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Nutritive Evaluation of *Brachiaria Decumbens,* Three Tropical Browses and Their Combinations Using *In Vitro* Gas Production Technique

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In vitro gas production technique was used to predict the nutritive values of Brachiaria decumbens, Moringa oleifera, Tephrosia candida and Cajanus cajan as well as to compare the supplementation effects of the selected tropical browses on Brachiaria decumbens at ratio 60:40. Evaluation parameters were proximate composition, gas production volumes, Gas production constants, predicted metabolizable energy (ME), organic matter digestibility (OMD) and short chain fatty acid (SCFA) production. Significant (P<0.05) differences existed in all the parameters evaluated. Crude protein was highest in sole Tephrosia candida (21.44 %) and least in sole Brachiaria decumbens (13.55 %). Ether extract ranged from 3.50 % in sole Cajanus cajan to 4.50 % in Brachiaria decumbens combined with Moringa oliefera. The highest (32.43 %) crude fibre was obtained from Brachiaria decumbens in combination with Moringa oleifera and least (24.96 %) value was from sole Brachiaria decumbens. Ash content was between 14.38 % (sole Moringa oleifera) and 16.50 % in Brachiaria decumbens combined with Moringa oleifera and sole Brachiaria decumbens. Gas production from Moringa oleifera was significantly (P<0.05) highest from the beginning to the end compared to any of the experimental browses or their combination with Brachiaria decumbens. In vitro gas production characteristics also varied significantly (P<0.05) across the treatments. The potential gas production (a+b) ranged from 15.00 (Brachiaria decumbens combined with Cajanus cajan) to 21.67 ml/200mgDM (Moringa oleifera). Significant (P<0.05) differences were observed in ME, OMD and SCFA among treatments. Sole Cajanus cajan and Moringa oleifera had lower values than their combination with Brachiaria decumbens. However, sole Tephrosia candida had significantly (P<0.05) higher value of ME, OMD and SCFA than its combination with Brachiaria decumbens. It was concluded that combining Brachiaria decumbens with the selected browses improved the nutrient composition and availability.

Keywords: Gas Production, Tropical, *Bracharia decumbens,* Treatments.

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INTRODUCTION

Inadequate availability of feed and fodder is a major constraint to the prevalent small ruminant production system. Large number of feed ingredients of variable chemical composition, digestibility and nutrient quality derived from agriculture, forest, marine and industrial sources are being utilized as animal feed resources. Signal grass (*Brachiaria decumbens*) is naturally found in open grasslands or in partially shaded areas, between 27°N and 27°S, from sea level up to an altitude of 1750 m. It grows in frost-free areas with temperatures over 19 °C. Optimal growth occurs between 30 – 35 °C (FAO, 2016) and in places where average rainfall is over 1500 mm. Signal grass has a deep root system which effectively extracts P and N from the soil; it can grow on a wide range of soils including low fertile soils with low pH (down to 3.5) and high Al concentration (it does better than *Brachiaria brizanthain* in similar conditions). Signal grass is also moderately tolerant of Mn. However, unlike Rhodes grass and many other perennial grasses, signal grass is sensitive to salinity (Deifel *et. al.,* 2006). *Brachiaria decumbens* is important in the feed of ruminants because of its high productivity under intensive use, and its tolerance to low fertile soil and relative freedom from pest and diseases apart from spittlebugs. Data on nutritive value indicated that forage from *brachiaria* is highly palatable to stock, leading to high intake, whether fed fresh or grazed *in situ* (Ndikomana and Leeow de 1996) such as field selection, species and variety selection. One major approach that has been promoted to improve ruminant feeding and by implication, their productivity is supplementation of natural pastures with leaves from a number of leguminous and non-leguminous browse plants such as *Moringa oleifera Cajanus cajan, and Tephrosia candida* among others. The forages from these trees generally contain reasonable amounts of protein, in both the soluble and insoluble components and are also an important source of minerals such as sulphur, copper and iron (Dixon and Egan 1987; Somasiri *et. al*., 2010).

