Growth Performance and Intestinal Biometrics of Pigs Administered *Piper guineense* Seed Powder

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Abstract
There is need for the use of non-synthetic materials which are considered safer than synthetic drugs in animal production. A total of 40 large white male weaner pigs of average age of ten weeks were used to evaluate the effects of *Piper guineense* seed powder (PGSP) on their growth and intestinal biometrics. The pigs were grouped into four experimental groups replicated 5 times to contain 2 pigs per replicate. The groups were randomly allocated to four treatments: T_1, T_2, T_3, and T_4 containing 0.0, 0.3, 0.6, and 0.9% PGSP per 100 kg feed, respectively. PGSP significantly ($p<0.05$) increased total weight gain in T_2 and T_3. Total feed intake significantly ($p<0.05$) decreased in T_4. Feed conversion ratio significantly ($p<0.05$) improved in T_3 and T_4. Goblet cell count increased ($p<0.05$) in T_3 and T_4. The results of this study showed that the PGSP has the potentials to enhance growth and goblet cell count especially when administered at 0.3 and 0.6% levels. Therefore, the administration of *Piper guineense* seed powder as feed additive in male pig production should be limited to 0.6% level.
Key words: Growth performance, Goblet cell count, Pig. *Piper guineense*.

Introduction

The use of synthetic drugs and preparations in animal production to enhance productivity poses some health hazards to the animal and human consumers as they have been reported to cause antimicrobial resistance, disruption of intestinal normal flora, cancer and other health challenges due to the harmful residues these synthetic preparations leave on the animals and animal products (Ture *et al*., 2019). Therefore, there is need for the use of natural non-synthetic materials or preparations which are considered safer for consumption or have minimum side effects than synthetic products to enhance productivity in animal production.

Some of these natural non-synthetic materials are plant materials which have been used by man for centuries for medicinal purposes (Bauer and Veličkovska, 2025) due to their antioxidative, anti-inflammatory, antidiabetic, antihypertensive and antimicrobial activities (El-Sayed and Youssef, 2019). The medicinal effects of these plants are attributed to the bioactive compounds they contain such as flavonoids, alkaloids, tannins, steroids, saponins, pectins, glycosides, organic acids and phenolic compounds (Kuralkar and Kuralkar, 2021).

Researchers are now exploring alternative natural feed additives to improve productivity. This is because animal product consumers are aware of these hazards associated with animals produced with synthetic drugs and as such, prefer animal products produced without synthetic drugs (Radzikowski and Milczarek, 2022). Various natural substances, basically herbs and spices of plant origin are being explored in this area.

One of the spices which may be of importance is the seed of *Piper guineense*. It is commonly used as a spice in West Africa. Its common English names include West African black pepper, guinea pepper, ashanti pepper, benin pepper, and false cubeb (Alagbe *et al*., 2021). The seeds are also usually added to the food of lactating mothers during postpartum period as it encourages or stimulates uterine contraction and return of uterine muscles to the original shape (Okwunodulu *et al*., 2023)

Piper guineense has been successfully used to enhance performance of animals such as rats, guinea pigs, rabbits and birds but unfortunately, there is a dearth of reports on the utilization of *Piper guineense* seed on male pigs. Therefore, this research was designed to determine the growth performance, and intestinal biometrics of pigs administered *Piper guineense* seed powder.

Materials and methods

The research was done at the Piggery Unit of the Teaching and Research Farm of Federal University of Technology Owerri, Imo State, Nigeria. Imo State is located in the Southeastern agro-ecological zone of Nigeria, which lies between latitude $4^0 4'$ and $6^0 3'$ N, and longitude $6^0 15'$ and $8^0 15'$ E. Owerri is about 100m above sea level with mean annual rainfall of 2500 mm, humidity of 70–80%, and temperature of 26.5–27.5 °C (Iwuji *et al*., 2018)

Preparation of *Piper guineense* seed powder

The *Piper guineense* dry seeds were obtained from a reputable dealer in Relief Foodstuffs Market, Owerri, Imo State. The Identification and authentication of the seeds were done at the Department of Crop Science and Technology, Federal University of

Technology Owerri, Imo State. The seeds were ground to powder using the Lab Willey Grinder Arthur H. Thomas Type and then stored in a screw capped plastic container to avoid moisture before using it as additive in the feed formulation.

The experimental pigs and their management

A total of 40 male large white growing pigs of average age of ten weeks were used for this experiment. The pigs were housed in an open-sided pig house roofed with asbestos roofing sheet with each pen measuring 2 m × 4 m. The pigs were divided into four experimental groups on weight equalization basis with each group containing ten (10) pigs, and replicated five (5) times to contain 2 pigs per replicate. A standard diet (Table 1) was formulated for the experimental pigs, while the treatments comprised T_1 (control), T_2, T_3, and T_4, representing 0.0, 0.3, 0.6, and 0.9 kg of *Piper guineense* seed powder respectively as additive to the standard diet of 100 kg. This also represents 0.0, 0.3, 0.6, and 0.9% of the standard diet, respectively. The four experimental groups were then randomly assigned to the four (4) treatments.

