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Potentials of Ensiled *Panicum maximum* with Cassava Peel and Poultry Droppings as Ruminant Feed During Dry Season

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ABSTRACT

In vitro gas fermentation techniques stimulate the rumen fermentation process and it has been used to assess the potential nutritive value of ensiled Panicum maximum with dried cassava peel and dried poultry droppings. The parameters of interest are silage quality, chemical composition, in vitro gas production volume over 24hours, metabolizable energy (ME), organic matter digestibility (OMD) and short chain fatty acid (SCFA). Six different silage treatment compositions T1 to T6 were applied in the experiment. All the silage treatments were firm in texture except silage T6 which was moderately firm. The colour varied from very brown, brown and light brown. The smell of the silage treatments are almost pleasant, pleasant, offensive and fairly pleasant. The silage dry matter content (DM) ranged from 21.1%-57.15%, crude protein content (CP) from 11.85%-19.15%, ash from 8.90%-41.65%, ether extract (EE) from 2.15%-2.75%, neutral detergent fibre (NDF) from 48.20%-57.00%, acid detergent fibre (ADF) from 23.85%-36.35%, hemicellulose from 20.25-23.30 and cellulose from 11.45%-19.40%. The cumulative gas production value ranged from 4.67 and 32.67ml/200mgDM at the end of 24hours of incubation with T1 having the highest value. The metabolizable energy (ME), organic matter digestibility (OMD), and short chain fatty acid (SCFA) were between 27.65%-51.89%, 3.97%-7.60% and 0.05%-0.69% respectively. Treatment 1 had the highest values for gas volume production, ME, OMD and SCFA. Ensiling Panicum maximum with dried cassava peel and dried poultry droppings is sufficient to meet the nutritional requirement of ruminants for optimal productivity.

Keywords : Panicum maximum, Dried cassava peel, Dried poultry droppings, Chemical composition, Silage quality, in vitro gas production.

I. INTRODUCTION

Ruminant production is one of the major important livestock activities in most of the developing countries in the tropics. The tropic is characterized by long periods of dry season with little rainfall. This makes ruminants in developing countries like Nigeria often experience unstable level of productivity (Odeyinka and Okunade, 2005). The seasonal fluctuation in nutritive value of the native pastures is further complicated by bush encroachment and stiff competition between man and livestock for conventional feeds. This problem of feed shortage is a contributory factor to high cost of ruminant feeds which makes the business unprofitable and unsustainable (Okoruwa*et al.*, 2012). Thus, there is need to find reliable and sustainable alternative feed sources with the view to reduce the scarcity of feeds and improve the profitability of small ruminant production in the tropics ((Fasae*et al.*,2005).

Guinea grass (*Panicum maximum*) is a tall vigorous perennial grass with stems up to 3.5m tall that varies widely in growth habit. It produces high yields of palatable fodder to ruminant livestock and responds well to maturing at early growth stage, but rapidly declines in nutritive value with age. It dies if continually grazed close to the ground in the dry season; hence it needs rest late in the growing season and supplement with other feeds to provide balance nutrient for maintenance in ruminant production. Reling*et al*., (2001) also reported that increase in maturity of guinea grass and long dry season had negative effect on the nutritive value, indicating that it would be best utilized at younger stages of development and wet season.

The use of agro-industrial by-products have been identified to play an important role in the nutrition of small ruminant livestock and ensure all year round availability of feed. Cassava peels in Nigeria are always discarded as waste and even constitute nuisance in waste disposal of these industries. Cassava peels account for 10 to 13% of the tuber by weight; this is in spite of the potential of the by-product as an animal feedstuff. Several reports indicated that, among the root crops producing in Nigeria, cassava from which cassava peels are obtained constitute 20% total tubers produced annually (Okoruwa*et al*., 2012 and Olorunnisomo*et al*., 2012). There is evidence in literature that cassava peels could serve as a cheap source of energy which can be utilized to a great extent in feeding of ruminant livestock. However, the potential use of cassava peels to adequately fill the nutritional gap in ruminants are heavily constrained by intrinsic factors, which includes high crude fiber ,low crude protein and the presence of toxic levels of hydrogen cyanide (HCN) that limits its utilization.