Moringa (*Moringa oleifera Lam*ack) is a multipurpose tropical tree. It is mainly used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding. Nutritious, fast-growing and drought-tolerant, this traditional plant was rediscovered in the 1990s and its cultivation has since become increasingly popular in Asia and Africa, where it is among the most economically valuable crops. It has been dubbed the "miracle tree" or "tree of life" by the media (FAO, 2014; Radovich, 2009; Orwa *et. al*., 2009; Bosch, 2004). Moringa leaves are a valuable source of protein for ruminants but they have a moderate palatability. They are used in smallholder rabbit farming in several African countries. Using moringa leaves for feeding poultry, pigs and fish is feasible but only in limited amounts due to the presence of fibre and anti-nutritional factors. Moringa oil seed cake, the by-product of oil extraction, is not very palatable to livestock and mainly used as green manure or a flocculating agent in water purification.

Pigeon pea (*Cajanus cajan*) is one of the most widely grown legume crop in the tropical and subtropical countries (Purdue, 2006). The plant is an erect, short-lived perennial shrub, attaining a height of between six and fourteen feet. It has compound leaves with three leaflets which are covered with short hairs. Pigeon pea leaf is used as fodder and valuable source of feed for farm animals (Foster *et al.,* 2009). The plant is also good source of vitamin A, but the forage is not relished in the immature stage. Grazing should be deferred to the early green pod-stage. It is a common practice to allow livestock to browse the remains of the crop after harvest if further grain yield is not expected. The plant has high feeding value for beef and dairy cattle, swine, sheep, and goats. It is a relatively drought-resistant plant, which can thrive in a harsh environment in tropical region of the world, particularly sub-Saharan Africa (Ajebu *et al.,* 2013). With climate variability and the occurrence of prolonged drought, pigeon pea offers resilience to cropping systems and its cultivation is expected to expand to new areas (Khoury, 2015). Moreover, pigeon pea has a huge untapped potential for improvement both in quantity and quality of production in Africa (Odeny, 2007). Pigeon pea is widely used as fodder and feed for livestock (Rao *et al.,* 2002) due to its excellent fodder with high nutritional value and higher digestibility (Onim *et al.,* 1985).

Tephrosia candida is a perennial shrub found mainly in research stations (Babayemi *et al.,* 2003) and is commonly grown as a shade tree for tea (Ahmed *et al* 1993). The plant has been described by ABRATES (2000) as a root nodulating legume with potential for use in agroforestry. The plant is reported to be tolerant to a range of soils and temperatures (Nguyen and Thai 1993). Its tolerance to pests and diseases, biomass yield and weed suppression abilities informed its selection as one of the forages by farmers in Tanzania (Ahmed *et al.,* 1993). Tephrosia was reported to be well accepted with high dry matter intake, digestibility and nitrogen utilization when used as supplement for the goats on range (Babayemi and Bamikole 2006). The use of *T. candida* as a browse plant for livestock feeding is not common. Notwithstanding, the leguminous shrub is among the over 300 species of Tephrosia well distributed in the tropics (Babayemi *et al.,* 2003).

The *in vitro* gas method based on syringes (Menke *et.al*, 1979, Blummel *et.al*, 1997) appears to be the most suitable for use in developing countries. It is extensively used for the estimation of in vitro digestibility and metabolizable energy for ruminants. The gas test is of interest because of the possibility of estimating the extent and rate of degradation in one sample by time-series measurements of their accumulating gas volume. Gas measurements provide useful data on digestion kinetics of both soluble and insoluble fractions of feedstuffs. They can also be used to generate information on the proportions of volatile fermentation products. This experiment was therefore set up to predict the nutritive values of *Brachiaria decumbens, Moringa oleifera, Tephrosia candida, Cajanus cajan* and compare the supplementation effects of their combinations with *Brachiaria decumbens* using the *in vitro* gas production technique.

MATERIALS AND METHOD

Collection of forage sample

Brachiaria decumbens, Moringa oleifera, Cajanus cajan and *Tephrosia candida* were obtained from the Teaching and Research Farm pasture plot of Ladoke Akintola University of Technology, Ogbomoso Oyo State. Representative samples of leaves with tender stems of the forages were weighed, oven dried, and reweighed to determine the dry matter. The dried samples were grinded using a hammer mill into smaller sizes that can pass through a 2 mm sieve for laboratory analysis of Crude protein, Crude fiber, Ether extract, and Ash. The proximate analysis was done according to AOAC (2005).

