IN VITRO DIGESTIBILITY OF FIVE PLANTS CONSUMED BY WEST AFRICAN DWARF SHEEP

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ABSTRACT
The competition between man and livestock for conventional feedstuffs and the exorbitant cost of concentrate diets can be reduced through the use of alternative feed materials that are cheap, available all year-round. Thus, a study was conducted to evaluate in vitro digestibility of Anacardium occidentale, Gmelina arborea, Mangifera indica, Gliricidia sepium and Panicum maximum. The plants were sundried and kept in polythene bags for further investigation. In vitro digestibility study was carried out for 24 hours. In vitro gas production and post incubation parameters were measured. In vitro study reveals that at 24 hr of incubation Mangifera indica had highest (P<0.05) value of 20.67mL/200mgDM gas production while lowest value (9.67mL/200mgDM) was obtained in Panicum maximum. Mangifera indica had highest (P<0.05) values for ME, OMD and SCFA across the plants while the least (P<0.05) values were observed in Panicum maximum. The study concluded that the forages investigated can be fed to sheep to improve their nutritional status especially in the period of feed scarcity without any adverse effect on the animals.
Keywords: Forages, *in vitro* gas, Metabolizable energy, ruminants, Fermentation

INTRODUCTION

In Nigeria ruminants are important sources of animal protein where they contribute to the cultural and socio-economic life of people (Adebayo *et al.,* 2017). A major constraint to livestock production in developing countries is the scarcity and fluctuating quantity and quality of the year-round feed supply (Olafadehan and Adewumi, 2009). Consequently, the productivity of ruminant livestock in the tropics and subtropics is limited by inadequacy of good quality and nutritive feed. This becomes critical during the long dry season when the little available standing hay forages are lignified with adverse effects on voluntary intake, digestibility, productive and reproductive performance. A number of browse plants worldwide serve as alternative feedstuffs for livestock (Ammar *et al.*, 2004; Aregawai *et al.,* 2008; Fayemi *et al* 2011). This is due to their abundant biomass and availability all year round. Browse plants are considered palatable, highly digestible and as a result improves animal performance (Isah *et al.,* 2012).

In vitro fermentation techniques (Babayemi and Bamikole, 2006) is a quick means of evaluating and revalidating nutritive value of feedstuffs. The *in vitro* fermentation technique is capable of quantifying the amount of methane (energy loss) production (Fievez *et al.,* 2005). The study is to determine the *in vitro* gas production of some plants.

MATERIALS AND METHODS

Location of the experiment: The experiment was carried out at the teaching and research farm of the School of Agricultural technology, Yaba College of Technology, Epe Lagos state. The farm is located on 3 58^{o} E and longitude 6 47^{o}N. It is 42m above the sea level along the Epe- Ijebu Ode road. Epe lies in the low land rain forest, vegetation zone within the savannah agro ecological zones of south Nigeria (Google Earth, 2020).

Collection of forages: Five forages were collected during the dry season around the premises of Yaba College of Technology School of Agriculture Odoragunshin, Epe campus, Lagos State, Nigeria. The forage plants were: *Mangifera indica* (Mango)*, Anacardium occidentale* (Cashew)*, Gmelina aborea* (Gmelina)*, Gliricidia sepium* (Gliricidia) *and Panicum maximum* (Guinea grass)*.* About 500g sample of each plant was collected from different mature plants before flowering from several stands. They were oven dried at 65^{o}C to constant weight to determine the dry matter. The dried samples were milled and sieved to 1.0mm particles size, bulked on individual leaf basis and stored in an air tight container pending analysis.

***In vitro* gas production**

Five forage plants were used for *in vitro* fermentation to estimate digestibility; Rumen fluid was obtained from six West African dwarf goats. The method for collection as described (Babayemi and Bamikole, 2006) using a stomach suction tube pass through the oesophagus to the rumen. The animals were being placed on 40% DM concentrate feed and 60% DM *Panicum maximum*. The concentrate feed consisted of (as fed basis) 4% corn, 10% wheat offal, 10% palm kernel cake, 20% groundnut cake, 5% soyabean meal, 10% dried brewers' grain, 1% common salt, 3.75% oyster shell and 0.25% fish meal. The rumen liquor was collected before morning feeding into a thermos flask that was pre-warmed to a temperature of 39°C.

Incubation procedure involved 120mL calibrated transparent plastic syringes with fitted silicon tube. Each milled sample weighing 200mg (0.2 g) was carefully put into incubation bag, sealed with the aid of sealing machine and dropped into the syringe and thereafter 30ml inoculum containing cheese Cloth strained rumen liquor and buffer 1g per litter ($NaHCO_3$+$3Na_2HPO_4$+KCl+NaCl+$MgSO_4.7H_20$+$CaCl_2.2H_20$) was dispensed using another 50ml plastic calibrated syringe. The syringes were tapped and pushed upward by the piston in order to completely eliminate air in the inoculum. The silicon tube in the syringe was then tightened by a plastic and metal clip to prevent escape of gas. The syringes were carefully arranged in the incubator and maintained at a temperature of 39^0C. Incubation will be carried out at 39 $\pm$ 1°C and the volume of gas production was being measured at 3, 6, 9, 12, 15, 18, 21, and 24, hours. At post incubation period 4mL of NaOH was introduced to estimate methane production (Fievez *et al;* 2005). The mean volume of gas produced from blank syringe was deducted from the volume of gas produced from sample. After estimating methane, bags containing residue was dried in the oven at 60^0C for 24 hours, weighed and digestibility was calculated as follows:

Metabolizable energy (ME, MJ/Kg DM) and organic matter digestibility (OMD %) were estimated (Menke and Steingass, 1988) and short chain fatty acids (SCFA (mL) was calculated (Getachew *et al.,*2004).

