
RUMEN METABOLITES AND MICROBIAL COUNT OF WEST AFRICAN DWARF GOATS FED GUINEA GRASS (*PANICUM MAXIMUM*) GROWN WITH DIFFERENT ORGANIC MANURE SOURCES

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ABSTRACT

This study was conducted to investigate rumen metabolites and microbial counts of West African Dwarf goats fed Guinea grass grown with different organic manure sources. Sixteen (16) female West African Dwarf goat of about 5-6 months with average weight of 6.50 ± 0.25 were randomly assigned to four treatments with four replicates in a Complete Randomized Design (CRD). 60% Panicum maximum grown with different organic manure and 40% concentrate were allotted as the diet 1 (control), diet 2, 3 and 4. respectively. Rumen parameters (pH, ammonia nitrogen, acetic acids, butyric acids, propionic acids and total volatile fatty acids) were significantly different ($p < 0.05$) among dietary treatments except temperature. All microbial parameters were significantly ($P > 0.05$) influenced by the experimental diets. Microbial counts were significantly ($p < 0.05$) influenced by dietary treatments. Higher count was observed in goats fed 60% Panicum maximum and 40% concentrate diet. The value was also significantly ($P > 0.05$) higher in goats fed 60% Panicum maximum grown with cattle manure and 40% concentrate diet. The use of organic fertilizer to grow pasture grass has the potentials to support favourable rumen ecology for better productivity of goats.

Keyword: Goats; *Panicum maximum*; rumen; microbial; organic.

INTRODUCTION

Ruminant animal production faces serious threats due to seasonal fluctuations of available feed resources. As important and productive as small ruminants, they often experience feed shortage particularly during the off-seasons. This results to low productivity in the tropics (Arigbede *et al.*, 2005). Guinea grass (*Panicum maximum*) is common forage in the tropics. It is one of the best fodders in the tropics and relished by goats at all stages. Its persistent growth and quality when managed properly makes it important in ruminant production (Olanite *et al.*, 2014). Being one of the most important fodder crops in the tropics, application of specific amounts of organic manure at precise times is necessary in order to maximize yield and quality. According to Olasupo *et al.* (2016), applying organic manure directly to the soil helps maintain an acceptable quantity of organic matter, which is an important component of soil fertility and production. The rumen is a sophisticated ecosystem where anaerobic digestion of nutrients by rumen microbes takes place. Therefore, this study was carried out to investigate rumen parameters and microbial count of West African Dwarf goats fed *Panicum maximum* grown with different organic manure.

MATERIALS AND METHODS

The feeding trial was conducted at Anyigba using the facilities of the Livestock Teaching and Research Farm of Prince Abubakar Audu University Anyigba, Kogi State, Nigeria. The location of the study area lies between Latitude 7° 15' and 7° 29' N of the equator and Longitude 7° 11' and 7° 32' of Greenwich Meridian. It has a bimodal rainfall pattern with the peak occurring in July and September. The mean annual rainfall is 1,808mm, daily temperatures vary from 17°C to 36°C and humidity 65-85% throughout the year (Amhakhian *et al.*, 2010). Guinea grass (*Panicum maximum*) was planted at 25cm x 25cm on different plots with different organic manure application which includes plot 1 (zero manure application), poultry manure (plot 2), swine dung (Plot 3) and cattle dung (Plot 4) respectively. The organic manures were supplied through broadcasting method 2 weeks prior to planting while other agronomic practices were carried out to ensure effective growth. *Panicum maximum* seed were sourced from National Animal Production Research Institute (NAPRI), Zaria, Kaduna State. Forage was harvested 12 weeks after planting and fed to growing West African dwarf goats

Experimental animal and management

Sixteen (16) female West African Dwarf goat kids of about 5-6 months were purchased from Anyigba and environs for a 45 days experiment. The procedure on animal care was conducted according to the guidelines established by the Animal Care Committee of Prince Abubakar Audu University, Anyigba. Adequate vaccination procedures were followed to ensure the animals were healthy for the study. They were randomly assigned to four treatments with four replicates in a Complete Randomize Design (CRD). 60% *Panicum maximum* without manure + 40% concentrate was allotted as Diet 1 (control), 60% *Panicum maximum* grown with poultry droppings + 40% concentrate (Diet 2), 60% *Panicum maximum* grown with swine dung + 40% concentrate (Diet 3), 60% *Panicum maximum* grown with cow dung + 40% concentrate (Diet 4) respectively. Concentrate diet consisted of Cassava peel meal= 40%, Maize bran= 10%, Brewers Dried Waste= 40%, Palm kernel cake= 9%, Limestone= 0.5% and Salt= 0.5%. Goats were fed daily on 5% body weight.

