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Nutritive Evaluation of Ensiled Signal Grass (*Brachiaria Decumbens)* and Cassava Leaves (*Manihot Esculenta)* With Millet Additive as Feed for Small Ruminants.

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This study was conducted to determine the nutritive value of ensiled Brachiaria decumbens with cassava leaves using in vitro gas production techniques. Brachiaria decumbens and cassava leaves were ensiled in varying proportions with millet additive as T1 (60% Brachiaria decumbens +40% cassava leaves), T2 (60% Brachiaria decumbens +30% cassava leaves+10% millets), T3 (60% Brachiaria decumbens +20%% cassava leaves+20% millets), T4 (60% Brachiaria decumbens +10%% cassava leaves+30% millets), T5 (100% Brachiaria decumbens), T6 (100% cassava leaves) were incubated for 24hrs. The silage quality, chemical composition and in vitro gas production were determined. The colours varied among the silage treatments and were closer to the colour of fresh forages. All the silages had pleasant and acceptable smell. The textures of all the silages were firm which was expected to be the best texture of good silage. There is significant different (P>0.05) among the pH of the silages and it varied from 3.83-5.00. Dry matter DM (31.71 to 48.55%), Crude protein CP (12.56 to 16.05%), Ether extract (3.44 to 4.36%), Crude fibre CF (26.10 to 30.57%) Ash content (15.03 to 18.39%), Nitrogen free extract NFE (34.08 to 39.38%), of the silages differs significantly (P <0.05) among the treatments. The total gas (ml/200mg DM) at post incubation was measured. The cumulative gas produced varied from (7.00 to 25.00 ml/200mg DM) and Methane (ml/200mg DM) produced varied from (7.00 to 25.00 ml/200mg DM) 60% Brachiaria decumbens +10%% cassava leaves+30% millets has the highest digestibility potential. It can therefore be concluded from the result gotten from the silages that ensiled Brachiaria decumbens and cassava leaves with millet additive had high values of crude protein, metabolizable energy, short chain fatty acids, and therefore have the potential that would meet the nutrient requirements of small ruminants in the tropical regions particularly during dry season.

Keyword: Silage, *Brachiaria decumbens*, Proximate composition, Gas Production

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INTRODUCTION

In the tropics, natural pastures, crop residues and indigenous fodder trees are the main feed resources for ruminant livestock, with natural pastures and crop residues providing the bulk of most basal diets. Due to seasonal fluctuations in the availability and quality of these feed resources in these areas, intake of energy, protein and some essential minerals by most ruminants species fall below their maintenance requirements resulting in 'under-nutrition' and low productivity in most animal production systems (Larbi and Olaloku, 2005).The lack of good nutritive feed during dry season is partly responsible for low productivity and reproduction. Babayemi and Igbekoyi (2008) described silage production in the tropics as a sustainable means of supplementing feed for ruminants in the dry season. Hence, the perennial forage surplus obtained when the weather is favourable is recommended for storage as silage in order to meet the animal requirements throughout the year (Bonelli *et al.,* 2013). The basic principle of silage is to store the surplus forage keeping its stability and nutritional value until it is required to feed the animals. This process takes place in anaerobic conditions, where the lactic acid produced by the Lactic acid bacteria (LAB) inhibits the proliferation of spoilage microorganisms, which are less tolerant to acidic conditions. Thus, as the pH values decline, the silage losses decline as well due to the greater conversion of plant soluble carbohydrates (the main substrate for LAB) in lactic acid, with 96.9% rate of energy recovery (Mc Donald *et al.,* 1991). In order to assist in the fermentation process, various silage additives have been used to improve the nutrient and energy recovery in silage, often with subsequent improvements in animal performance. The purpose for applying additives to the silage is to ensure that the growth of lactic bacteria predominates during the fermentation process, producing lactic acid in quantities high enough to ensure good silage. (Melkamu and Birhan., 2014). It is widely accepted that silage additives can increase animal intake and animal performance through their effect on silage quality (Merry *et al.,* 1993).