EXPERIMENTAL FORAGE COMBINATIONS

The study was conducted with the experimental forages singly, and with *Moringa oleifera, Cajanus cajan*, *Tephrosia candida* in combination with *Brachiaria decumbens* as follows:

1. T1: 100 % *Brachiaria decumbens*
2. T2: 100 % *Moringa oleifera*
3. T3:100 % *Cajanus cajan*
4. T4: 100 % *Tephrosia candida*
5. T5: 60 % *Brachiaria decumbens* + 40 % *Moringa oleifera*
6. T6: 60 % *Brachiaria decumbens* + 40 % *Cajanus cajan*
7. T7: 60 % *Brachiaria decumbens* + 40 % *Tephrosia candida*

THE *IN VITRO* GAS PRODUCTION TECHNIQUE

Rumen fluid was obtained from three West Africa Dwarf goats using the method of collection previously described by Babayemi and Bamikole (2006). The rumen liquor was collected into the thermo flask that had been pre-warmed to a temperature of 39 °C before feeding the animals in the morning. Incubation using 120 ml calibrated syringes in three batches as reported by Menke and Steingass (1988) was employed; 200 mg sample was placed in the syringes and 30 ml inoculums containing strained rumen liquor and buffer (1:2, v/v) under continuous flushing with carbon dioxide was introduced into the syringe. Incubation was carried out at 39 °C. The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24 hour. At post incubation period, 4ml of NaOH (10M) was introduced to estimate methane production (Fievez *et al.,* 2005). The volume of gas that was produced were plotted against the incubation time and from the graph, the gas production characteristics were estimated from the linear equation:

$Y=a + b (1-e^{-ct})$ (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 for the insoluble fraction (b), t = incubation time.
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).
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) were calculated from gas production volume (GV ml/200mg) as
SCFA= 0.0239 GV – 0.0601 (Getachew *et al.,* 1999).
Where GV, CP, CF and XA are total gas volume (ml/200mgDM), crude protein, crude fibre and ash respectively of the incubated samples.

Proximate analysis

Milled samples of the forages were analysed for dry matter, crude protein, crude fibre, ether extract and ash by the procedures of AOAC (2005).

STATISTICAL ANALYSIS

Data collected were analyzed using analysis of variance by following the procedure of SAS (SAS, 2002). Significant means were separated using the Duncan multiple range test of the same package.

RESULT AND DISCUSSION

RESULTS

Presented in Table 1 is the proximate composition (g/kgDM) of *Brachiaria decumbens*, three tropical browses and their respective combinations at ratio 60:40. There were significant differences in proximate composition among the forages. Dry matter ranges from 27.83 % to 57.66 % in sole *Brachiaria decumbens* and *Tephrosia candida* respectively. Crude protein was highest (21.44 %) in *Tephrosia candida* and least (13.55%) in sole *Brachiaria decumbens*. The ether extract was highest (4.50 %) *Brachiaria decumbens* and its combination with *Moringa oliefera* and lowest (3.50 %) in sole *Cajanus cajan*

The crude fibre was between 24.96 % (sole *Brachiaria decombens*) and 32.43 % (*Brachiaria decumbens* combined with *Moringa oleifera*). Ash content was least for sole *Moringa oleifera* (14.38%) and highest in *Brachiaria decumbens* combined with *Moringa oleifera* and sole *Brachiaria decumbens* in which both had the same value of 16.50%.

