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EVALUATION OF THE POTENTIAL OF *PANNICUM MAXIMUM* FORAGE ON GUT MICROBIAL POPULATION OF PIGS

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ABSTRACT

The gut of pigs is the foundermental organ which plays an important role in digestion and host defence. A trial was conducted to determine the potential of fresh *Panicum maximum* forage using pigs. A total of 30 grower pigs at average weight of 18kg were used in the 63 days feeding trial. The pigs were allocated to five treatment groups in a completely randomized design with treatments having three replicates of two pigs each. The experimental diets (T_1 , T_2 , T_3 , T_4 and T_5) were formulated with varying levels of inclusion of *Panicum maximum* forage. T_1 served as the control while T_2 , T_3 , T_4 and T_5 had 0, 5, 10, 15 and 20% levels of fresh forage respectively. Feed and water were given ad-libitum. The parameters taken were segmental gut contents from the stomach, caecum and colon which were collected by dissecting the segments. The contents from the segments were collected in a plane sterile tube and taken to the laboratory for microbial gut population count. Results from the treatments showed that the numerical values of these beneficial microbes significantly ($p < 0.05$) increased in the forage treated groups when compared with the control. This trial therefore concludes that dietary inclusion of *Panicum maximum* forage in pigs can influence the beneficial microbial gut population, thereby helping in the production of digestive organisms, synthesis of vitamin B and possibly immune stimulation. It is therefore, recommended that pig farmers should include grass forages in the diet of pigs for improved gut health.

INTRODUCTION

The challenges of monogastric farm animals in digesting high fibre content diets, have been of great concern to livestock and poultry nutritionists. Recent understanding of the beneficial gut microbes and identification of marker linked to favour gut condition has been of tremendous assistance in handling this difficult situation (Callay *et al.*, 2003)

Available information shows that gut microbes can increase the efficiency of transforming high fibre diets into animal products, this can be maximized using lower energy and protein density diets than the so-called optimal diet with the aim of improving nitrogen retention and also reduce protein cost (Anya *et al.*, 2010). Various intestinal regions of pig have different structural elements that provides optimal condition for the digestion and absorption processes in the digestive tract. Johansen and Bach Knudsen (1994) reported that large dietary inputs and the secretion from the stomach, intestine, pancreas, and gall bladder determines the composition of the digest in the stomach and the upper part of the small intestine. The animal relies on the microbes in their gut to digest and ferment the plant biomass to provide energy in the short chain volatile fatty acids (VFA) and protein yielding nutrients that support animal maintenance, growth, and lactation. It has also been reported that the population of useful bacteria like lactobacillus in the

gut increased the pH of the gastrointestinal tract (GIT) due to increased production of VFA (Ziggers, 2000). Forage has been reported to be helpful in the development of digestive tract, particularly the large intestine. Jorgensen *et al.*, (1996) in their trial found that grower pigs fed on high forage diet had a significantly heavier caecum and colon, and the gut content were also heavier than pigs fed on low forage diet. Plaske *et al.*, (1998) found that carcass yield was reduced to 0.025g for each additional gramme of forage. In another development, Ogle (2006) observed that dressing percentage, over two percentage units is lower in pigs given a high fibre diet containing 300g/kg neutral detergent fibre (NDF) when compared with those given lower fibre diet (200g/kg NDF). In another trial, he observed that all fibre digestion take place in the caecum and colon where bacteria break down fermentable carbohydrates that have escape digestion in the stomach and small intestine to produce VFA. The aim of this study, therefore, is to evaluate the effect of panicum maximum (guinea grass) forage on beneficial microbes in the gut of grower pigs.

Location of Study:

The experiment was conducted at the piggery unit of the teaching and research farm of college of animal science and animal production, Michael Okpara University of Agriculture, Umudike, Abia State

Nigeria. Umudike is located at latitude 5°29¹N and longitude 7°32¹E at an altitude of 82.4m above sea level (GPS,2022) the area falls within the rainforest zone having an average mean annual rainfall of 2000mm, relative humidity during raining season of 50-75% and characterized by daily temperature range of 27-35°c all through the years.

Source of experimental pigs and Design.

A total of thirty (30) grower pigs (Landrace x Large white) purchased from the University livestock farm were used for the feeding trial. The pigs were 120 days old, with initial average weight of 18kg. They were randomly distributed into five dietary treatments replicated three times with two pigs per replicate in a

completely randomized design (CRD) in the model shown thus:

Model: $T_{ij} = \mu + T_i + e_{ij}$

Where, T_i = Overall mean

μ = Individual mean

T_i = Treatment effect

e_{ij} = Error

Procurement and Processing of Test Ingredients

The grass forage used for the study was obtained from the vicinity of the university. The fresh forages cut at the blossom stage, was chopped into small sizes and incorporated into a formulated diet (concentrate) at 0, 5, 10, 15 and 20% at supplementary levels, the forage was analysed in the laboratory to determine the chemical composition shown in table 1.

Table 1 Chemical composition of *Panicum maximum*

Composition	<i>Panicum maximum</i>
Dry matter (%)	85.96 ± 0.69
Crude protein (%)	7.35 ± 0.69 ^b
Ether extract (%)	5.78 ± 0.73 ^a
Crude fibre (%)	37.30 ± 0.94 ^a
Crude ash (%)	12.00 ± 0.58
Nitrogen free extract (%)	23.53 ± 1.17 ^b
GE (kcal/kg)	4.87 ± 0.17 ^a

Experimental diets.

Five experimental diets were formulated to meet the nutritional requirements of pigs as shown in Table 2. Diet 1 serves as control while diets 2, 3, 4 and 5 contained 5, 10, 15and 20% of fresh forage respectively.