Brachiaria decumbens is an important forage grass used for pasture in the tropics because it has exceptional adaptation to acid soils, vigorous growth, ease of establishment and good forage value throughout the year. (Simioni and Valle, 2009). *Brachiaria decumbens* is high in of dry matter when planted in areas with low rainfall (Mutimura and Everson 2012). *Brachiaria decumbens* produces more dry matter than most tropical grasses during the dry season (Bulo *et al.,*1994) and is capable of producing 15–27 mt (metric tonnes) dry matter (DM)/hectare/year (Balachandran, 2015). It has been suggested that the ability to respond to small amounts of rainfall that occurred in the dry season was due to the extensive root system of *Brachiaria decumbens* (Guenni *et al.,* 2002), plants produce new growth rapidly with out-of-season rain events during the dry season and with the break of season.

Cassava (*Manihot esculenta*) is a crop commonly grown in the tropics/subtropics for the production of tubers for human consumption. Cassava leaves are the most common part of cassava used as feed by farmers in the villages. It contains quite high crude protein up to 25 % on dry matter (DM) basis, a nutrient which is generally deficient in feeds for livestock in the tropics. Thus, it can potentially be used as a protein source for livestock. However, cassava leaf production is only concentrated during cassava tubers harvest thus, these are abundantly available only in short periods of time. As other forages, cassava leaf cannot stand for long time without any treatment, consequently the excess of cassava leaf are sometimes left in the field underutilized. Preservation of the excess of cassava leaf available such as through silage making, will maximize and improve the efficiency of the excess cassava leaf utilization as feed. As silage, the excess of cassava leaf available can be stored and utilized for a longer period of time as a protein feed supplement. Large quantities of vegetative material are the by-product after root harvesting, which would be discarded if not used for livestock feeding. This can prove to be a problem, because cassava contains both anti-nutritional and chemo-toxic substances, such as tannins and hydrocyanic acid (Ravindran, 1992). However, it has been shown that cattle and goats can tolerate the undesirable phytochemical effects (Theng *et al.,* 2003; Seng *et al.,* 2001; Seng and Rodriguez, 2001).

The *in vitro* method of feed evaluation is less expensive and less time consuming compared with *in vivo* methods. The *in vitro* gas production system helps to better quantity the nutrient utilization and its accuracy in describing digestibility in animal has been validated in numerous experiments (Sallam *et al.,* 2007). Gas production test are used routinely in feed research as gas volumes are related to both the extent and rate of substrates degradation (Blummel *et al.,* 1997). The *in vitro* gas production method is accurate and predict feed intake digestibility, microbial nitrogen supply and animal performance (Blummel and Øskov, 1993). For the past two decades, the technique had been used in advanced countries as a instrument to determine the amount of short chain fatty acids, carbon dioxide and metabolizable energy of the feed for ruminant (Blummel and becker, 1997, Getachew *et al.,* 1998).

This experiment was conducted to determine chemical composition and in vitro fermentation characteristics of ensiled *Brachiaria decumbens* and cassava leaves with millet additive in sheep production.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at The Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso ($8^0$101N, $4^0$101E). The climatic of Ogbomoso is mostly influenced by the north-east and south-west trade wind. *In vitro* gas production experiment was carried out at the Department of Animal Science, University of Ibadan, Ibadan, Nigeria

Sample collection and Preparation of silage

Brachiaria decumbens and cassava leaves was gotten from Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso.

Brachiaria decumbens was harvested manually at 8 week old re-growth. The harvested grasses at 8 weeks of re-growth was chopped and wilted for 6 hours in order to reduce the moisture content.

The grasses and cassava leaves was chopped into 2-3cm length for ease of compaction and consolidation for silage. *Brachiaria decumbens* and cassava leaves with millet additive were ensiled at graded level. Filling and compaction was done simultaneously to eliminate inherent air. The silage was prepared in 5kg polythene bag plastic buckets, the polythene bags was sealed in the buckets. It was compressed with piles of heavy sand bag.

Treatments

There were six treatments comprising of mixture of *Brachiaria decumbens,* cassava leaves, with millet additive at graded level.

T1: 60% *Brachiaria decumbens* +40% cassava leaves
T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets
T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets
T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets
T5: 100% *Brachiaria decumbens*
T6: 100% cassava leaves

Determination of silage quality

The fermentation was terminated after 157 days and the silage was opened for silage quality. The quality characteristics assessed were colour, aroma, texture, pH and temperature according to Babayemi and Igbekoyi (2008). Colour assessment was ascertained using visual observation with the aid of colour charts. The aroma of the silage was relatively assessed as to whether nice, pleasant, fruity or pungent. The pH of the silage was determined by using a pH meter. Dry matter was determined by taking sub-samples from different points and depths and mixed together, for oven drying at 65°C until a constant weight is achieved. The samples was later milled and stored in an air-tight container until ready for chemical analysis.