Table 1: Proximate composition (g/kgDM) of *Brachiaria decumbens*, three tropical browses and their respective combinations at ratio 60:40

Treatment	DM	CP	CF	Ash	EE
T1	27.83^{c}	13.55^{e}	24.96^{d}	16.50^{a}	4.00^{ab}
T2	44.98^{b}	16.16^{d}	29.33^{c}	14.38^{b}	4.49^{a}
T3	47.08^{b}	17.30^{c}	29.38^{c}	14.70^{b}	3.50^{b}
T4	57.66^{a}	21.44^{a}	28.38^{d}	14.44^{b}	3.95^{ab}
T5	38.11^{bc}	13.60^{c}	32.43^{a}	16.50^{a}	4.50^{a}
T6	39.38^{bc}	19.00^{b}	31.00^{b}	16.21^{a}	3.61^{b}
T7	45.72^{b}	16.65^{cd}	25.85^{e}	16.10^{a}	3.71^{b}
SEM	0.11	0.07	0.08	0.01	0.03

^{abc} means with different superscripts along the same Column differs significantly($P<0.05$) SEM = Standard Error of Mean.

T1: 100% *Brachiaria decumbens*; T2: 100% *Moringa oleifera;* T3: 100% *Cajanus cajan ;* T4: 100% *Tephrosia candida;* T5: 60% *Brachiaria decumbens* + 40% *Moringa oleifera*; T6: 60% *Brachiaria decumbens* + 40% *Cajanus cajan*; T7: 60% *Brachiaria decumbens* + 40% *Tephrosia candida*

Gas production was consistently and significantly ($p<0.05$) affected by the experimental treatments at all incubation intervals (Table 2). The gases produced increased with increasing incubation time. Gas production from *Moringa oleifera* was significantly ($p<0.05$) higher than most of the experimental browses or their combinations having gas volume of 21.67 ml /200 mgml at 24 hour.

Amongst the browses combination with *Brachiaria decumbens*, the least gas was produced by the combination of *Cajanus cajan* (15.00ml/200mgDM*)* while highest in the combination with *Tephrosia candida* (85.00 ml/200mg/DM).

Table 2: Gas production volumes (ml/200mg sample) of *Brachiaria decumbens,* three tropical browses and their respective combinations at ratio 60:40

Treatment	3hr	6hr	9hr	12hr	15hr	18hr	21hr	24hr
T1	5.67^{a}	8.00^{bc}	8.33^{a}	9.33^{b}	10.67^{b}	12.67^{b}	15.57^{ab}	21.33^{a}
T2	7.00^{a}	14.00^{a}	14.33^{a}	16.00^{a}	18.00^{a}	18.33^{a}	20.00^{a}	21.67^{a}
T3	6.00^{a}	13.67^{a}	14.00^{a}	15.33^{ab}	15.00^{ab}	15.67^{ab}	17.00^{ab}	19.00^{ab}
T4	5.33^{a}	9.33^{ab}	10.33^{a}	12.67^{ab}	13.00^{ab}	13.67^{ab}	14.33^{ab}	15.67^{b}
T5	4.67^{a}	8.67^{ab}	11.67^{a}	12.67^{ab}	13.67^{ab}	14.33^{ab}	14.67^{ab}	16.33^{b}
T6	5.00^{a}	7.33^{b}	8.67^{a}	9.33^{b}	9.33^{b}	10.33^{b}	11.33^{b}	15.00^{b}
T7	6.33^{a}	9.00^{ab}	10.33^{a}	13.00^{ab}	15.00^{ab}	15.33^{ab}	17.00^{ab}	18.00^{ab}
SEM	**2.94**	**3.07**	**4.25**	**3.57**	**4.42**	**4.45**	**3.28**	**2.28**

^{abc} means with different superscripts along the same Colomns differs significantly($P<0.05$) SEM = Standard Error of Mean.

T1: 100% *Brachiaria decumbens*; T2: 100% *Moringa oleifera;* T3:100% *Cajanus cajan ;* T4: 100% *Tephrosia candida;* T5: 60% *Brachiaria decumbens* + 40% *Moringa oleifera*; T6: 60% *Brachiaria decumbens* + 40% *Cajanus cajan*; T7: 60% *Brachiaria decumbens* + 40% *Tephrosia candida*.