Poultry dropping (PD) includes the beddings and other contamination in the poultry house and the poultry manure. Poultry dropping is a good source of nitrogen, protein and ash (Oluyemi and Roberts, 1979; Ekanem, 2012). The ensiling of by-products is a simple and appropriate method of conservation. It is the most effective way to improve animal feed resources through the rational use of locally available agricultural and industrial by- products likely to be available to small-scale farmers at village level. Fermentation analyses have long been used to assess silage quality and to determine whether an excellent, average or poor fermentation has occurred and also the kind of organisms that controlled the ensiling process (Kung and Shaver, 2001; Ifut*et al*.,2015).

In vitro gas production based on syringe appears to be the most suitable for use in developing countries. (Menke *et al*., 1979., Blummel*et al*., 1997) and it is used for the estimation of the *in vitro* digestibility and metabolizable energy for ruminants. It facilitates the determination of degree and rate of degradation of feed samples using time-series measurement of accumulating gas volume. It provides information or useful data on digestive kinetic of both soluble and insoluble fraction of feedstuffs, and proportion of volatile fermentation products. The *in vitro* gas production method helps to easily assess nutrient utilization and its accuracy in describing digestibility in animal, reported by Brancio*et al.,* (2007).

Studies that have been conducted on silages prepared with *Panicum maximum*, cassava peels, brewery's waste, rice husk and other crop residues have been revealed to meet the requirement of ruminants in the tropics. In order to enhance the scope of ruminants access to quality feed during the dry season, this study aims at assessing the nutritive value of *Panicum maximum*(Guinea grass) ensiled with varying proportion of cassava peel and poultry droppings using *in vitro* gas production method.

II. MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Teaching and Research farm, Ladoke Akintola University of Technology, Ogbomosho, Oyo state, in the south western part of Nigeria. The *in vitro* analysis was carried out at the ruminant laboratory, Animal Science Department University of Ibadan, Ibadan Nigeria.

Collection of samples and silage preparation

Panicum maximum was harvested after 8 weeks of re-growth from already existing pasture plot in the Teaching and Research farm. Dried cassava peel was purchased from a reputable market around the Teaching and Research farm, LAUTECH, Ogbomoso, Oyo state. Poultry dropping was collected from the poultry unit of LAUTECH Teaching and Research farm, Ogbomoso, Oyo state. The harvested guinea grass was wilted and chopped to a smaller length to ease the rate of compaction. It was then packed into ensiling plastic drum after the addition of dried cassava peel and dried poultry droppings. A 25litres mini silo lined with a 20mm thick nylon was used for the ensiling. *Panicum maximum*, dried cassava peel and dried poultry droppings were mixed homogenously in the varying proportion below:

Treatment1 =*Panicum maximum* (60%), Dried cassava peel (40%), Dried poultry droppings (0%)

Treatment2 =*Panicum maximum* (60%), Dried cassava peel (30%), Dried poultry droppings (10%)

Treatment 3 =*Panicum maximum* (60%), Dried cassava peel (20%), Dried poultry droppings (20%)

Treatment 4 =*Panicum maximum* (60%), Dried cassava peel (10%), Dried poultry droppings (30%)

Treatment 5 = *Panicum maximum* (60%), Dried cassava peel (0%), Dried poultry droppings (40%)

Treatment 6 = *Panicum maximum* (100%).

Each mixture was packed in the mini silo (lined 20mm thick nylon sheets) and compressed with heavy force, stone were placed and sand bags to eliminate air and immediately, the plastic cover was placed and sealed with a cello tape and the silage was allowed to ferment for 42days.

Silage Quality Assessment

The fermentation was terminated at 42days and the silage was opened for assessment. The assessed quality characteristics were colour, smell, texture, taste, pH and temperature according to Babayemi and Igbekoyi (2008).Sub-samples from different points and depths were taken and well mixed together, oven dried at 85^{0}C until a constant weight was achieved for dry matter determination. The samples were milled and stored in an air-tight container for chemical analysis.