Chemical analysis

Samples were analyzed for their Crude protein, crude fibre, ether extract, nitrogen free extract and ash contents as described by (AOAC, 2002) and the amount of CP was calculated (N x 6.25). Data was analyzed using analysis of variance by following the procedure of SAS (SAS, 2002).

In vitro gas production procedure

This procedure has been documented in previous research works (Babayemi, 2007; Yusuf *et al.,* 2013). Rumen fluid was obtained with suction tube from three female WAD goats that were previously fed with *Panicum maximum*, *Gliricidia sepium* and cassava peels at 5% of their body weights. Incubation procedure was as reported by Menke and Steingass (1988) using 120 ml calibrated transparent plastic syringes with fitted silicon tube. The dietary treatments (T1, T2, T3 and T4) samples, in triplicates were carefully dropped into the syringes and then 30 ml inoculums containing cheese cloth strained rumen liquor and buffer (g/liter)) under continuous flushing with CO_2 was dispensed using another 50 ml plastic calibrated syringe. The syringe was tapped and pushed upward by the piston in order to completely eliminate air in the inoculums. The silicon tube in the syringe was then tightened by a metal clip so as to prevent escape of gas. Incubation was carried out at 6, 12, 18, and 24 h. At post incubation period, 4 ml of NaOH (10 M) was introduced to estimated methane production as reported by Fievez *et al.,* (2005). The average of the volume of methane gas produced from the blanks was deducted from the volume of gas produced from the samples.

Methane Determination

The volume of methane gas produced from each sample was determined by adding NaOH to absorb CO_2 produced during the process of fermentation and the remaining gas was recorded as methane according to Fievez *et al.,* (2005).

Calculations

Rates and extent of gas production were determined for each substrate from the linear equation: Y = a + b (1 e -ct) (as described by Orskov and McDonald (1979).

Where: Y = volume of gas produced at time t; a = intercept (gas produced from the soluble fraction); b = potential gas production (ml/ g DM) from the insoluble fraction; c = gas production rate constant (h-1) for the insoluble fraction (b); t = incubation time. Post incubation parameters which include metabolizable energy, organic matter digestibility and short chain fatty acids were estimated at 24hrs post gas collection as follows:
Organic matter digestibility (OMD%) was assessed as;

OMD = 14.88 + 0.889 GV + 0.45 CP + 0.651 XA (Menke and Steingass, 1988).
Short chain fatty acids (SCFA) was estimated as;

SCFA = 0.0239 GV - 0.0601 (Getachew *et al.,* 1999).
Metabolizable energy (ME, MJ/kg DM) was calculated as; ME = 2.20 + 0.136 GV + 0.057 CP + 0.0029 CF (Menke and Steingass, 1988).

Where GV, CP, CF and XA are total gas volume, crude protein, crude fibre and ash respectively of the incubated samples. Gas volume at 24hrs was expressed as ml/o.2 g DM, CP and ash as g/kg DM, ME as MJ/KG DM, OMD as % and SCFA as molµ/g DM.

Statistical analysis

Data obtained in the experiment was subjected to analysis of variance (ANOVA) technique of the statistical analysis system institute (SAS, 2002). Significant means was separated using the Duncan's multiple range F-test.

RESULTS

SILAGE CHARACTERISTICS

COLOUR, SMELL, TEXTURE AND TEMPERATURE (^{O}C) OF THE SILAGE

Shown in Table 1 is the colour, smell and texture of the silages. Silage from T1 had olive green while T2, T3 and T4 had olive green with white patches. On the other hand, T5 had brown colour and T6 had yellowish green.
The silages gave smells that differs from one another. All silages prepared had pleasant and acceptable smell. The texture of the silages was firm in all silages except *Brachiaria decumbens* only which was soft a little. All the silages give good and pleasant smell which is accepted as a good silage characteristics.