Table 1: Composition of the experimental standard diet

Ingredients	Composition (% DM)
Maize	30.00
Cassava chip meal	18.00
Palm kernel cake	20.00
Brewers spent grain	5.00
Groundnut cake	8.65
Soybean meal	15.00
Bone meal	2.50
Vit/Min premix*	0.25
Sodium Chloride	0.30
Lysine	0.20
Methionine	0.10
Total	100
Calculated composition:	
Crude protein (%)	18.47
Metabolizable energy (ME) (Kcal/kg)	2833.23
Crude fibre (%)	6.55

*Vitamin/Mineral Premix: To provide; Vit. A. 5,500,000 IU, Vit D3. 1500,000 IU, Vit E. 10,000 (mg), Vit. k3 1,500 mg, Vit. B1, 1,600 mg, Vit. B2 24,000mg, niacin 20,000 mg, pantothenic acid 5,000 mg vit B6 1,500 mg, Vit. B12 10 mg, folic acid 500 mg, Biotin H2 750 mg, chlorine chloride 175,500 mg, cobalt 200 mg, copper 300 mg, io dine 1,000 mg, iron 20,000 mg, manganese 40,000 mg, selenium 200 mg, zinc 30,000 mg, antioxidant 1,250 mg.

Data collection

Growth performance

Growth performance parameters evaluated include final body weight, daily feed intake, body weight gain, feed conversion ratio (FCR) and mortality. Before commencement of the treatments, weights of the pigs were measured and recorded as the initial weights and thereafter measured weekly and recorded as weekly weights. The measured weights of the pigs at the end of the experiment were recorded as final body weights. Body weight gain was calculated as the difference between the final body weights and the initial body weights of the pigs. Daily feed intake was calculated by subtracting the leftover feed from the feed offered to the pigs on daily basis, while FCR was calculated as the weight (g) of feed consumed divided by the weight (g) gained by the pigs. The growth indices were measured for the first 90 days of the experiment.

Intestinal biometrics

Prior to slaughtering, the pigs were given only drinking water for 12 hours. Five pigs were randomly selected from each treatment, one from each replicate, slaughtered and cut open through the abdominal region to obtain the different segments of the small and large intestines. These intestines were fixed in 10% formalin for histological examination. The intestinal biometrics were evaluated following the procedure reported by Lee *et al*. (2021). The evaluation of the intestinal biometrics was done at the end of 180days of the experiment.

Results

Growth performance

The growth performance parameters of the male growing pigs are presented in Table 2. Final weight was highest ($p<0.05$) in T_3 followed by T_2 which recorded a similar ($p>0.05$) value with pigs on T_4. Pigs on T_4 had similar ($p>0.05$) final body weight

with those on T_1. Total weight gain followed the same trend with final weight. Daily weight gain in T_3 was significantly ($p<0.05$) higher than in T_1 but similar ($p>0.05$) to T_2 and T_4 which were similar to T_1. Daily feed intakes of pigs on T_1 and T_2 were significantly ($p<0.05$) higher than T_4 but similar to the value recorded in pigs on T_3. Pigs on T_3 also had similar ($p>0.05$) daily feed intakes with pigs on T_4. Total feed intakes of pigs on T_1, T_2 and T_3 showed no significant ($p>0.05$) difference but are significantly ($p<0.05$) higher than the value recorded in T_4. Feed conversion ratio of pigs on T_1 was significantly ($p<0.05$) higher than the values recorded in T_3 and T_4 but similar ($p>0.05$) to feed conversion ratio in T_2. Pigs on T_2 also had similar ($p>0.05$) FCR to those on T_4. No mortality was recorded in any of the treatments.

Table 2: Growth Performance Indices of Growing Pigs Administered *Piper guineense* Seed Powder

Parameter (Kg)	T_1	T_2	T_3	T_4	SEM
Initial weight	12.21	12.00	11.93	12.30	0.49
Final weight	45.42^{c}	47.33^{b}	49.67^{a}	47.01^{bc}	0.49
Total weight gain	33.21^{c}	35.33^{b}	37.74^{a}	34.71^{bc}	0.53
Daily weight gain	0.37^{b}	0.39^{ab}	0.42^{a}	0.38^{ab}	0.01
Daily feed intake	1.26^{a}	1.24^{a}	1.23^{ab}	1.18^{b}	0.01
Total feed intake	113.40^{a}	111.60^{a}	110.70^{a}	106.20^{b}	0.88
FCR (kg feed/kg gain)	3.41^{a}	3.18^{ab}	2.92^{c}	3.11^{bc}	0.06
Mortality (Counts)	0.00	0.00	0.00	0.00	-

abc: Means within a row with different superscripts are significantly ($P<0.05$) different. T_1 = 0.0% *Piper guineense* seed powder, T_2 = 0.3% *Piper guineense* seed powder, T_3 = 0.6% *Piper guineense* seed powder, T_4 = 0.9% *Piper guineense* seed powder, FCR= Feed conversion ratio, SEM = Standard error of means.