Table 3 shows the *in vitro* gas production characteristics of *Brachiaria* decumbens, three tropical browses and their respective combinations at ratio 60:40. All the *in vitro* gas production characteristics were observed to vary significantly (P<0.05) across all the treatment. Gas production potential (a+b) ranged from 15.00 ml/200mgDM (*Bracharia decumbens* and *Cajanus cajan*) to 21.67 ml/200mgDm (*Moringa oleifera*). The 'a' component ranged from 4.67 ml/200mgDM for both sole *Moringa oleifera* and its combination with *Brachiaria decumbens* to 6.33 ml/200mgDM in *Bracharia decumbens* and *T. candida*

The 'b' component ranged from 10.00 ml/200mgDM in *B. decumbens* and *C. cajan* to 15.67 ml/200mgDM for sole *Brachiaria decumbens* while the fermentation rate of substrate (c) ranged from 0.04 m/hr^{-1} (*Bracharia decumbens* combined with *Cajanus cajan* and sole *Brachiaria decumbens*) to 0.14m/hr^{-1} for sole *C. cajan*. The variations in total time taken (hour) to produce the final gas volumes were such that 't' was highest for both sole *Tephrosia candida* and its combination with *Brachiaria decumbens* while the lowest was recorded for the sole *Cajanus cajan* combined with *Brachiaria decumbens*, and sole *Moringa oleifera*.

Table 3*:* *In vitro* gas production characteristics of *Brachiaria decumbens* three tropical browses and their respective combinations at ratio 60:40

Treatment	a (ml)	b	a+b (ml/200mgDM)	C (h^{-1})	T (hr)	Y (ml/200mgDM)
T1	5.67	15.67	21.33^{a}	0.04	13.00	10.67
T2	4.67	14.67	21.67^{a}	0.10	6.00	14.00
T3	6.00	13.00	19.00^{ab}	0.14	6.00	13.67
T4	5.33	10.33	15.67^{b}	0.11	8.00	11.00
T5	4.67	11.67	16.33^{b}	0.13	7.00	10.67
T6	5.00	10.00	15.00^{b}	0.04	6.00	7.33
T7	6.33	11.67	18.00^{ab}	0.05	8.00	10.33
SEM	2.95	4.19	2.28	0.001	1.50	4.40

^{abc} means with different superscripts along the same Colomns differs significantly(P<0.05) SEM = Standard Error of Mean.

T1: 100% *Brachiaria decumbens*; T2: 100% *Moringa oleifera;* T3:100% *Cajanus cajan ;* T4: 100% *Tephrosia candida;* T5: 60% *Brachiaria decumbens* + 40% *Moringa oleifera*; T6: 60% *Brachiaria decumbens* + 40% *Cajanus cajan*; T7: 60% *Brachiaria decumbens* + 40% *Tephrosia candida ;* Y= volume of gas produced at time 't'. a= intercept (gas produced from soluble fraction); b= potential gas production (ml/mgDM) from the insoluble fraction; c= gas production rate constant(h^{-1}) for the insoluble fraction (b); t= incubation time

Shown in Table 4 are the predicted metabolizable energy, organic matter digestibility and short chain fatty acid of *Brachiaria decumbens*, three tropical browses and their combinations at ratio 60:40. Significant (P<0.05) differences were observed in OMD, ME and SCFA across the treatments (Table 4). The sole *Cajanus cajan* had the least value of metabolizable energy (5.40MJ/kgDM) while the sole *Tephrosia candida* had the highest value of 6.45MJ/kgDM. Sole *Tephrosia candida* also had the highest value of OMD (53.19%) but least value was from sole *Moringa oleifera* (46.03%). *Brachiaria decumbens* and its combination with *Cajanus cajan* had the least value of short chain fatty acid (0.41 µmmol/200mg), while it was highest (0.57mmol/200mg) was recorded for sole *Tephrosia candida* and *Brachiaria decumbens* combined with *Moringa oleifera*

Table 4: Predicted Metabolizable energy (ME, MJ/Kg DM), Organic Matter digestibility (OMD%) and Short Chain Fatty Acid (µmmol) *of Brachiaria decumbens*, three tropical Browses and their respective combinations at ratio 60:40

TREATMENT	ME	OMD	SCFA
T1	6.16[a]	49.78[a]	0.57[a]
T2	5.42[b]	46.03[b]	0.45[b]
T3	5.40[b]	46.16[b]	0.43[b]
T4	6.45[a]	53.19[a]	0.57[a]
T5	5.65[b]	48.63[b]	0.51[ab]
T6	5.41[b]	47.32[b]	0.41[b]
T7	5.67[b]	48.85[b]	0.49[ab]
SEM	0.04	1.86	0.001

[abc] means with different superscripts along the same Colomns differs significantly(P<0.05) SEM = Standard Error of Mean.