Table 1: Colour, Smell, and Texture of varied combination of *Brachiaria decumbens* ensiled and cassava leaves with millet additive

Treatment	Colour	Smell	Texture
T1	Olive green	Pleasant	Firm
T2	Olive green with White patches	Pleasant	Firm
T3	Olive green with White patches	Very Pleasant	Firm
T4	Olive green with White patches	Pleasant	Firm
T5	Deep olive greens	Fairly pleasant	Soft
T6	Yellowish green	Fruity	Firm

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves

The pH of varied combination of ensiled *Brachiaria decumbens,* Cassava leaves and with Millet grain is shown in Table 2. The pH ranges from (3.83 to 5.00) There were significant differences (P<0.05) in the pH of the silage. The highest pH value (5.00) was observed in T5 while the least value (3.83) was observed in T4. The pH value of T2, T3 and T4 were close to each other.

Table 2: pH of varied combination of ensiled *Brachiaria decumbens* and cassava leaves with millet additive

Treatment	pH
T1	4.83[a]
T2	4.10[bc]
T3	4.27[b]
T4	3.83[c]
T5	5.00[a]
T6	3.97[bc]
SEM	0.12

[a,b,c,]means with different superscripts in a column differ significantly (p<0.05)

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves
SEM: Standard Error of the Mean

Chemical Composition of varied combination of ensiled *Brachiaria decumbens* and Cassava leaves with millet additive

The percentage chemical composition of varied combination of *Brachiaria decumbens* ensiled with Cassava leaves and Millet as shown in Table 4. There were significant differences (P<0.05) in the crude protein (CP) contents of the silage. The highest crude protein value (16.05%) was observed in T4 while the least value (12.56%) was observed in T5. Except for T3, increasing millet in the combination led to increase in the CP content of the silage.

The highest value for Crude fibre (CF %) was observed in T5 (30.57%) and the least numerical value were observed in T1 (26.10%). Percentage ether extract (EE%) was observed to have its highest value in T5 and T6 (4.33%) while the least value was observed in T3. Values obtained for ash were significantly (P<0.05) different from each other, the highest value was however observed in T3 (ensiled 60% *Brachiaria decumbens* +20% cassava leaves +20% Millet) (18.39%) followed by T1 (17.88%) while the least value was observed for T5(15.03%).

Table 4: Chemical Composition of varied combination of ensiled *Brachiaria decumbens* and Cassava leaves with millet additive

Treatments	DM (%)	CP (%)	CF (%)	EE (%)	ASH (%)	NFE (%)
T1	31.71[b]	13.90[c]	26.10[d]	4.36[a]	17.88[ab]	37.76[ab]
T2	41.05[ab]	15.28[b]	27.46[bcd]	3.72[b]	17.15[ab]	36.40[bc]
T3	39.49[ab]	13.83[c]	26.20[cd]	3.44[b]	18.39[a]	38.15[ab]
T4	48.53[a]	16.05[a]	27.98[b]	4.30[a]	17.61[ab]	34.08[c]
T5	39.61[ab]	12.56[d]	30.57[a]	4.33[a]	16.56[b]	35.98[bc]
T6	42.06[ab]	13.52[c]	27.75[bc]	4.33[a]	15.03[c]	39.38[a]
SEM	3.52	0.18	0.50	0.11	0.42	0.85

[a,b,c,d]means with different superscripts in a column differ significantly (p<0.05)

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves
SEM: Standard Error of the Mean

In Vitro Gas Production Volume

Table 5 Show the gas production volume (ml/200mg sample) of the silages. As the incubation hour increases, the volume of gas produced increases. The cumulative gas produced ranged between (2.00 to 37.00 ml/200mg DM). Gas production was consistently and significantly (P<0.05) affected by the experimental treatments at all incubation intervals. Ensiled sole *Brachiaria decumbens* had the least volume of gas produced at all incubation hours. Among silages with millet grain, least gas produced volume (8.33ml/200mgDM) was recorded for T3 (ensiled 60% *Brachiaria decumbens* +20% cassava leaves +20% Millet) while the highest gas volume produced (37.00ml/200mgDM) at the end of the incubation was recorded for T4 (ensiled 60% *Brachiaria decumbens* +10%% Cassava Leaves +30% Millet).

