IN VITRO EVALUATION OF GUINEA GRASS ENSILED WITH DIFFERENT SUBSTRATES

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Abstract

The research was carried out to determine the feed quality of guinea grass ensiled with different substrates using *in vitro* gas production technique. Guinea grass were harvested from the University of Port Harcourt Demonstration grassland, chopped to 2-3cm, wilted and ensiled with cassava peels and plantain peels at equal proportions (%) in three experimental treatments. The treatments are: 100% of ensiled guinea grass (T1), 50% of ensiled guinea grass + 50% of cassava peels (T2) and 50% of ensiled guinea grass + 50% of plantain peels (T3) respectively. The ensiled materials were kept for 21 days. Gas production was continuously measured by incubating samples in buffered rumen fluid from goats for 24 hours. Cumulative gas production was recorded at 3, 6, 9, 12, 15, 18, 21 and 24 hours of incubation periods and kinetics of gas production was described.There was significant difference ($P< 0.05$) in the gas volume produced throughout the 24 hours of incubation. The T2 and T3 had the highest methane reduction. While, organic matter digestibility, short chain fatty acid and metabolizable energy were significantly different ($P<0.05$) across treatments. Thus, ensiling Guinea grass with cassava peels and plantain peels have potentials for reduction in methane emission and effective utilization by ruminants in the tropics during the dry season.

Keywords: cassava peels, fermentation, gas production, guinea grass, plantain peels

Introduction

Nigerian ruminant industry is facing the problem of forage scarcity with high cost of feeds precipitated by inadequate supply of feed ingredients (Lamidi and Akhigbe, 2018). Silage as fermented forage stored under anaerobic condition (Amodu and Abubakar, 2004) is one of the major ways of conserving forages. Fortunately, apart from the conventional forage crops, materials that can be ensiled include fodder, crops and crop residues or by-products ('t Mannetje, 2000). Also, cassava and plantain processing produces large amount of waste (peels) that contributes to environmental pollution when left in the surrounding of processing plants or- left to rot away in the field. These residues can serve as useful source of ruminant animal feed if processed. To identify the most suitable substrate for ensiling guinea grass as feed resources, the use of *in vitro* techniques for feed evaluation in ruminants is now, widely, used and has been accepted due to its ease of adoption, repeatability, minimized use of animals and the decrease in funding for *in vivo* evaluation of feeds (Getacheow *et al*., 2005). Therefore, the study was conducted to identify and determine the nutritive values of guinea grass ensiled with different substrates required to meet the nutrient requirements of small ruminants.

Materials and Methods

Experimental Location

The experiment was carried out in the University of Port Harcourt Research and Demonstration farm, Abuja campus, Obio-Akpo LGA of Rivers State in the South South Zone of Nigeria. It is situated on latitude 4'47'21" North and Longitude 6'59'55" East of the equator with a temperature range of 25 - 28°c and a very high relative humidity and an annual rainfall of about 11000mm to 14000mm (Ukanwoko and Okehielem, 2016).

Preparation of experimental materials

Guinea grass was harvested from the University of Port Harcourt Demonstration Grassland, at 10 cm above ground level, wilted for 24 hours and chopped into 2 – 3cm long pieces. Cassava and plantain peels were collected from identified cassava and plantain peels smallholder farmers within University community and chopped. The guinea grass and cassava and plantain peels were then mixed at different proportions to have three (3) experimental treatments as follows (%):
The treatments are:
T1 = 100% of ensiled guinea grass
T2 = 50% of ensiled guinea grass + 50% of cassava peels
T3 = 50% of ensiled guinea grass + 50% of plantain peels
Air tight buckets with lidswere used as laboratory silos after the materials were mix thoroughly; the buckets were tightly covered to avoid air penetration. Each treatment had three replicates and the ensiled materials were kept at room temperature of 28 to 32ºC for 21 days.

In vitro gas production

The *in vitro* incubation was carried out using 120mL calibrated syringes containing the inoculums (Rumen liquor: buffer, 1:2). 200 mg of substrate was weighed into Ankom bags for the incubation at 39ºC with 30mL of inoculums. The bags were placed inside the syringes before the inoculum was introduced into the syringes. The syringes were fitted with silicon tube and clipped before placing them in the incubator at 39°C. The syringes containing only inoculum served as the blank while the bags containing only the substrate served as the control (i.e. 0% plant extract). The time for the commencement of incubation was noted and the syringes were monitored at three hour intervals for the next 24 hours. For each incubation time, the head space of the syringes were measured and recorded. At 24 hours of incubation, the final readings were taken and the syringes put on ice to stop further gas production (Babayemi *et al.,* 2006).

