Acid detergent lignin (ADL) of the milled grass sample were determined with the procedure of Van Soest *et al.* (1991). Cellulose content was taken as the difference between ADF and ADL while hemicellulose content was also calculated as the difference between NDF and ADF.

#### ***Anti-nutritional factors***

Tannin and saponin contents were

determined according to the methods described by Lamidi and Ogunkunle, (2015). **Oxalate was according to Munro (2000) while phytate was determined as described by Prokopet and Unlenbruck (2002).**

#### ***In vitro digestibility trial***

The *in vitro* trial was carried out at the laboratory of Department of Animal Science, University of Benin, Benin City, Edo State, Nigeria. The method adopted was as described by Bamikole *et al.* (2019). The modified *in vitro* fermentation procedure of Navarro-Villa *et al.* (2011) was adopted as described by Bamikole *et al.* (2019). A phosphate – bicarbonate buffer (Mould *et al.*, 2005) used (g/L) were: 1.98 Na<sub>2</sub>HPO<sub>4</sub>.12H<sub>2</sub>O, 1.302 KH<sub>2</sub>PO<sub>4</sub>, 0.105 MgCl<sub>2</sub>.6H<sub>2</sub>O, 1.407 NH<sub>4</sub> HCO<sub>3</sub>, 5.418 NaOH. Rumen fluid was obtained from three fistulated goats before morning feeding into a thermos flask and taken to the laboratory where it was strained through four layer of Cheesecloth under continuous flushing with CO<sub>2</sub>. Inoculum for incubation was prepared using ratio of rumen fluid to buffer of 1:2. 190 mg of substrate (mixture of equal proportion ground maize, Guinea grass and *Centrosema molle*) was weighed with 10 mg of the test material (experimental treatments) into nylon bags, sealed and incubated using 30ml of inoculum in 100 ml graduated syringes at 30°C for 24hrs. Syringes containing only the substrate (i.e. without the experimental treatments) and those containing only the inoculum (i.e. without sample) represent the control and blank respectively. Gas production (i.e. accumulated gas in the head space of each fermentation syringe) was read 3 hourly for 24 hours to know the volume of gas produced. At the end of incubation, 4mL of 10M NaOH was introduced into the headspace of the syringes for methane determination. The

bags with the residue were removed from the syringes, rinsed thoroughly with water and dried at 100°C for 24 h, and then to constant weight to determine *in vitro* dry matter disappearance (IDMD).

#### ***Calculation for post incubation parameters***

Organic matter digestibility (OMD) was estimated as:  $OMD = 14.88 + 0.889 GV + 0.45 CP + 0.651 \text{ ash}$  (Menke and Steingass, 1988).

Short-chain fatty acids (SCFA) were estimated as:  $SCFA = 0.0239 GV - 0.0601$  (Getachew *et al.*, 1999).

Metabolizable energy (ME) was calculated as:  $ME = 2.20 + 0.136 GV + 0.057 CP + 0.00029 CF$  (Menke and Steingass, 1988).

Fermentation Efficiency (FE) was calculated as:  $\text{Fermentation Efficiency (FE)} = \text{Dry matter Digestibility (g/kg)} / \text{Total Gas Volume (mL/g)}$ .

#### ***Nutritive values parameters calculations***

Nutritive parameters such as Dry matter intake (DMI), Digestible dry matter (DDM) and Relative feed value (RFV) were calculated as follows:  $DMI = (120 \div NDF\% \text{ dry matter basis})$ ,  $DDM = 88.9 - (0.779 \times ADF\% \text{ dry matter basis})$ ,  $RFV = (DDM\% \times DMI\% \times 0.775)$  (Horrock and Valentine, 1999; Baba *et al.*, 2018).

#### ***Data analysis***

The experimental design was a completely randomized design (CRD), in which the experimental treatments were the only source of variability.

The statistical model is as follows:  $X_{ij} = \mu + T_i + ij$

Where  $X_{ij}$  = value of observation;  $\mu$  = population mean;  $T_i$  = treatment effect;  $ij$  = error term

All data obtained were subjected to the analysis of variance (ANOVA). Means were separated using Least Significant Difference (LSD) SAS (1999) package.

**Results and discussion**

Table 1 shows the physical features of ensiled maize stover and groundnut haulms. The colour of the silage were cream, greenish brown and light brown for T1, T2 and T3, respectively. Texture was smooth for T1 and coarse for T2 and slightly coarse for T3. All the silages were moist with pleasant aroma. The pH and temperature value ranged from 3 – 4.5 and 30–31.5°C, respectively.