Housing and Management of Pigs

The pigs were housed in an open-sided pig house roofed with asbestos roofing sheet. The open sides of the building were covered with expanded metal and iron net to prevent flies and other insects from entry. Each pen measuring 2m x 7m replicated into three, housed two pigs each. The pens had a dwarf wall each of 120cm separating each other on a concrete floor.

Each of the pens had a wallow, feeder, and watering troughs, all made of concrete and a dung area.

Two weeks before the commencement of the trial, the pens were washed, disinfected, and fumigated with formalin. On arrival, the pigs were given the formulated ration for a period of two weeks, within this period, broad spectrum antibiotics, multi-vitamin and deworming drugs were administered to keep the animals fit for the trial. The pigs had adjustment period of two weeks after which they were feed daily at 8.00 hours and 16 hours at 4% of their body weight. Water was provided both in the wallow and drinking troughs throughout the management period.

Table 2. Composition of Experimental Diets Supplemented with Grass Forage

Ingredients	T ₁	T ₂	T ₃	T ₄	T ₅
Concentrates (%)	100.00	95.00	90.00	85.00	80.00
Grass (%)	0.00	5.00	10.00	15.00	20.00
Total	100.00	100.00	100.00	100.00	100.00
Analysed Composition					
Dry Matter (%)	86.16	86.70	86.98	86.34	85.33
Crude Protein (%)	20.18	19.54	18.90	18.25	17.61
Ether Extract (%)	3.76	3.86	3.96	4.61	4.17
Crude Fibre (%)	5.38	6.95	8.57	10.17	11.76
Ash (%)	9.5	9.63	9.75	9.88	10.00
Nitrogen Free Extract (%)	54.47	54.51	54.30	54.04	53.05
Gross Energy ((kcal/kg)	4.00	3.97	3.94	3.90	3.87

Microbiology

For each of the treatment groups, three pigs were randomly selected for microbial gut count. They were slaughtered and the intestine removed using a surgical blade, the gut contents from the stomach, caecum and colon were collected by dissecting the segments. The gut contents collected were then placed in a plane sterile tube and taken to the laboratory for microbial population count.

Isolation and Characterization of Micro-Organisms from Samples.

1g from the sample was weighed out on a mettle sensitive balance scale. A plastic rack was arranged with sterile test tubes containing 9ml of sterile distilled water. A 10-fold serial dilution (Fawole and Oso, 1988) was done by dispensing the weighed sample (1g) into the first test-tube (10^{-1}) shaken together. 1ml was taken with the aid of sterile pipette and transferred into the next test tube (10^{-2}). Each test-tube was shaken vigorously before each transfer.

Inoculation

A pour plate method (Fawole and Oso, 1988) was employed in plating on the sample. 1ml from dilution 10^{-3} was dropped into a sterile petric dish with the aid of a sterile pipette. A molten nutrient agar was poured into the plates (about 10ml). The plate was rotated clockwise for easy mix up of the sample and the media and all plates duplicated. All the inoculated plates were transferred into an incubator at 37°C for 18-24hrs.

Subculture and Purification

After incubation period, discrete colonies from the bacteria plates were picked with flame wire loop and sub-cultured onto a newly prepared nutrient agar plate. All subculture plates were later transferred into an incubator at 37°C for 24hrs. Purified colonies were

transferred into slants and stored in refrigerator at 4°C for characterization.

Statistical analysis

Data collection from the experiment were subjected to analysis of using the general procedure of (SAS, 2001). Significant differences among treatment means were separated using Duncan's Multiple Range Test as described by Steel and Torrie (1980).

Results and Discussion

The results of *Panicum maximum* forage on the microbial gut population in various segments of the gastrointestinal tract of pig is shown in Table 3. Its inclusion in the diet of pig significantly ($P < 0.05$) increased the population of microbes in the stomach, caecum, and colon, with treatment groups supplemented at 10, 15 and 20% respectively. The treatment group with little or no forage had low microbial population. The control group (0.0% forage) had the lowest gut microbial population. Their population increased from the stomach down to the distal small intestine and further to the colon. This result agreed with the observation by Bach Knudson (2001) and Jensen and Jorgensen (1994) who reported that gastrointestinal tract of pigs densely populated with bacteria increased from the stomach to the distal small intestine and further to the colon. The presence of these microbes may have contributed to the positive influences observed in the apparent nutrient digestibility which was reported in the trial. Ziggers (2000) in his finding, reported that the population of these beneficial bacteria like lactobacillus in the intestine increased the pH of the gastrointestinal tract due to increasing production of volatile fatty acid, hence the environment of the system becomes unsuitable for the activities and multiplication of pathogen. In another observation, Nurmi and Rantala (1973) stated that pathogen could be expelled out of the gut by useful bacteria if it is already occupied in

the gut site. Micro flora in the gut of young birds could inhibit further colonization of pathogens.

Table 3: Effects of grass forage on the microbial gut population of pigs.

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	SEM
Stomach ($\times 10^3$ cfu/ml)	4.50 ^c	5.40 ^b	6.32 ^a	6.42 ^a	6.39 ^a	0.14
Caecum ($\times 10^3$ cfu/ml)	4.25 ^c	5.42 ^b	6.40 ^a	6.70 ^a	6.80 ^a	0.12
Colon ($\times 10^3$ cfu/ml)	6.90 ^b	7.20 ^{ab}	7.22 ^{ab}	7.60 ^{ab}	7.83 ^a	0.15

a-b means along the same row with different superscripts are significantly ($P < 0.05$) different. SEM = Standard Error of Mean

Conclusion

The study showed that dietary inclusion of fresh *Panicum maximum* forage in the diet of pigs increased their beneficial microbial gut population in stomach, caecum and colon, also enhanced growth of pig treatment in the group. Farmers are therefore encouraged to include forage in the diets of their growing pigs.

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