Rumen Fluid Collection and Analysis

About 20mL of the rumen liquor was collected from two (2) replicates per treatment into sample bottles using stomach tube at the end of the feeding trial. The rumen pH and temperature of each sample were determined immediately after collection using the Jenway pH meter, model 3150 and digital thermometer. It then immediately stored in the freezer at -5°C for analysis. Rumen fluid samples were strained through four layers of cheese cloth. Individual volatile fatty acids production was determined using gas chromatography (Mabrahtu and Tenaye, 1997). Volatile fatty acids were analyzed using high performance liquid chromatography method by Matthew *et al.* (1997). Rumen bacteria count was carried out using the procedure outlined by Cheesebrough (2000) while protozoan count was carried out using neubauer hemocytometer (Gurelli, 2014).

Statistical Analysis

Data collected were subjected to one way analysis of variance (ANOVA) with the aid of Statistical Package for the Social Sciences (SPSS 20) computer software package. Significantly different means were separated using the same software with Duncan Multiple Range test at 5% level of significance.

RESULTS AND DISCUSSION

Rumen parameters

Rumen metabolites of West African Dwarf goats fed *Panicum maximum* grown with different organic manure is presented in Table 1. All rumen parameters examined were significantly different ($p < 0.05$) across the treatments except for temperature. All measurements for pH were within the specified range 6.00-7.20, which is ideal for rumen bacteria' optimum development and activity (Jallow and Hsia 2011). The values were comparable to 5.92-6.60 reported by Okoruwa *et al.* (2016) on the rumen metabolites of West African Dwarf Sheep and lower than 7.86-8.70 reported by Binuomote *et al.* (2022) who examined the rumen parameters of West African Dwarf Sheep fed *Panicum maximum* supplemented with varying concentrations of *Gmelina aborea* leaves. The values of $\text{NH}_3\text{-N}$ concentration varied between 9.95-11.51mg/100mL and were significantly different ($p < 0.05$) across the treatments with group fed grass grown with swine manure having the highest value (11.51). This may be a result of the degree of crude protein degradability and nitrogen uptake by the rumen microorganisms in preference to amino acids in animals. However, the ammonia nitrogen levels obtained in this study were within the typical range of 0.130mg/100mL reported by Yusuf *et al.* (2013). Volatile fatty acids in this study were significantly influenced ($p < 0.05$) by the dietary treatments. This is an indication that *Panicum maximum* as basal diet has the potential to influence the level of volatile fatty acids production in the rumen. The values obtained for acetic acid were comparable to 42.03-46.65% reported by Okoruwa *et al.* (2016). According to these authors, the difference observed in acetic acid values might be due to varying levels of the diets. The propionic acid values recorded in this study 16.26-17.45% fell within the values 21.6%-28.8% reported by Suarez *et al.* (2006) in their study on effects of different levels of roughage concentrate dietary treatment on rumen fermentation characteristics. Also the values recorded in this study were not at variant with the reports of Ajagbe *et al.* (2020). Variations in values may be attributed to the physical fibrousness, starch content, and carbohydrate solubility of various dietary treatments employed in various researches. The proportion of the major portions of volatile fatty acid concentration in the

rumen is largely dependent on the kind of feed that the animals eat as pointed out by Dung *et al.* (2011).