***In Vitro* Gas Production**

Rumen Fluid Collection And Inoculums Preparation

Rumen fluid was collected using esophageal tube, before morning feed from four goats, by suction method. It was put into thermo flask that has been pre-warmed (sterilized) with hot water, to maintain the temperature (Babayemi and Bamikole, (2006), Babayemi, 2007). The rumen fluid (liquor) was later filtered through three layers of cheese cloth. The inoculums (incubation medium) was prepared from cheesecloth filtered rumen liquor and the prepared buffer in the ratio of 1:2 (v/v) under continuous flushing with carbon dioxide (CO_2) (Menke and Steingass, 1988). This was to maintain anaerobic condition of the liquor, this is to keep the needed microbes alive, to avoid the death of anaerobes in the liquor and to perform optimally by total expulsion of oxygen gas, because methanogens cannot function in an oxygen (O_2) environment. Incubation was as reported by Menke and Steingass (1988) using 100 ml calibrated syringes in three batch incubation at 39^{o}C. Into 200 mg sample in the syringe was introduced 30 ml inoculums containing cheese cloth strained rumen liquor and buffer ($NaHCO_3$+ Na_2HPO_4+KCl+NaCl+$MgSO_4.7H_2O$+$CaCl_2.2H_2O$) (1:4, v/v) under continuous flushing with CO_2. The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24 h and after 24 h of incubation, 4 ml of NaOH (10 ml) was introduced into the incubated samples as reported (Fievez*et al*., 2005) to estimate the amount of methane produced. The average of the volume of gas produced from the blanks was deducted from the volume of gas produced per sample. The volume of the gas produced at intervals was plotted against the incubation time, and from the graph, the gas production characteristics were estimated using the equation $Y = a + b (1 - e^{-ct})$ described by Ørskov and McDonald (1979), where Y = volume of gas produced at time ‘t’, a = intercept (gas produced from the soluble fraction), b = gas production from the insoluble fraction, c = gas production rate constant for the insoluble fraction (b), t = incubation time. Metabolizable energy (ME, MJ/Kg DM) and organic matter digestibility (OMD %) were estimated as established (Menke and Steingass, 1988) and short chain fatty acids (SCFA) was calculated as reported (Getachew *et al.*, 1999).

Chemical Analysis

Samples of the feeds were oven dried at 85^{0}C and milled for dry matter, crude protein, crude fibre, ether extract, and Ash determination according to AOAC (2002), and the amount of crude protein (CP) was calculated (N × 6.25). The fibre composition including neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined as described by Van Soest*et al.,* (1991).

Statistical analysis

Data obtained were analyzed by one way analysis of variance in Complete Randomized Design using the general linear model procedure of Statistical Analysis Institute (SAS, 2002). The significant means were compared by the use of Duncan multiple range F-test.

III. RESULTS AND DISCUSSION

RESULTS

Silage Quality Characteristics

Table 1 shows the colour, smell, and texture of ensiled *Panicum maximum* with cassava peel and poultry droppings. The colours differ slightly among the treatments, ranged from dark brown to olive green. The smell also ranged from almost pleasant to fairly pleasant. All the treatment appeared firm in texture except treatment 6 which appeared moderately firm.

Table 1: Colour, Smell And Texture Of Ensiled *Panicum Maximum*, Dried Cassava Peel And Dried Poultry Dropping

TREATMENT	COLOUR	SMELL	TEXTURE
T1	BROWN	PLEASANT	FIRM
T2	DARK BROWN	ALMOST PLEASANT	FIRM
T3	DARK BROWN	ALMOST PLEASANT	FIRM
T4	DARK BROWN	ALMOST PLEASANT	FIRM
T5	VERY DARK	OFFENSIVE	FIRM
T6	OLIVE GREEN	FAIRLY PLEASANT	MODERATELY FIRM

Treatment 1 = *Panicum maximum* (60%), Dried cassava peel (40%), Dried Poultry droppings (0%)
Treatment 2 = *Panicum maximum* (60%), Dried cassava peel (30%), Dried Poultry droppings (10%)
Treatment 3 = *Panicum maximum* (60%), Dried cassava peel (20%), Dried Poultry droppings (20%)
Treatment 4 = *Panicum maximum* (60%), Dried cassava peel (10%), Dried Poultry droppings (30%)
Treatment 5 = *Panicum maximum* (60%), Dried cassava peel (0%), Dried Poultry droppings (40%)
Treatment 6 = *Panicum maximum* (100%).