T1: 100% *Brachiaria decumbens*; T2: 100% *Moringa oleifera;* T3:100% *Cajanus cajan ;* T4: 100% *Tephrosia candida;* T5: 60% *Brachiaria decumbens* + 40% *Moringa oleifera*; T6: 60% *Brachiaria decumbens* + 40% *Cajanus cajan*; T7: 60% *Brachiaria decumbens* + 40% *Tephrosia candida*

Figure 1 shows the methane production of *Brachiaria decumbens*, three tropical browses and their combinations at ratio 60:40, Methane (m/200mgDM) production ranged from 8.50 to 13.00 ml/200mgDM. The least value is obtained for sole *Cajanus cajan* (8.5oml/200mgDM) while the highest was from sole *Brachiaria decumbens*. There were significant (P<0.05) differences in methane production by the experimental forages.

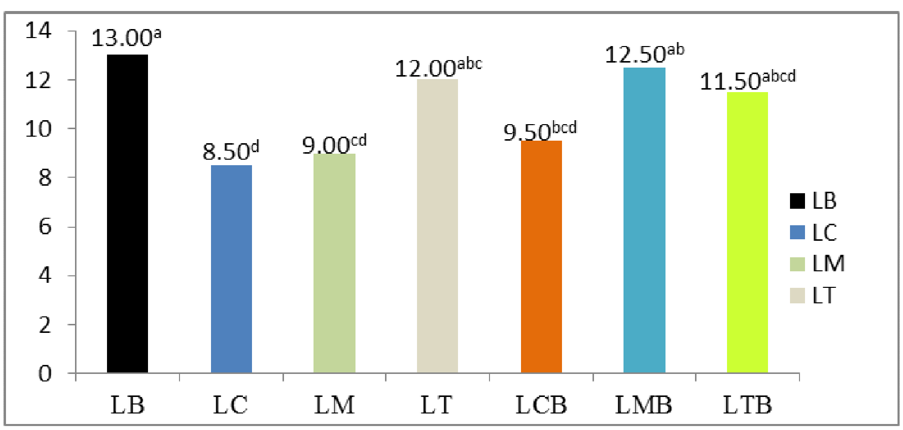

Figure 1: Methane Production by *Brachiaria decumbens,* three tropical browses and their combination at ratio 60:40

DISCUSSION

Proximate composition is usually the basic and most common form of forages evaluation by animal nutritionist. There are many factors affecting proximate composition and mineral content of forages such as stage of growth maturity, species or variety (Agbagla-Dohnani *et al*., 2001; Promkot and Wanapat, 2004). The CP of the forage species ranged from 12.2 to 27.3%, which is above the 7% CP requirement for ruminants which will provide ammonia required by rumen microorganisms to support optimum microbial activity (Van Soest, 1994) and above the range of 11.0 - 13.0 % known to be capable of supplying adequate protein for maintenance and moderate growth in goats (NRC, 1981: Mc Lennan and Poppi:, 1995). The value of 21.44 % CP obtained for *Tephrosia candida* in this study is higher than 10.8 and 11.4 g/100 g reported for *Tephrosia uniflora* and *T. villosa* respectively (Lamprey *et al*., 1980) and 17.2 g/100 g reported for *Tephrosia candida* (Babayemi and Bamikole, 2006). Generally, the variation that existed between the present study and the past works on the forages considered may be traced to time and seasons of harvest, age of plant, leaf to petiole ratio, ecological location and edaphic (soil) (Makkar and Beacker, 1997; Babayemi and Bamikole, 2006).

Moringa oleifera in combination with *Brachiaria decumbens* had the highest amount of Crude fiber (32.43%), followed by 31.00% for *Cajanus cajan* combined with *Brachiaria decumbens*. High level of fibre has been acknowledged to be inversely related to feed digestibility and nutrient availability (Mc Donald *et al.,* 1995).