Table 5. Gas production volumes (ml/200mg) of the silage

Treatment	3hrs	6hrs	9hrs	12hrs	15hrs	18hrs	21hrs	24 hrs
T1	5.00^{ab}	9.00 ^{ab}	11.33^{abc}	12.33 ^{b}	14.33^{bc}	14.00^{bc}	14.33^{cd}	14.33^{c}
T2	8.67^{ab}	13.33^{a}	15.33^{ab}	16.33^{ab}	16.67^{bc}	18.00^{bc}	19.00^{bc}	23.00^{b}
T3	8.33^{ab}	14.00^{a}	16.00^{a}	18.00^{ab}	18.67^{ab}	20.33^{ab}	25.33^{ab}	31.00^{a}
T4	10.00^{a}	15.67^{a}	19.00^{a}	23.33^{a}	26.67^{a}	28.67^{a}	31.67^{a}	37.00^{a}
T5	2.00^{c}	5.00^{b}	5.56^{c}	7.67^{b}	8.33^{c}	8.67^{c}	9.33^{d}	9.33^{c}
T6	2.67^{c}	5.67^{b}	6.67^{bc}	8.67^{b}	10.33^{bc}	10.67^{c}	12.00^{cd}	13.33^{c}
SEM	1.37	2.05	2.79	3.27	2.98	2.82	2.20	1.99

^{a,b,c}means with different superscripts in a column differ significantly (p>0.05)

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves
SEM: Standard Error of the Mean.

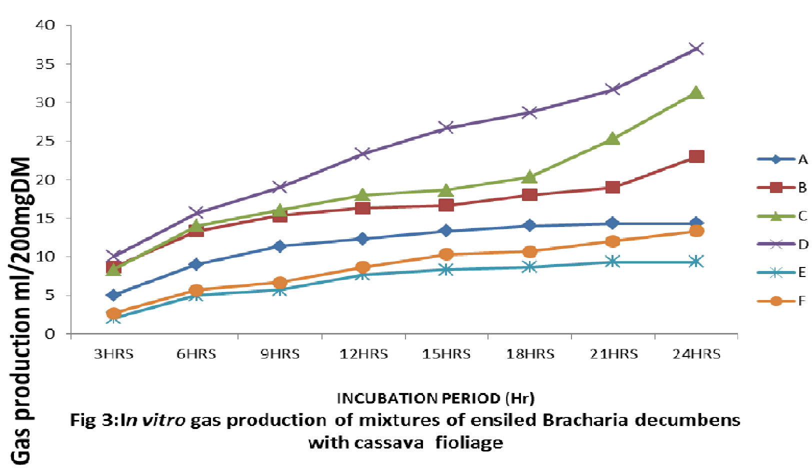

Fig 3:*In vitro* gas production of mixtures of ensiled Bracharia decumbens with cassava fioliage

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves

Methane gas production

Shown in table 6 is the methane production volume of varied combination of *Brachiaria decumbens* ensiled with Cassava leaves and Millet. The methane gas production volume differs significantly (P<0.05) among the treatments. Methane (ml/200mgDm) production ranged from (7.00 to 25.00 ml/200mg DM) among different silages, the least was T5 (ensiled *Brachiaria decumbens* only) (7.00 ml/200mg DM) and the highest being recorded for T4 (25.00 ml/200mg DM)

Table 6. Methane gas production volume of the silages

Treatment	**Methane** (ml/200mgDm)
T1	7.50[e]
T2	16.00[c]
T3	19.00[b]
T4	25.00[a]
T5	7.00[d]
T6	9.50[e]
SEM	0.44

[a,b,c,d,e]means with different superscripts in a column differ significantly (p>0.05)

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves
SEM: Standard Error of the Mean.