Chemical composition of ensiled *Panicum maximum* with dried cassava peel and dried poultry droppings

Table 2 shows the chemical composition of ensiled *Panicum maximum* with cassava peel and poultry droppings which differed significantly (P<0.05) among all parameters measured except the ADL and Hemicellulose. The dry matter content of silage ranged from 21.1% (T6) to 57.15% (T1). The dry matter was high in all the treatments with dried poultry dropping and dried cassava peel. Except for

Panicum maximum alone, this had the least value. The crude protein content ranged from (11.85% to 19.20%). The value of Crude protein increased as the proportion of poultry drooping increased and dried cassava peel decreased. Ash content ranged from 8.90% to 41.65%. The ether extract values ranged from 2.15(T2) to 2.75 (T3); T2 being the lowest and T3 the highest.

The value of neutral detergent fibre (NDF) varied significantly having T1 (57%) as the highest and T2 (47.15%) as the lowest. Acid detergent fibre (ADF) of the silage varied from 36.35% to 23.85% having T2 as the highest and T5 as the lowest. There are significant differences amongst the treatment.

Table 2: Chemical Composition (%) Of Ensiled *Panicum Maximum* with Dried Cassava Peel and Dried Poultry Dropping

PARAMETERS	T1	T2	T3	T4	T5	T6	SEM
Dry Matter	48.78^{a}	49.75^{a}	51.1^{a}	57.15^{a}	51.65^{a}	21.1^{b}	3.68
Crude Protein	17.85^{a}	18.35^{a}	19.02^{a}	19.05^{a}	19.20^{a}	11.85^{b}	1.1
Ash	8.9^{b}	13.5^{b}	28.58^{ab}	32.5^{ab}	41.65^{a}	9.55^{b}	6.7
Ether Extract	2.44^{ab}	2.15^{b}	2.75^{a}	2.55^{a}	2.65^{a}	2.4^{ab}	0.01
crude fibre	24.95^{b}	21.15^{b}	19.35^{b}	19.00^{b}	18.80^{b}	35.65^{a}	2.83
NDF	57^{a}	56.6^{a}	53.11^{ab}	48.2^{b}	47.15^{b}	54.83^{a}	1.68
ADF	33.87^{a}	36.35^{a}	32.5^{ab}	25^{bc}	23.85^{c}	33.39^{ab}	2.3
ADL	16.44	16.95	16.51	13.33	12.40	14.60	1.27
HEMICELLULOSE	23.13	20.25	20.61	23.20	23.30	21.44	1.23
CELLULOSE	17.43^{a}	19.4^{a}	15.99^{ab}	11.67^{b}	11.45^{b}	18.8^{a}	1.41

^{a,b} Means on the same column with different subscripts are significantly different ($P<0.05$).

NDF(neutral detergent fibre), ADF(acid detergent fibre), ADL(acid detergent lignin), SEM(standard error of mean).

Treatment 1 = *Panicum maximum* (60%), Dried cassava peel (40%), Dried Poultry droppings (0%)
Treatment 2 = *Panicum maximum* (60%), Dried cassava peel (30%), Dried Poultry droppings (10%)
Treatment 3 = *Panicum maximum* (60%), Dried cassava peel (20%), Dried Poultry droppings (20%)
Treatment 4 = *Panicum maximum* (60%), Dried cassava peel (10%), Dried Poultry droppings (30%)
Treatment 5 = *Panicum maximum* (60%), Dried cassava peel (0%), Dried Poultry droppings (40%)
Treatment 6 = *Panicum maximum* (100%).