The colour of the silage was close to the

original colour of the grass. This was an indication of good quality silage that was well preserved (Oduguwa *et al.*, 2007). The range of pH value (3 – 4.5) recorded in this study was within the value (3.81 - 4.90) reported by Akinbode *et al.* (2017) when sugarcane top was ensiled with broiler litter. Generally, the mild sweet aroma perceived in all the silage is an indication of normal physical characteristics of good silage (Lamidi and Akhigbe, 2018).

**Table 1: Physical features of ensiled maize stover and groundnut haulms**

Parameters	Experimental treatments		
	T1	T2	T3
Colour	Cream	Greenish brown	Light brown
Texture	Smooth	Coarse	Slightly coarse
Wetness	Moist	Moist	Moist
Aroma	Mild sweet	Mild sweet	Mild sweet
pH	3.5	3	4.5
Temperature (°c)	32	30	31.5
Mouldiness	No mould	No mould	No mould

T1: 100% maize stover; T2:100 % groundnut haulms; T3:50 % maize stover and 50 % groundnut haulms.

The proximate composition and fibre fractions of ensiled fresh maize stover and groundnut haulms in wet season are shown in Table 2. There were significant differences (P<0.05) in all the proximate composition and fiber fractions of the silage across the experimental treatments. The T3 had highest (P<0.05) content for proximate composition and fiber fractions except the hemicellulose which was similar (P>0.05) in T2 and T3. The CP contents of the silage (11.67 – 12.67%) were above the critical lower limit (7% CP) which forage intake by ruminants and rumen microbial activity could be negatively affected (Norton, 2003). It implies that the silage would provide the adequate nitrogen requirement for the rumen microorganisms to maximally digest the main components of dietary fibre leading to the production of volatile fatty acids (Lamidi and Ogunkunle, 2016), which in turn facilitates microbial protein synthesis (Lamidi and Aina, 2013)

and improve the production of meat, milk, skin and hide for man uses. Higher levels of NDF and lignin have been reported to have negative effect on DM intake and digestibility (Bakshi and Wadhwa, 2004). However, the NDF (47.39 – 51.15 %) values observed for the silage were less than 60% which is considered safe for acceptable intakes of forage in ruminants (Meissner *et al.*, 1991).

Mineral profile of ensiled maize stover and groundnut haulms is shown in Table 3. There was a significant difference (P<0.05) in the minerals content of the silage across the experimental treatments. The T3 had higher (P<0.05) content of the minerals analyzed, followed by T2 and T1 recorded least (P<0.05) contents of minerals. The Ca, P, K, Na, Mg, Fe and Zn contents varies from 0.18 – 0.20 %, 0.32 – 0.36 %, 0.46 – 0.51 %, 0.23 – 0.27 %, 0.25 – 0.29 %, 159.78 – 167.21 mg/kg and 31.29 – 34.56 mg/kg, respectively.

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**Table 2: Proximate composition and fibre fractions of ensiled fresh maize stover and groundnut haulms in wet season**

Parameters	Experimental treatments			
	T1	T2	T3	SEM LOS
Dry matter	86.96 <sup>b</sup>	87.07 <sup>b</sup>	87.24 <sup>a</sup>	0.05 **
Crude protein	11.67 <sup>c</sup>	12.18 <sup>b</sup>	12.69 <sup>a</sup>	0.15 **
Ether extract	2.12 <sup>c</sup>	2.23 <sup>b</sup>	2.37 <sup>a</sup>	0.04 **
Crude fibre	13.21 <sup>c</sup>	13.35 <sup>b</sup>	13.67 <sup>a</sup>	0.07 **
Ash	6.56 <sup>c</sup>	6.78 <sup>b</sup>	6.89 <sup>a</sup>	0.05 **
Neutral detergent fibre	47.39 <sup>c</sup>	49.23 <sup>b</sup>	51.15 <sup>a</sup>	0.54 **
Acid detergent fibre	25.67 <sup>c</sup>	27.12 <sup>b</sup>	29.05 <sup>a</sup>	1.35 **
Nitrogen free extract	52.33 <sup>b</sup>	52.47 <sup>b</sup>	51.15 <sup>a</sup>	0.07 **
Acid detergent lignin	8.59 <sup>c</sup>	8.76 <sup>b</sup>	9.23 <sup>a</sup>	1.00 **
Cellulose	17.75 <sup>c</sup>	18.36 <sup>b</sup>	19.82 <sup>a</sup>	0.36 **
Hemicellulose	21.72 <sup>b</sup>	22.10 <sup>a</sup>	22.11 <sup>a</sup>	0.07 **

<sup>a, b, c</sup> Means on the same row with different superscripts differ significantly (P<0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms; LOS= level of significant.

The Ca recorded for the silage in this study (0.18 – 0.20 %) was within the recommended range (0.20 - 0.26g/100g) for maintenance of growing and lactating sheep (Reuter and Robinson, 1997) while P content (0.32 – 0.36 %) was also within the recommended range (0.15-0.48g/100g) required by ruminants (McDowell, 1997).

