

Performance, Nutrient Digestibility and Carcass Traits of Weaned Pigs as Affected by Dietary Guinea Hen Weed (*Petiveria alliacea*) Leaf Meal Supplementation

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Abstract

The need for the production of meat without residues of chemical arising from antibiotic use which impact human health negatively necessitates the search for alternatives to antibiotic growth promoters. A ten-week study was conducted to evaluate the effects of Guinea hen weed (*Petiveria alliacea*) leaf meal (PALM) on growth performance, nutrient digestibility, and carcass characteristics of weaned pigs. Thirty-six weaned pigs (Large White × Landrace), aged ten weeks with an initial weight of 8 ± 0.1 kg, were randomly assigned to four dietary treatments. The control group (T1) received a standard maize-soybean-based diet, while groups T2, T3, and T4 were supplemented with PALM at 0.50%, 0.75%, and 1.00%, respectively. Performance data were collected weekly. Apparent nutrient digestibility was assessed in week eight, and carcass traits were measured at week ten. Pigs fed 0.50% PALM supplemented diet (T2) showed significantly ($P < 0.05$) higher final weight (FW), greater weight gain, and better feed conversion ratio. Feed intake was higher ($P < 0.05$) in pigs fed 0.75% and 1.00% PALM (T3 and T4). Dry matter digestibility (DMD) was significantly improved in T3 and T4, while crude protein digestibility (CPD) was higher in T4 than those in T1 and T2 but similar to those in T3. Live and slaughter weights were higher in T2 pigs than other treatments. Fore and hind trotters were heavier in T1 and T3, while kidney weight was reduced ($P < 0.05$) in pigs fed 0.75% and 1.00% PALM supplemented diets. In conclusion, PALM supplementation at 0.50% enhanced growth performance, while 0.75% and 1.00% levels improved DMD and CPD without any adverse effect on pig's organ development.

Keywords: Antibiotics, Guinea hen weed, nutrient utilization, organs, phytogetic plant

Description of Problem

Pig production globally has recently gained credence owing to its high feed conversion efficiency (1). Its hardiness under intensive rearing and low susceptibility to diseases is

another added advantage (2). Pig's ability to live on forages, industrial and agricultural by-products has edged it above many other livestock (3). Although pigs are known to be voracious in their feed consumption,

however, their quick return on investment has submerged this problem and it stands out as one animal with a high dressing percentage (4, 5). A major concern lately is how to enhance nutrient utilization to yield more meat to succour low protein intake by the ever-growing population. Earlier on, antimicrobial feed additives were employed in stimulating better digestibility and nutrient utilization in pigs' production (6) but the recent advances into the production of organic meat devoid of any intricacies of residual chemicals which may constitute health hazard on human is a matter of great interest (7). Plant parts have been resorted to recently as sources of the digestive stimulants in most livestock (8, 9) and they have been adjudged effective. Nualart *et al.* (10) also reported that medicinal plants improve the protein and dry matter digestibility of livestock feeds.

Petiveria alliacea is known as Guinea hen weed in English and it is called Awogba or Ojusaju by the Yoruba speaking people of South-western Nigeria, Kanufari in Hausa of Northern Nigeria and Akwa-Osa amongst Igbo of Eastern Nigeria (11). Guinea hen weed (GHW) is a wild perennial shrub that grows widely in tropical area such as South and Central America, Caribbean and Africa (12). *Petiveria alliacea* is a very important plant in traditional Latin America herbal medicine where it is used as an anti-rheumatic and anti-inflammatory and to treat fever, headache, diabetes, malaria, arthritis, skin allergies and cancer (13). It is widely used as growth promoter because of its high content of secondary metabolites like flavonoids, benzenoid and terpenoids (14).

Petiveria alliacea had been reported to improve the dressed weight and reduce abdominal fat in broiler chicken (15). In West

African dwarf goats, Adebayo *et al.* (16) explore the use of extract of *Petiveria alliacea* to reduce faecal worm eggs. Muhammad *et al.* (17) applied *Petiveria alliacea* plant part as phytobiotics in diets of laying birds which boosted egg production. There is however a paucity of information on the use of *Petiveria alliacea* in pigs. Therefore, this study investigates the growth promoting properties of *Petiveria alliacea* as it affects weaned pigs.

Materials and Methods

Experimental Site

The experiment was carried out at the Teaching and Research Farm of the Department of Animal Production Technology, Yaba College of Technology, Epe along Lagos-Ijebu-Ode Road, Lagos State, Nigeria. The farm is located on longitude 3.97°E and latitude 6.47°N (18). It lies in the low land rain forest vegetation zone within the agro-ecological zones of southwestern Nigeria.