In Vitro Gas Production Volume of Ensiled *Panicum maximum*, Dried Cassava Peel And Dried Poultry Dropping

Table 3 shows the *in vitro* gas production of ensiled *Panicum maximum* with cassava peel and poultry droppings. The gas production increased with the increasing incubation time. The cumulative gas produced ranged between 4.67 and 32.67ml at end of

24hours of incubation. There were significant differences in the gas produced at 24hours incubation time. Gas production of T1(60% *Panicum maximum*, 40% cassava peel and 0% poultry droppings) was significantly higher than those obtained from all other experimental treatments at all incubation periods (32.67ml/200mg), while silage from T5 (60% *Panicum maximum*, 0% dried cassava peel and 40% dried poultry droppings) produced the lowest gas volume (4.67ml/200mg) at 24hours of incubation.

Table 3: *In Vitro* Gas Production of Ensiled *Panicum Maximum*, Dried Cassava Peel And Dried Poultry Dropping

	3HRS	6HRS	9HRS	12HRS	15HRS	18HRS	21HRS	24HRS
T1	6.00[a]	10.00[a]	12.00[a]	12.00[a]	18.00[a]	24.00[a]	27.00[a]	32.67[a]
T2	4.67[ab]	8.33[ab]	9.00[ab]	9.33[ab]	13.00[ab]	15.33[b]	16.33[b]	17.67[b]
T3	4.33[ab]	6.67[abc]	8.33[ab]	9.67[ab]	12.33[ab]	13.00[b]	13.33[bc]	13.67[bc]
T4	0.00[d]	1.67[a]	2.33[c]	3.67[c]	4.00[c]	5.00[c]	5.00[d]	5.67[d]
T5	1.67[cd]	3.67[c]	3.67[c]	3.67[c]	4.00[c]	4.00[c]	4.00[d]	4.67[d]
T6	3.33[bc]	5.00[bcd]	5.67[bc]	6.67[bc]	7.33[bc]	7.33[c]	7.67[cd]	7.67[cd]
SEM	0.54	1.11	1.36	1.5	1.84	1.56	2.01	2.42

Treatment 1 = *Panicum maximum* (60%), Dried cassava peel (40%), Dried Poultry droppings (0%)
Treatment 2 = *Panicum maximum* (60%), Dried cassava peel (30%), Dried Poultry droppings (10%)
Treatment 3 = *Panicum maximum* (60%), Dried cassava peel (20%), Dried Poultry droppings (20%)
Treatment 4 = *Panicum maximum* (60%), Dried cassava peel (10%), Dried Poultry droppings (30%)
Treatment 5 = *Panicum maximum* (60%), Dried cassava peel (0%), Dried Poultry droppings (40%)
Treatment 6 = *Panicum maximum* (100%).