The Mg content of the silage was in line with the recommended range (0.25 – 0.29 %) for ruminant animals (McDowell, 1997). This is an indication that the silage i.e. ensiled fresh maize stover and groundnut haulms will supply the required minerals for body metabolism for ruminant animal without mineral fortification.

**Table 3: Mineral profile of ensiled maize stover and groundnut haulms**

Parameters	Experimental treatments			SEM	LOS
	T1	T2	T3		
Calcium	0.18 <sup>b</sup>	0.19 <sup>a</sup>	0.20 <sup>a</sup>	0.00	**
Phosphorus	0.32 <sup>c</sup>	0.34 <sup>b</sup>	0.36 <sup>a</sup>	0.01	**
Potassium	0.46 <sup>c</sup>	0.49 <sup>b</sup>	0.51 <sup>a</sup>	0.01	**
Sodium	0.23 <sup>c</sup>	0.26 <sup>b</sup>	0.27 <sup>a</sup>	0.01	**
Magnesium	0.25 <sup>c</sup>	0.28 <sup>b</sup>	0.29 <sup>a</sup>	0.01	**
Iron	159.78 <sup>c</sup>	164.46 <sup>b</sup>	167.21 <sup>a</sup>	1.08	**
Zinc	31.29 <sup>c</sup>	34.15 <sup>b</sup>	34.56 <sup>a</sup>	0.51	**

<sup>a, b, c</sup> Means on the same row with different superscripts differ significantly (P<0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms; LOS= level of significant.

Table 4 shows the anti-nutritional factors of ensiled fresh maize stover and groundnut haulms. There was a significant difference (P<0.05) in the anti-nutritional factors across the experimental treatments. The T3 had higher (P<0.05) contents of all the anti-nutritional factors. Saponins and tannin were similar (P>0.05) in T1 and T2. The least (P<0.05) phytate, oxalate and trypsin inhibitor contents was recorded in T1.

Feedstuff containing saponin has been shown to be defaunating agent (Fajemisin, 2015) and capable of reducing methane production (Babayemi *et al.*, 2004). Diagayete and Hugg (1981) reported that, sheep and cattle can tolerate 2 – 5% dietary tannin while Nastis and Malecheck (1981) reported that goats can tolerate about 9% tannin in their diets. The saponins value recorded for the ensiled fresh maize stover

and groundnut haulms in this study were ranged for varieties (0.40 – 0.42%), feedstuff containing saponin had been shown to be defaunating agent (Teferedegne, 2000) and capable of reducing methane production (Babayemi *et al.*, 2004). Alalade *et al.* (2019) reported that saponin have effect on erythrocyte haemolysis, reduction of blood and liver cholesterol, depression of growth rate, bloat

(ruminant) inhibition of smooth muscle activity, enzyme inhibition and reduction in nutrient absorption. Saponin have been reported to alter cell wall permeability and therefore to produce some toxic effect when ingested (Belmar *et al.*, 1999). Oxalates bind calcium and are excrete through urine or form crystals which might cause kidney stones (Kubkomawa *et al.*, 2016).

**Table 4: Anti-nutritional factors of ensiled fresh maize stover and groundnut haulms in wet season**

Parameters	Experimental treatments				SEM	LOS
	T1	T2	T3			
Phytate (%)	0.20 <sup>c</sup>	0.22 <sup>b</sup>	0.23 <sup>a</sup>	0.00	**	
Oxalate (%)	0.16 <sup>c</sup>	0.18 <sup>b</sup>	0.19 <sup>a</sup>	0.00	**	
Tannin (%)	0.18 <sup>b</sup>	0.18 <sup>b</sup>	0.19 <sup>a</sup>	0.00	**	
Saponins (%)	0.40 <sup>b</sup>	0.40 <sup>b</sup>	0.42 <sup>a</sup>	0.00	**	
Trypsin inhibitor (mg/g)	1.97 <sup>c</sup>	2.26 <sup>b</sup>	2.38 <sup>a</sup>	0.01	**	

<sup>a, b, c</sup> Means on the same row with different superscripts differ significantly (P<0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms; LOS= level of significant.

Table 5 shows the post *in-vitro* digestibility characteristics of ensiled maize stover and groundnut haulms. There were significant differences (P<0.05) in all the post *in-vitro* digestibility parameters observed across the experimental treatments. The T3 had highest (P<0.05) value for all the parameters considered except ME which was similar in T2 and T3. The value recorded for methane (CH<sub>4</sub>) production ranges from 10.33 – 14.00, methane and gas volume ratio (CH<sub>4</sub>GV), *In-vitro* dry matter digestibility (%) (IDMD), Fermentation efficiency (FE), CH<sub>4</sub> reduction (%), Short chain fatty acid (SCFA), Metabolizable energy (ME) and *In-vitro* organic matter digestibility (%) (IOMD) were 0.65 – 0.83, 39.33 – 71.83%, 2.37 – 4.30, 84.61 – 88.64%, 0.23 – 0.40, 4.54 – 5.53, and 35.75 – 41.43%, respectively.