***In vitro* Gas Production Characteristics**

The *in vitro* gas production characteristics, Metabolizable Energy(MJ/kg DM), Organic matter digestibility (%) short chain Fatty Acids (µmol/g DM) of the silages were shown in table 4.6. Potentially degraded fraction (a+b) (ml/0.2g DM) ranged from (9.33 to 37.00 ml/200mg DM) among different silages, Gas production increases as incubation progresses and later drop down toward the end and there are significant differences (P<0.05) in the gas production characteristics of all the silages. The highest (P<0.05) potential gas production (a+b) value is (37.00 ml/200mg DM) was recorded for T4 (60% *Brachiaria decumbens* +10%% cassava leaves+30% millets). The gas production for T5(100% *Brachiaria decumbens)* is significantly lower than all others.
Metabolizable energy was significantly different and it was high in T4(ensiled 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets) with the value of (8.23MJ/kgDM) while the least value (4.27MJ/kgDM) was obtained in T5 (100% *Bracharia decumbens)*. The metabolizable energy increases with the increasing level of millet. Organic Matter Digesibility (OMD), highest value was obtained in T4(ensiled 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets) with the value of (66.45%) while the least value (39.61) was obtained in T% (100%*Bd*). The organic matter deficiency increases with the increasing levels of millet.
Short chain fatty acid (SCFA) is highest in T3 (ensiled 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets) with the value of (0.94µmol/g DM while the least value (0.28µmol/g DM) was obtained in T5 (100% *Brachiaria decumbens)*. The short chain fatty acid increases with the increasing level of millet.

Table.7. *In vitro* Gas production characteristics, Metabolizable Energy (MJ/Kg DM), Organic Matter digestibility (%) and short Chain Fatty (µmol) of the silages.

Treatment	a(ml)	a+b(ml/200mgDM)	B(ml/g DM)	C (h^1)	T(Hr)	Y(ml/200mgDM)	ME(MJ/kg DM)	OMD (%)	SCFA(µmol/g DM)
T1	5.00[bc]	14.33[c]	9.33[bc]	0.09	6.00	9.00[bc]	5.02[d]	45.52[d]	0.40[c]
T2	8.67[ab]	23.0[b]	14.33[b]	0.07	6.00	13.33[b]	6.28[c]	53.37[c]	0.61[b]
T3	8.33[ab]	31.00[a]	22.67[a]	/0.07	11.00	18.67[a]	7.28[b]	60.63[b]	0.80[a]
T4	10.00[a]	37.00[a]	27.00[a]	0.05	9.00	18.00[a]	8.23[a]	66.45[a]	0.94[a]
T5	2.00[c]	9.33[c]	7.33[c]	0.09	6.00	5.00[c]	4.27[d]	39.61[c]	0.28[c]
T6	2.67[c]	13.33[c]	10.67[bc]	0.05	6.00	5.67[c]	4.86[d]	42.60[de]	0.39[c]
SEM	1.37	1.99	1.92	0.02	2.38	1.96	0.27	1.83	0.05

[a,b,c]means with different superscripts in a column differ significantly (p>0.05); SEM: Standard Error of the Mean.

T1: 60% *Brachiaria decumbens* +40% cassava leaves; T2: 60% *Brachiaria decumbens* +30% cassava leaves+10% millets; T3: 60% *Brachiaria decumbens* +20%% cassava leaves+20% millets ; T4: 60% *Brachiaria decumbens* +10%% cassava leaves+30% millets; T5: 100% *Brachiaria decumbens*; T6: 100% cassava leaves
a: soluble fraction, b: potential gas production, a+b: potentially degraded fraction, c: rate of fermentation, t: time, ME: metabolizable energy, OMD: organic matter digestibility, SCFA: short chain fatty acids

DISCUSSIONS

Good silage usually preserves the original colour of the pasture or any forage (Mannatje, 1999). The olive green colour obtained in the present study was close to the original colour of the grass which was an indication of good silage characteristics that was well preserved (Oduguwa *et al.,* 2007). The colours were closed to the colour of the fresh forage which implies that ensiling *Brachiaria decumbens* and cassava leaves with millet improved the colour attribute of the silage. Silage with millet grains had more improved green colour than those without. The silages with cassava leaves exhibit pleasant aroma which is an indication of well-made silage, Kung and Shaver (2002) reported that pleasant smell is accepted for good or well-made silage. The texture of the silage was firm which was expected to the best texture of good silage (Kung and Shaver, 2002). Slimy texture or mold or fungi growth indicates spoilage in the silage. Ensiled *Brachiaria decumbens* only exhibit poor silage characteristics possessing a fairly pleasant smell, deep olive green coloration and molded appearance. This indicates that *Brachiaria decumbens* which is tropical is low in water soluble carbohydrate. Woolford (1984) reported that tropical grasses and legume are not natural ensiled material because they have a low content of water soluble carbohydrate which are essential to successful ensilage these leads to them having a higher buffering capacity and leaves their protein susceptible to proteolysis. This is in agreement with the suggestion for more water soluble carbohydrate in silage material for good fermentation (McDonald *et al.,* 1995).