Determination of post *in vitro* fermentation parameters

The sealed Ankom bags containing the sample were taken out from the syringes, washed with water until the water becomes clear and oven dried at 100°C to constant weight and the dry matter determined expressed as the percentage of the original sample weight to calculate dry matter degradability (DMD) formula below.

$$\text{DMD \%} = \frac{\text{Wt of sample before incubation} - \text{Wt of sample after incubation}}{\text{Wt of sample before incubation}} \times \frac{100}{1}$$

The Fermentation Efficiency (FE) and effect of methane reduction (CH_4red %) were calculated using the following formulas

$$\text{Fermentation Efficiency (FE)} = \frac{\text{Dry Matter Digestibility (mg/kg)}}{\text{Total Gas Volume (mL/g)}}$$

$$CH_4\text{red (\%)} = \frac{\text{Average } CH_4 \text{ of the control} - CH_4 \text{ of treated sample}}{\text{Average } CH_4 \text{ of the control}} \times \frac{100}{1}$$

The post incubation parameters such as metabolisable energy (ME), Organic matter digestibility (OMD), Gas volume and short chain fatty acids (SCFA) were estimated using the equation below:

$ME = 2.20 + 0.136\ GV + 0.057\ CP + 0.00029\ CF$

$OMD = 14.88 + 0.88\ GV + 0.45\ CP + 0.651\ XA$

$SCFA = 0.0239\ GV – 0.0601$

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) using General linear model procedure of Statistical Package for the Social Sciences (SPSS) (Version 16.0).

Results and Discussion

Table 1 shows the volume of gas production at different hours of incubation for ensiled guinea grass with different substrates. The gas produced increased and differed significantly ($P<0.05$) from the 3rd hour to the 24th hour of incubation. The T3 produced the highest gas volume (14.67±2.18m^3) during 24th hour of incubation, while T2 recorded the least gas volume (10.00±2.18m^3) at the 24th hour of incubation. The gas production is a nutritionally wasteful product (Mauricio *et al.*, 1999), but, provides a useful basis from which ME, OMD and SCFA may be predicted (Fajemisin *et al.*, 2015).

Table 1: Volume of gas production (m^3) at different hours of incubation of ensiling guinea grass with different substrates

INCUBATION HOURS	T1	T2	T3
3 HOURS	2.00±0.39^{b}	2.00±0.39^{b}	2.67±0.39^{a}
6 HOURS	6.00±1.02^{b}	6.67±1.02^{a}	6.00±1.02^{b}
9 HOURS	8.00±1.02^{a}	7.33±1.02^{b}	8.00±1.02^{a}
12 HOURS	9.33±0.67^{b}	7.33±0.67^{c}	11.33±0.67^{a}
15 HOURS	10.00±0.77^{b}	8.00±0.77^{c}	12.67±0.77^{a}
18 HOURS	12.67±1.76^{b}	9.33±1.76^{c}	13.33±1.76^{a}
21 HOURS	12.67±1.76^{b}	9.33±1.76^{c}	13.33±1.76^{a}
24 HOURS	12.67±2.17^{b}	10.00±2.18^{c}	14.67±2.18^{a}

a b c= Means within same row with different superscripts are significantly different [$P<0.05$]. T1=100% Guinea Grass, T2=50% guinea grass + 50% Cassava peels, T3=50% guinea grass + 50% Plantain peels

Table 2 shows significant differences ($P< 0.05$) in methane (CH_4), methane gas volume, methane reduction, short chain fatty acids (SCFAs) production, metabolizable energy and organic matter digestibility. T1 (7.33±0.67ml) was the highest producer of methane gas, while T2 and T3 had low production of methane gas. Reduction in methane was higher in T2 and T3 than in T1 (26.67±6.67ml). T3 (0.40±0.05 mL/200mgDM) had the highest short chain fatty acids. Organic matter digestibility was higher in T3 (45.02±1.76%), than in T2 (39.45±1.76%) and T1 (37.96±1.76%) respectively. The high production of methane will lead to an increase in global warming. Meanwhile, the higher preponderance of SCFA in T3 probably showed an increased proportion of acetate and butyrate, but, may mean a decrease in propionate production (Babayemi *et al.*, 2006).

Table 2:Post *in vitro* parameters of ensiling guinea grass with different substrates

PARAMETERS	TI	T2	T3
Methane (mL)	7.33±0.67[a]	6.67±0.67[b]	6.67±0.67[b]
Methane gas	0.61±0.04[a]	0.52±0.04[b]	0.36±0.04[c]
Methane reduction	26.67±6.67[b]	33.33±6.67[a]	33.33±6.67[a]
Fermentation efficiency	1.35±0.28[a]	0.63±0.28[c]	0.94±0.28[b]
Short chain fatty acid (mL/200mgDM)	0.27±0.05[b]	0.27±0.05[b]	0.40±0.05[a]
Metabolisable energy (MJ/kg DM)	4.85±0.28[c]	5.00±0.28[b]	6.04±0.28[a]
Organic matter digestibility (%)	37.96±1.76[c]	39.45±1.76[b]	45.02±1.76[a]

a b c= Means within same row with different superscripts are significantly different [P<0.05]. T1=100% Guinea Grass, T2=50% guinea grass + 50% Cassava peels, T3=50% guinea grass + 50% Plantain peels

Conclusion and Recommendation

All experimental treatments are good sources of short chain fatty acids. The T2 (50% Ensiled guinea grass + 50% Cassava peels) and T3 (50% Ensiled guinea grass + 50% Plantain peels) has the potential to reduce methane emission. Hence, environmental nuisance caused by cassava and plantain peels can be mitigated by ensiling cassava and plantain peels withguinea grassfor dry season feed.

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