Meanwhile, the higher SCFA (0.40(μM)) and ME (5.53 MJ/kg/DM) recorded for T3(50% Maize stover + 50% Groundnut

haulms) is an indication that the silage has a potential to make energy available to ruminant. This observation correlates with the report of Ajayi (2007) that higher SCFA or VFA such as butyrate and acetate suggest a potential to make energy available to ruminant. The estimation of the Metabolizable energy (ME) values is valuable for purposes of ration formulation and to set economic value of feed for other purposes (Akinyemi *et al.*, 2019). It is also a good index for measuring the quality of feeds particularly forages.

Table 6 shows the dry matter intake, digestible dry matter, and relative feed value for ensiled fresh maize stover and groundnut haulms. Similar (P>0.5) feeding value were recorded in the nutritive value (Dry matter intake, digestible dry matter, and relative feed value) of the experimental treatments. The values observed for DMI, DDM and RFV ranges from 2.44 – 2.45, 67.62 – 67.67 and 127.86 – 127.98, respectively.

**Table 5: Post *in-vitro* digestibility of ensiled fresh maize stover and groundnut haulms**

Parameters	Treatments				SEM	L/S
	T1	T2	T3			
CH <sub>4</sub>	10.33 <sup>b</sup>	10.67 <sup>b</sup>	14.00 <sup>a</sup>		1.23	**
CH <sub>4</sub> GV	0.65 <sup>b</sup>	0.72 <sup>b</sup>	0.83 <sup>a</sup>		0.52	**
<i>In-vitro</i> dry matter digestibility (%)	39.33 <sup>c</sup>	51.77 <sup>b</sup>	71.83 <sup>a</sup>		6.62	**
Fermentation efficiency	2.37 <sup>c</sup>	3.88 <sup>b</sup>	4.30 <sup>a</sup>		0.44	**
Methane reduction(%)	84.61 <sup>b</sup>	88.28 <sup>a</sup>	88.64 <sup>a</sup>		1.35	**
Short chain fatty acid (µM)	0.23 <sup>c</sup>	0.33 <sup>b</sup>	0.40 <sup>a</sup>		0.04	**
Metabolizable energy (MJ/kg/DM)	4.54 <sup>b</sup>	5.14 <sup>ab</sup>	5.53 <sup>a</sup>		0.21	**
<i>In-vitro</i> organic matter digestibility (%)	35.75 <sup>c</sup>	39.09 <sup>b</sup>	41.43 <sup>a</sup>		1.26	**

<sup>a, b, c</sup> Means on the same row with the same superscripts not differ significantly (P>0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms; LOS= level of significant; N/S= Not significant

**Table 6: Dry matter intake, digestible dry matter, and relative feed value for ensiled fresh maize stover and groundnut haulms**

Parameters	Experimental treatments				SEM	L/S
	T1	T2	T3			
Dry matter intake	2.45	2.44	2.44		0.027	N/S
Digestibility dry matter	67.62	67.65	67.67		0.381	N/S
Relative feed value	127.86	127.94	127.98		2.105	N/S

<sup>a, b, c</sup> Means on the same row with the same superscripts not differ significantly (P>0.05).

SEM= standard error of mean; T1= 100% Maize stover; T2=100% Groundnut haulms; T3=50% Maize stover + 50% Groundnut haulms; LOS= level of significant; N/S= Not significant

The similarity might be attributed to the contents of the proximate composition e.g. CP which was above the 7% required for rumen microbe and the moderate value recorded for NDF. This is corroborated by the report of Lamidi *et al.* (2019b) who viewed similar value recorded for DMI, DDM and RFV in the experimental treatments within the context of ADF and NDF levels. The similarity observed for the nutritive value is an indication that the experimental treatments have the potential to be used as feed resources for ruminant animals.

### Conclusion

Conclusively, the silage exhibited good physical features, appropriate proximate composition, fibre fractions without deleterious anti-nutritional factors and post *in-vitro* digestibility characteristics that justified its potential in solving the challenges of dry season feed for ruminant production. Meanwhile, the similarity of

nutritive value for the experimental treatments further proof that the silages (T1, T2 and T3) have the potential to mitigate the challenges of dry season feeding. Treatment 3 (50% maize stover and 50% groundnut haulms) is recommended for ruminant farmers.

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