The pH value of the silages pH 3.83-5.00 falls within the range of 3.5- 5.5 classified to be pH for good silage (Menesses *et al.,* 2007). Generally pH is one of the simplest and quickest ways of evaluating silage quality. However, pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH (be more acidic) than the original forage. The pH values of 3.83-5.00 obtained in this study was in agreement with 4.2 -5.0 reported by Babayemi (2009) but lower than 4.5-5.5 reported by Meneses *et al*. (2007).

The dry matter and crude protein values of the silage in this study ranged between 31.71-48.53% and 12.56-16.05 which compared well with (Marjuki *et al.,* 2008), but the CP value is less than 24.7% reported by (Adegbola and Okonkwo, 2002). The CP content was higher than the minimum level for maintenance of 7.70% for goats reported by NRC (1981). The CP for silages are above the minimum level and also exceeded the 8% CP observed by Norton (1994) to provide the ammonia level required by the rumen microbes for optimum activities. Devendra (1997), attributed the apparent lack of interest in the use of cassava leaves for feeding ruminants to inadequate appreciation of the relative high crude protein content of the leaves.

The ether extract of the silage ranged between 3.44-4.36 which was below the acceptable range (4.0-15.2) and crude fibre of the silage ranged between 26.10-30.57 which was higher than the acceptable range (4.8-15.4), the ash content was higher compared to (Smith, 1992). The dry matter and crude fibre of the CP were similar to those reported by (Adeloye, *et al.,* 2006). Also the ash content of the silage ranged between 15.03-18.39%. However, the ether extract was lower and the ash content higher.

The potential gas production (a + b) value for ensiled *Brachiaria decumbens* only has the lowest value of (9.33 ml/200mg DM) and this may be due to its crude fibre because it has the highest fibre content (30.57%). Babayemi and Bankole (2006) explained that sole guinea grass (*Panicum maximum*) is high in crude fibre and this may reduce its digestibility which is also applicable to *Brachiaria decumbens.* Also digestibility has been described to be synonymous to in *in vitro* gas production (Fievez *et al.,* 2005). The low gas production in *Brachiaria decumbens* in this study does not however reduce its importance in ruminant feeding. This is because it is one of the commonest grasses in the tropics.

In most cases, feedstuffs that shows high capacity for gas production are also observed to be synonymous with high methane production. Methane production in the rumen is an energetically wasteful process, since the portion of the animal feed which is converted to CH_4 is eructated as gas.

Generally, gas production is a function of degradable carbohydrate and therefore, the amount depends on the nature of the carbohydrate. (Demeyer and Van Nevel, 1975; Blummel and Becker, 1997). The presence fatty acids on silages ma also affect gas volume measurement in carbonated buffered *in vitro* measures, where the half of the gas volume is accounted for by CO_2 released upon buffering short chain fatty acid (SCFA) (Blummel and Ørskov., 1993). In another research (Ajayi and Babayemi, 2008), it was further explained that short chain fatty acid (SCFA) is one of the end rumen fermentation, and that a high volume of gas produced when substrate is fermented to acetate and butyrate, relatively lower gas production is associated with propionic production.

CONCLUSION

In conclusion, ensiling *Brachiaria decumbens,* cassava leaves with millet additives is advisable for farmers interested in enhancing the fermentation quality of the silages. The addition of millet grain helps to increase water soluble carbohydrate (WSC) which is low in most tropical grass thereby improving the fermentation process which increase the crude protein of the silage which invariably enhance feed intake and thereby improve the productivity of the animal. Results showed that silage characteristics in terms of colour, aroma, texture, pH, temperature, chemical composition and *in vitro* digestibility were within the acceptable property of well made silage. 60% *Brachiaria decumbens* + 10% Cassava leaves + 30% Millet has the highest crude protein, Dry matter, gas production volume. Therefore, the study shows that 60% *Brachiaria decumbens* + 10% Cassava leaves + 30% Millet is the best. . However residue from millet grain can also be used.

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