Although, gas production is regarded as nutritionally wasteful (Mauricio *et al,* 1999), it however provides a useful basis from which metabolizable energy, organic matter digestibility and short chain fatty acid can be predicted (Babayemi *et al*, 2006). In the present study, forages with high CP produced higher gas volume. Digestibility has been reported to be synonymous to *in vitro* gas production (Fievez *et al.,* 2005) that is, forages with high gas production will exhibit better digestibility.

Sole *Brachiaria decumbens* had high gas production and methane production. The low gas production observed for *Cajanus cajan* and *Moringa oleifera* when the two browses was combined with *Brachiaria decumbens* agrees with earlier reports (Babayemi and Bamikole, 2006; Ajayi and Babayemi, 2008). The workers observed reduction in methane production as browse legumes were increasingly added to grass. The least amount of gas was produced by *Brachiaria decumbens* combined with *Cajanus cajan* followed by *Brachiaria decumbens* combined with *Moringa oleifera*. This may be due to the differences in the nature of the carbohydrates of the forages. Blummel and Becker (1997) explained that generally, gas production is a function and a mirror of the degradable carbohydrate in the diet and thus the amount depends on the nature of the carbohydrate. The difference could also be attributed to the protein contents of the forages. Nature and fibre levels, presence of anti-nutrition factor had been reported to influence the amount of gas produced during fermentation (Babayemi 2004). High level of crude fibre reduce digestibility which is synonymous to in-vitro gas production.

Gas production is associated with volatile fatty acid production following fermentation of substrate (Blummel and Ørskov 1993). In addition, the application of models permits the fermentation kinetics of the soluble and readily degradable fraction of the feeds, and more slowly degradable fraction to be described (Gatechew *et al.,* 1998). Moreover the gas production parameters of trees might demonstrate differences in their nutritional value that may be closely related to their chemical composition (Cerrillo and Juarez 2004). The inconsistency observed in the gas production is as a result of the different rate of different anti nutritional content as well as the forage degradability.

Methane production represent a significant energy loss to ruminants; it also contributes to global warming which is a worrisome phenomenon in the recent time and many tropical feedstuff have been indicated to increase methanogenesis (Babayemi *et al.,* 2004; Babayemi and Bamikole, 2006).

In this study, the OMD and ME of Moringa as a sole browse substrate and its combination with *Brachiaria decumbens*, both treatments have the values lower than 58.16% and 9.85 MJ as reported by Asaola *et al.,* (2009). Moringa have 46.03% and 5.42MJ, such values were considered by the author as moderate to high and a demonstration of *Moringa oleifera*'s high nutritive value when used in ruminant feeding. ME is an indication of energy. SCFA is one of the end products of rumen fermentation and is a reflection of energy availability in a feed stuff. (Ajayi and Babayemi, 2008; Asaolu, *et al.,* 2009). The resultant increased SCFA from the combination of *Brachiaria decumbens* and *Moringa oleifera* relative to sole *Moringa oleifera* could be interpreted to mean increasing energy availability to the ruminant. Fierez *et al.,* (2005) reported that the level of SCFA is an indicator of the energy value of diets. A high value of SCFA is an indication of energy availability to the animal.

The differences in effect of in-vitro fermentation on metabolizable energy (ME), organic matter digestibility (OMD) and short chain fatty acid (SCFA) of the browse forages could be as a result of morphological fraction, environmental factor or maturity stage as also observed by Babayemi *et al.* (2004).

CONCLUSION

Results indicated that combining *Brachiaria decumbens* with the selected browse plants at ratio 60:40 improved nutrient composition and availability. The high levels of fibre also indicated reduced digestibility. *Brachiaria decumbens* is low in crude protein, but the supplementation of browse plants, *Moringa oleifera, Tephrosia candida* and *Cajanus cajan* which are of high in crude protein enhanced the crude protein and nutritive value. The high crude protein content and the high potential gas production, including the metabolizable energy, organic matter digestibility and short chain fatty acids values will benefit ruminants during the dry season.

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