Table 1: Rumen metabolites of WAD goats fed *Panicum maximum* grown with different organic manure

Parameters	<i>Panicum Maximum</i> (Zero Manure)	<i>Panicum Maximum</i> (Poultry Manure)	<i>Panicum Maximum</i> (Swine Dung)	<i>Panicum Maximum</i> (Cattle Dung)	SEM	LOS
TEMP (°C)	33.57	35.67	33.25	33.52	0.63	NS
pH	6.50 ^b	6.73 ^{ab}	6.62 ^b	7.02 ^a	0.73	*
NH ₃ -N(mg/100mL)	10.53 ^c	10.90 ^b	11.51 ^a	9.95 ^d	0.14	*
Acetic Acid (%)	46.34 ^c	47.61 ^b	48.91 ^a	44.3 ^d	0.45	*
Propionic Acid (%)	16.74 ^c	17.45 ^a	17.22 ^b	16.26 ^d	0.11	*
Butyric Acid (%)	9.46 ^b	8.81 ^c	8.20 ^d	9.66 ^a	0.14	*
Total Volatile Acid(mmol/L)	84.80 ^c	85.71 ^b	86.62 ^a	84.75 ^d	0.19	*

a,b,c,d= means on the same row with different superscripts are significantly different (P<0.05), NS= Not Significant. SEM= Standard error of mean, LOS= Level of Significance.

Rumen microbial count of West African Dwarf goats fed *Panicum maximum* grown with different organic manure

The result of rumen microbial count of West African Dwarf goats fed *Panicum maximum* grown with different organic manure is presented in Table 2. All the parameters examined in the rumen microbiology were significantly (p>0.05) influenced by the dietary treatments. The rumen bacteria count values ranged from 1.05 x 10⁷cfu/mL to 4.00 x 10⁷cfu/mL. The significantly (P<0.05) higher value was observed for goats fed 60% *Panicum maximum* grown with cattle manure + 40% concentrate diet. The higher rumen bacteria counts observed in the animal group might be responsible for high digestion of more protein and fibre by attaching the plant particle to provide more NH₃-N concentration and total volatile fatty acids which enhance microbial activities. The values observed in this study was higher than 3.20 x 10⁶ cfu/mL-5.20 x 10⁶ cfu/mL reported by Adebayo *et al.* (2017) and 4.00 x 10⁶ cfu/mL – 17.00 x 10⁶ cfu/mL reported by Isah *et al.* (2011) in their study on effect of anti-nutritional factors on rumen bacteria of West African Dwarf goats fed tropical browse species and crop by-products. Values observed for fungi population ranged between 3.20 x 10⁴cfu/mL and 9.10 x 10⁴cfu/mL. Although the value was highly significant (P>0.05) in goats fed 60% *Panicum maximum* grown with cattle manure + 40% concentrate diet. The values were lower than 6.85 x 10⁴cfu/mL-9.45 x 10⁴cfu/mL reported by Olajide (2018) and 0.05 x 10⁶cfu/mL-0.35 x 10⁶cfu/mL reported by Adebayo *et al.* (2019). Protozoan population ranged between 2.64 x 10⁵cfu/mL and 6.70 x 10⁵cfu/mL. Goats fed 60% *Panicum maximum* grown with poultry manure + 40% concentrate diet had the higher significant (P>0.05) in protozoan population. The values were higher than 0.25 x 10³cfu/mL-0.68 x 10³cfu/mL reported by Adebayo *et al.* (2019). Variations in microbial populations as reported by different authors might be attributed to chemical composition of the experimental diets administered to the experimental animals.

Table 2: Rumen Microbial Count of West African Dwarf goats fed *Panicum maximum* grown with different organic manure.

Parameters (cfu/mL)	<i>Panicum Maximum</i> (Zero Manure)	<i>Panicum Maximum</i> (Poultry Manure)	<i>Panicum Maximum</i> (Swine Dung)	<i>Panicum Maximum</i> (Cattle Dung)	SEM	LOS
Bacteria (x10 ⁷ cfu/mL)	1.800 ^b	1.05 ^b	1.35 ^b	4.00 ^a	0.48	*
Protozoa (x10 ⁵ cfu/mL)	3.52 ^c	6.70 ^a	2.64 ^c	4.57 ^b	0.64	*
Fungi (x10 ⁴ cfu/mL)	3.20 ^b	4.23 ^b	3.92 ^b	9.10 ^a	0.77	*

abcd= means on the same row with different superscripts are significantly different (P<0.05), , Standard Error Mean, LOS= Level of Significance.

CONCLUSION

This study showed that feeding organically grown *Panicum maximum* with concentrate supplements to ruminant has the potential to support optimum rumen ecology in goats. Also, adequate forage-concentrate ratio (60:40) gives better results for production of volatile fatty acids.

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