Intestinal biometrics of the adult pigs

The intestinal biometrics of the male growing pigs is presented in Table 3. Apart from goblet cell count, all other parameters measured did not show significant ($p>0.05$) difference among the treatment means. Goblet cell count increased in pigs on T_3 and T_4 while those on T_2 recorded a similar value with pigs on T_3 and T_1.

Table 3: Intestinal Biometrics of the Adult Pigs Administered *Piper guineense* Seed Powder

Parameter	TI	T2	T3	T4	SEM
Villus HT (mm)	1.55	1.53	1.65	1.60	0.04
Villus WTH (mm)	0.70	0.80	0.94	0.63	0.06
Crypt depth (mm)	1.11	1.01	1.06	1.10	0.02
VH/CD Ratio	1.40	1.52	1.56	1.46	0.06
GCC/100 HPF	30.00^{c}	32.00^{bc}	36.00^{ab}	39.00^{a}	1.16

abc: Means within a row with different superscripts are significantly ($P<0.05$) different. T_1 = Control treatment, T_2 = 0.3% treatment, T_3 = 0.6% treatment, T_4 = 0.9% treatment, SEM = Standard error of means, GCC = Goblet cells count.

Discussion

Growth performance indices

Growth performance is a good indicator of both an animal's health and the quality of the feed consumed (Baris, 2023). The improved weight gain recorded in pigs administered *Piper guineense* seed powder also reflected on the final body weight of the animals. This improvement could be attributed to piperine, the main bioactive component of *Piper guineense* seed which has been reported to improve feed efficiency and body weight gain (Shin *et al*., 2023). This is evidenced in the better feed conversion ratio recorded in the *P. guineense* treated pigs leading to improved body weight. Piperine improves digestion by stimulating an increase in the production of pancreatic lipase, amylase, proteases, and intestinal digestive enzymes (Raghunath *et al*., 2024), thus, leading to increased feed utilization, nutrient availability and absorption (Albaqami, 2024). Furthermore, Albaqami (2024) reported an increase in the digestive enzymes of whiteleg shrimp fed 0.5–2 gm/kg of dietary piperine leading to increase in nutrient digestion and aborption and as such, improved the feed conversion ratio and body weight gain. However, the slight decline in total weight gain and final weight in pigs on T_4 though similar to the weight recorded in T_2 and T_1 could be attributed to dose effect as pigs on T_4 received the highest dose (0.9%) of *Piper guineense* seed powder which translates to a higher piperine intake. Du *et al*. (2020) reported a decrease in the final body weight of mice administered high dose (30 mg/kg) of piperine in contrast to 15mg/kg which did not decrease the final

body weight. The reduction in the feed intake of pigs on T_4 (0.9%) could be also be attributed to dose effect since the pungency and biting taste of piperine is expected to be more in T_4 (0.9%) than other treatments, thus reducing voluntary feed intake which may have affected the weight gain. Previous studies also attributed this decrease in feed intake to the pungency and biting taste of piperine contained in *Piper guineense* seed (Obadire *et al*., 2023). The findings of this study is in line with the findings of Effiong and Ochagu (2019) who reported a decrease in feed intake of broiler chickens fed 0.6% *Piper guineense* seed powder while improving the weight gain and feed conversion ratio.

Intestinal biometrics

The increase in the goblet cell count of pigs administered *Piper guineense* seed powder may be an indication of the ability of *Piper guineense* seed to maintain a healthy gut. This is because the primary function of goblet cells is to secrete mucin to lubricate the digestive tract and create a mucus layer that constitutes a protective barrier against pathogens, physical and chemical attacks while harbouring symbiotic gut bacteria adapted to live within the mucus (Tonetti *et al*., 2024). They are also involved in immunoregulation (Tonetti *et al*., 2024). *Piper guineense* seed is known for its ability to maintain healthy gut as well its anti-microbial effect on animals (Huang *et al*., 2020; Ogbuewu and Mbajiorgu, 2023). Therefore, the *Piper guineense* seed powder may have induced more production of goblet cells in the treated pigs as part of its mechanism of action in maintaining healthy gut since the pigs administered *Piper guineense seed* powder in this study generally showed higher weight gain especially those on 0.3 and 0.6% of the seed powder. It has been reported that both the quantitative and qualitative characteristics of mucin are essential for optimal mucosal protection (Tonetti *et al*., 2024). Healthy gut promotes optimal growth, normal and stable microbiota, effective immune status, and nutrient utilization efficiency (Vasanthakumari *et al*., 2023). The result of this study agrees with the findings of Malintha *et al*. (2023) who observed an increase in the goblet cell count of olive flounder fishes fed dietary piperine which is a major phytochemical found in *Piper guineense* seed. Therefore, this increase in goblet cell count can be attributed to piperine since dietary piperine increased goblet cell count in olive flounder fish (Malintha *et al*., 2023).

Conclusion

The result of this study showed that the dietary *Piper guineense* seed powder has the potentials to enhance growth and intestinal goblet cell count especially when administered at 0.3% and 0.6%. Therefore, dietary *Piper guineense* seed powder can be administered to male pigs to enhance growth and intestinal goblet cell count. However, the administration of *Piper guineense* seed powder to male pigs should be limited to 0.6% inclusion level.

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