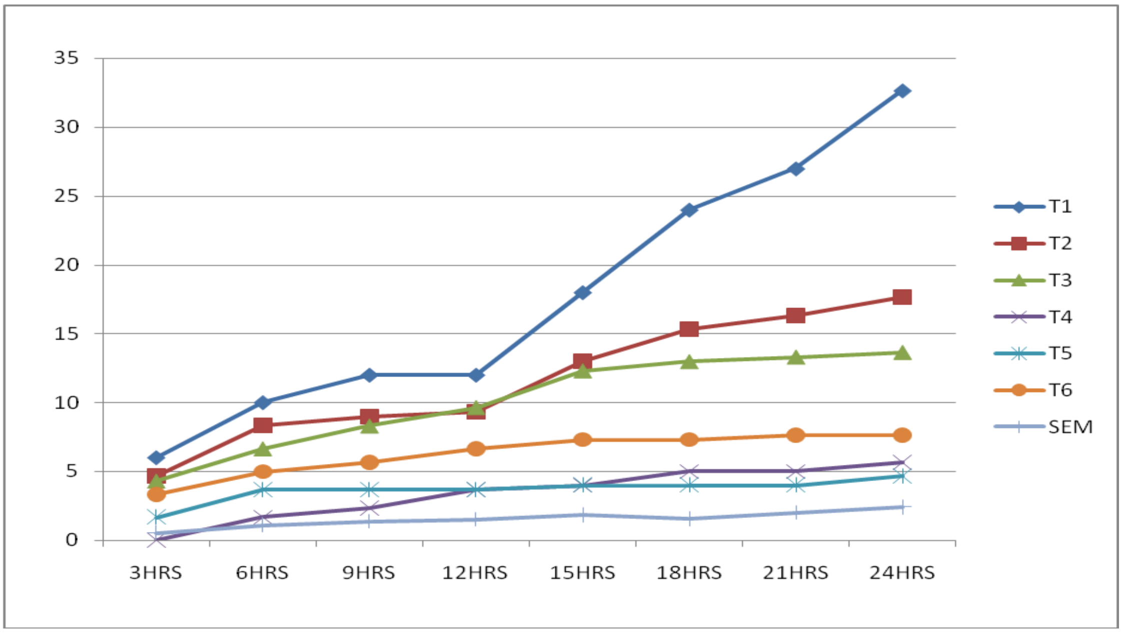

Table 4 shows the *in vitro* gas production characteristics, Metabolizable energy, organic matter digestibility and short chain fatty acid of ensiled *Panicum maximum* with dried cassava peel and dried poultry droppings.

Table 4: *In vitro* gas production characteristics, metabolizable energy (mj/kg dm), organic matter digestibility (%) and short chain fatty acids [μm] of ensiled *Panicum maximum* with dried cassava peel and dried poultry dropping

	A	B	a+b	C	T	Y	ME	OMD	SCFA
T1	6.00^{a}	25.33^{a}	31.33^{a}	0.06^{b}	13.00^{ab}	19.33^{a}	7.60^{a}	51.89^{a}	0.69^{a}
T2	4.33^{ab}	13.33^{b}	17.67^{b}	0.11^{ab}	16.00^{a}	15.33^{ab}	5.72^{b}	39.72^{b}	0.36^{b}
T3	4.33^{ab}	9.33^{bc}	13.67^{bc}	0.11ab	9.00^{bc}	9.33^{bc}	5.21^{b}	37.79^{b}	0.27^{bc}
T4	1.67^{c}	4.00^{c}	5.67^{d}	0.06^{b}	11.00^{abc}	3.67^{c}	4.07^{c}	30.88^{c}	0.08^{d}
T5	1.67^{c}	3.00^{c}	4.67^{d}	0.18^{a}	6.00^{c}	3.67^{c}	3.97^{c}	30.29^{c}	0.05^{d}
T6	3.33^{bc}	4.33^{c}	7.67^{cd}	0.10^{b}	6.00^{c}	5.00^{c}	4.02^{c}	27.65^{c}	0.12^{d}
SEM	0.61	2.44	2.2	0.02	1.73	1.95	0.3	1.95	0.05

a= soluble fraction, b= potentially degradable fraction, a+b= potential degradability, c= gas production rate constant, y= potential gas volume, t= time of incubation, OMD= organic matter digestibility, ME= metabolizable energy and SCFA= short chain fatty acid.
Treatment 1 = *Panicum maximum* (60%), Dried cassava peel (40%), Dried Poultry droppings (0%)
Treatment 2 = *Panicum maximum* (60%), Dried cassava peel (30%), Dried Poultry droppings (10%)
Treatment 3 = *Panicum maximum* (60%), Dried cassava peel (20%), Dried Poultry droppings (20%)
Treatment 4 = *Panicum maximum* (60%), Dried cassava peel (10%), Dried Poultry droppings (30%)
Treatment 5 = *Panicum maximum* (60%), Dried cassava peel (0%), Dried Poultry droppings (40%)
Treatment 6 = *Panicum maximum* (100%).

DISCUSSION

Silage Quality Characteristics of ensiled *Panicum maximum* with dried cassava peel and dried poultry dropping

Good silage usually preserves the original colour of the pasrture or forage (t'Mannatje, 1999). The olive green colour obtained in the present study was in order. It was close to the original colour of the *Panicum maximum* used in ensiling. The colour of the silage mixture was used to judge the colour attribute of the silage, which was an indication of good quality silage that was well preserved. The colours observed were in line with observed colours by (Oduguwa, *et al* 2007) for good quality silage. Differences were observed in the smell of the silage treatments and it ranged from almost pleasant, pleasant, offensive and fairly pleasant smell this supports the observation reported by Kung and Shaver, (2002) for a well made silage. All the silage treatments were firm, this was in accordance with the report of (Kung and Shaver, 2000) for good quality silage. The more the forage are allowed to wilt before packing for silage during ensiling, the more firm the end product of fermentation, in which the otherwise could result in wetness of the silage.