ME = 2.20 + 0.136GV + 0.057CP + 0.0029CF

OMD = 14.88 + 0.889GV + 0.45CP + 0.651 XA

SCFA = 0.0239GV – 0.0601

Where GV, CP, CF and XA are net gas production (ml/200mg DM), crude protein, crude fibre and ash of the incubated samples, respectively.

Statistical analysis

Data collected was subjected to one-way analysis of variance and significant differences among means was compared using Duncan Multiple Range test (SAS, 2008)

RESULTS AND DISCUSSION

Steady increment in the *in vitro* gas production of the selected plants was observed as incubation period progressed from 3 hour to 24 hour of incubation as shown in Table 1. Gas production of *Mangifera indica* was consistently high (P<0.05) throughout the incubation period from 3 – 24 hour. *Panicum maximum* had the least gas production volume throughout the period of incubation.

The Metabolizable energy, Organic matter digestibility, Short chain fatty acid and methane production of the selected plants are presented in Table 2. *Mangifera indica* had significant highest ME value

Table 1: *In vitro* gas production (mL/200mgDM) of the selected plants incubated at Twenty-four hour

	Period of incubation (hour)							
Samples	3	6	9	12	15	18	21	24
P. maximum	1.00^{b}	2.00^{b}	3.67^{b}	5.33^{b}	7.33^{b}	8.33^{c}	9.33^{c}	9.67^{d}
M. indica	2.00^{a}	4.00^{a}	6.00^{a}	9.00^{a}	13.00^{a}	15.00^{a}	17.33^{a}	20.67^{a}
G. aborea	1.00^{b}	3.33^{ab}	5.33^{ab}	7.00^{ab}	8.33^{b}	9.33^{bc}	10.00^{c}	12.33^{cd}
A. occidentale	1.67^{ab}	3.67^{ab}	5.67^{ab}	6.33^{b}	8.33^{b}	9.67^{bc}	11.33^{bc}	13.33^{bc}
G. sepium	1.67^{ab}	3.33^{ab}	4.33^{ab}	6.67^{ab}	8.00^{b}	11.33^{b}	13.00^{b}	16.00^{b}
SEM	0.13	0.27	0.33	0.42	0.59	0.68	0.82	1.07

^{abcd} Means along the same column with different superscripts are significantly different (p<0.05)

SEM= Standard error of mean

Table 2: Short chain fatty acid (SCFA), Organic matter digestibility (OMD), Metabolizable energy (ME) and Methane gas production of the selected plants Post incubation parameters

Samples	SCFA (mmol)	OMD (%)	ME (MJ/KgDM)	CH_{4G}
P. maximum	0.17^{d}	34.24^{c}	4.04^{d}	4.00^{d}
M. indica	0.43^{a}	45.70^{a}	5.62^{a}	9.00^{a}
G. aborea	0.23^{cd}	42.93^{ab}	5.10^{bc}	5.00^{cd}
A. occidentale	0.26^{bc}	42.83^{ab}	4.70^{c}	5.50^{c}
H. sepium	0.32^{b}	42.93^{ab}	5.33^{ab}	7.00^{b}
SEM	0.03	42.25^{b}	0.16	0.49

^{abcd} Means along the same column with different superscripts are significantly different ($p<0.05$)
SEM= Standard error of mean

(5.62 MJ/KgDM) while the least value (4.04 MJ/KgDM) was observed in *Panicum maximum*. The least organic matter digestibility value (34.24%) was obtained in *Panicum maximum* while significant highest value (45.70%) was observed in *Mangifera indica.* The results of *in vitro* gas production characteristics (ME, OMD and SCFA) of the various selected plants estimated from gas production revealed that metabolizable energy (ME) values obtained in this study ranged from 4.04 – 5.62 MJ/kgDM which fell below the reported energy value by Babayemi (2007) when *Leuceana leucocephala* (8.31 MJ/kgDM), *Gliricidia sepium* (11.88 MJ/kgDM) and *Centrosema pubescens* (9.95 MJ/kgDM) were assessed. Adebayo *et al.,* (2019) observed 7.57, 7.67, 6.47 and 9.22 MJ/kgDM in the sun-dried *Gmelina arborea*, *Leuceana leucocephala, Mangifera indica* and *Moringa olifeira* respectively. The predicted ME profile as shown in Table 2 was close to each other in the selected plants.The values of SCFA of the selected forages predicted from gas production ranged fell within the reported values for some browse forages (Ogunbosoye and Babayemi, 2010 and Akinfemi and Ladipo, 2014). SCFA is an indicator of energy availability to the animal and since higher values were predicted from the selected forages, that suggests more energy potential for the selected plants.The result of the methane gas production in the current study was in conformity with the submission of Babayemi (2007) that in most cases, feedstuff that show high capacity for gas production are also observed to be synonymous for high methane production, this agreed with the result of this finding as the higher methane production was observed in *Mangifera indica* which had earlier recorded highest gas production across the selected plants.

CONCLUSION

The highest *in vitro* gas production volume (20.67ml/200mg) was recorded in *Mangifera indica* at 24 hour of incubation.

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