Chemical composition of ensiled *Panicum maximum* with dried cassava peel and dried poultry dropping

The chemical composition of ensiled *Panicum maximum* with dried cassava peel and dried poultry droppings showing the dry matter (DM), crude protein (CP), crude fibre (CF), ash, ether extract (EE), neutral detergent fibre (NDF), acid detergent lignin (ADL), acid detergent fibre (ADF), Hemicellulose and Cellulose. There were significant differences ($p< 0.05$) in all the treatments. Treatment 6 has the lowest DM while treatment 1 has the highest DM. In CP, treatment 6 has the lowest while treatment 1 has the highest. The crude protein content of the silages were sufficient for meeting the requirement of the ruminants as the values obtained were above the critical levels indicated by different authors (ARC, 1980; NRC, 1981; Norton, 1994a) implying that the voluntary dry matter intake, as well as the rumen efficiency may not be negatively affected as to reduce protein and energy availability to the animal. The lowest CP was recorded in T6 (sole grass) with no addition. The low amount of protein in the present study shows that the grass is limited in protein and suggests a supplementation with richer protein sources. This can be achieved by fortifying with protein sources like ensiling with forage legume, browse plants, and industrial by-products. Ash has the lowest value in treatment 1 and highest in treatment 5. The highest ash content obtained in this study was higher than the (12%) reported by (Omole *et al.,* 2011).

The neutral detergent fibre (NDF) which is a measure of the plant cell wall material was highest in T1 with the highest proportion of cassava peel while T5 (with the highest proportion of poultry dropping) was the lowest. The range of NDF for these silages were below the range of 600-650g/kgDM suggested as the limit above which intake of tropical feeds by ruminants would be limited (Van Soest*et al.*, 1991*).* The NDF values were however, within the range of 24 – 61 reported for tropical forages (Muck and Shinners, 2000).

Humphreys and Patridge (1995) reported that ADF of forages and silages should be within 22-50 %. The ADF contents of forages in this study were within the range, indicating that the diets have potentials to supply needed energy to animals during dry season. Humphreys and Patridge (1995) reported that higher cellulose content is undesirable because rumen micro-organisms are unable to degrade it. The values of cellulose in this study for various silages are around the values of 30 to 40 % that are adequate for the maintenance requirement of ruminant livestock. The value of ADF obtained in this study was lower when compared with 49.5-69.5% and 46.5-61.0% reported by Babayemi and Bamikole (2009), and Fajemilehin*et al.* (2008) respectively. The observed variation in the chemical composition of the silages may be due to difference in geographical location, age of the grasses, soil characteristics, season and time of harvesting. (Larbi *et al.*, 1996). The difference between NDF and ADF is hemicellulose, which is degradable by rumen microbes. The higher the hemicellulose fraction, the higher is the feed value (Humphreys and Patridge, 1995). Hemicellulose was the highest in treatment 2 and lowest in treatment 3. Cellulose was lowest in treatment 2 and highest in treatment 3.

In vitro gas method primarily measure digestion of soluble and insoluble carbohydrates (Menke and Steingass, 1988) and the amount of gas produced from a feed on incubation reflects production of volatile fatty acid (VFA) which are a major source of energy for ruminants. Gas arises directly from microbial degradation of feed and indirectly from buffering of acids generated as a result of fermentation. Digestibility has been reported to be synonymous to *in vitro* gas production (Fievez*et al.*, 2005) so that the higher the gas produced, the higher the digestibility. The highest potential gas production (a+b) value is recorded in T1 (*Panicum maximum* with 40% cassava peel and0 % poultry droppings,) and this may be attributed to the high content of degradable carbohydrate as recorded by (Tona*et al*,. 2013). Silage from T5 (*Panicum maximum*with highest Poultry droppings) is having the lowest potential gas production (a+b) which is caused by its high content of crude protein and low crude fibre. Gas production of T1(60% *Panicum maximum*, 40% cassava peel and 0% poultry droppings) was significantly higher than those obtained from all other experimental treatments at all incubation periods (32.67ml/200mg), while silage from T5 (60% *Panicum maximum*, 0% dried cassava peel and 40% dried poultry droppings) produced the lowest gas volume (4.67ml/200mg) at 24hours of incubation. The low net gas production for T5 may be due to the high crude protein content of the mixtures. According to Jolaosho*et al*. (2013), gas production from protein fermentation is relatively compared to carbohydrate fermentation Guinea grass is high in crude fibre and this may reduce its digestibility. Digestibility has been described to be synonymous to *invitro* gas production (Fievez *et al*., 2005) that is, forages with high gas production will exhibit better digestibility. From thepresent study, the higher the gas production, the higher was the digestibility.

Generally, gas production is a function and a mirror of degradable carbohydrate and therefore, the amount depends on the nature of the carbohydrates (Blummel and Becker, 1997). The presence of fatty acids in silages may also affect gas volume measurements in carbonate buffered in vitro measures, where about half of the gas volume is accounted for by CO_2 released upon buffering SCFA (Beuvink*et al*., 1992). The fermentation is relatively intensive during the first 24 hours of incubation, after which it reaches a stationary phase. The kinetics of gas production appears to be determined by two distinct phases; the first one corresponds to the degradation of the soluble fraction of the tested mixtures and the second to the insoluble but potentially fermentable fraction. The same profile in the gas production kinetics between the 2 mixtures is probably due to their chemical composition.There are many factors that may determine the amount of gas to be produced during fermentation, depending on the nature and level of fibre, the presenceof secondary metabolites (Babayemi*et al*., 2004a) and potency of the rumen liquor for incubation. It is possible to attain potential gas production of a feedstuff if the donor animal from which rumen liquor for incubation was collected got the nutrient requirement met. The intake of a feed is mostly explained by the rate of gas production (*c*) which affects the passage rate of feed through the rumen, whereas the potential gas production (*a*+*b*), is associated with degradability of feed (Menke and Steingass, 1988). Therefore the higher values obtained for the potential gas production in the *T1(Panicum maximum* (60%), Dried cassava peel (40%), Dried Poultry droppings (0%))*, T2 (Panicum maximum* (60%), Dried cassava peel (30%), Dried Poultry droppings (10%))and *T3 (Panicum maximum* (60%), Dried cassava peel (20%), Dried Poultry droppings (20%)) might indicate a better nutrient availability for rumen microorganisms.

Gas production provides a useful basis from which the metabolizable energy, organic matter digestibility and short chain fatty acid can be predicted (Babayemi and Bamikole, 2006).The SCFA is one of the end product of rumen fermentation and is a reflection of energy availability in a feedstuff (Ajayi and Babayemi, 2008; Asaolu*et al.,* 2014),and that a high volume of gas is produced when substrate is fermented to acetate and butyrate, however relative lower gas production is associated with propionic production. Metabolizable energy (ME), organic matter digestibility (OMD) and short chain fatty acids (SCFA) of the silages did not differ significantly. The value for the ME, OMD and SCFA ranged from 3.97 (T5)to 7.60 (*T1), 27.65* (T6) to 51.89 (T1)and 0.05 (T5) to 0.69 (*T1)* respectively. There were no significant differences ($P < 0.05$) among the silages in ME, OMD and SCFA. In all these parameters, T1 (silage with 40% cassava peel was observed to be the highest and T5 (with the highest proportion of Poultry dropping) the lowest.

IV. CONCLUSION

The importance of silage is a potential way of safeguarding the problem of feed scarcity during the period of dry season in livestock industries. The study has shown the potential of ensiled *Panicum maximum* with cassava peel and poultry droppings as a livestock feed resources in the dry season. The experimental of the silage meet the standard attributes of good silage with high nutrient recommended to meet the requirement of ruminants. Ensiling 60% *Panicum maximum* 30 -40% cassava peel and 10 poultry dropping is recommended to improve their livestock production especially during the scarcity of forages.

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