Experimental Animals' Management

A total of thirty-six unsexed weaned pigs (Landrace x Large white) breeds of between 8 ± 0.1 kg body weight and ten weeks old were procured from Joan Exclusive Farms in Epe. The pigs were housed in a clean disinfected pens for two weeks for stabilization prior to the commencement of the feeding trials. During the period, the pigs were treated for endo and ecto-parasites using recommended veterinary drugs which was administered as prescribed and diet which met the nutrient requirement was offered to the animals daily and cool clean water was given to them liberally.

Experimental Diets and Design

The feed ingredients were sourced from Heralds Agro Allied Limited, Epe Local Government Area and moved to the Teaching and Research Farm of the Department of Animal Production Technology, Yaba College of Technology, Epe campus. Guinea hen weed was collected from Odoragunshin town, Epe Local Government Area of Lagos State. The leaves were severed and air-dried for 3-days and oven-dried at 65°C for thirty minutes and then milled using 2mm sieve to obtain *Petiveria alliacea* leaf meal (PALM). The milled product was then bagged in preparation for the feeding trial while some nutritional (proximate and phytochemical) composition was determined according to standard procedures (Table 1). Four

experimental diets were formulated (19) with the PALM supplemented at 0, 0.5, 0.75 and 1.0% in the diets. Thirty-six pigs were allotted randomly on weight equalization basis after stabilization into four dietary treatments. Each treatment has nine pigs, with three replicates of three pigs each. The pigs were assigned to the dietary treatments in which T1 is the control with 0% PALM, T2 is the diet with 0.50% PALM, T3 is the diet with 0.75% PALM and T4 is the diet with 1.00% PALM supplementation in the diet (Table 2). The experiment lasted for ten weeks. Proximate analysis of the experimental diets was carried out according to the method of AOAC (20) before the commencement of the feeding trial.

Table 1: Proximate and Phytochemical Constituent of PALM

Parameters	Value
Proximate (%)	
Dry matter	82.40
Moisture	17.60
Crude protein	10.51
Ash	3.96
NFE	57.69
Ether extract	7.00
Crude fibre	3.24
Energy (Kcal/g)	407.12
Phytochemical (g/100 ml)	
Flavonoid	1.07
Saponin	0.50
Alkaloid	1.29
Tannin	0.29
Oxalate	0.05
Phytate	0.10

PALM= *Petiveria alliacea* leaf meal, NFE= nitrogen free extract

Table 2: Ingredients and Nutrients Composition of Experimental Diets (g/kg)

Ingredient	T1 (0.00%)	T2 (0.50%)	T3 (0.75%)	T4 (1.00%)
Maize	40.00	40.00	40.00	40.00
Soyabean meal	14.00	14.00	14.00	14.00
Palm kernel cake	13.00	13.00	13.00	13.00
Wheat offal	29.00	28.50	28.25	28.00
PALM	0.00	0.50	0.75	1.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	1.40	1.40	1.40	1.40
Premix*	0.15	0.15	0.15	0.15
Salt	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Determined Nutrients (%)				
Dry Matter	87.13	85.58	88.10	84.16
Metabolisable Energy (Kcal/kg)	2550.10	2584.21	2544.15	2540.21
Crude protein	17.67	17.52	17.43	17.28
Crude fibre	4.43	4.22	4.16	4.10
Ether extract	4.77	4.74	4.72	4.68
Ash	3.22	3.17	3.14	3.09

*Premix: 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 24,000 (mg), niacin 20,000mg, pantothenic acid 5,000mg vit B6 1,500mg, Vit. B12 10mg, folic acid 500mg, Biotin H2 750mg, chlorine chloride 175,500 mg, cobalt 200mg, copper 300mg, iodine 1,000mg, iron 20,000mg, manganese 40,000 (mg), selenium 200mg, zinc 30,000mg, anti - oxidant 1,250mg
PALM = *Petiveria alliacea* leaf meal

Data Collection

Growth Performance

Initial weight of pigs was measured at the commencement of the trials, data were collected on a weekly basis on weight gain (WG), feed intake (FI), feed conversion ratio (FCR) and mortality. At the end of each week, the weekly weight gains were measured using digital weighing scale and recorded. Known quantities of feed were offered to the pigs and the left-over were collected and weighed to determine feed intake (total and daily intake). The weekly weight change and the weekly feed intake were used to calculate the feed conversion

ratio while the number of pigs per treatment that died were regarded as mortality.

Apparent Nutrient Digestibility Study

At the end of 8th week of the experiment, digestibility trial was conducted using pigs (1 each) randomly selected from each replicate and housed individually in metabolic cages that were already cleaned, disinfected and equipped with facilities for separate collection of faeces and urine. The adjustment period lasted for three days before commencement of the trial. Faecal collection was done for three days during which a known quantity of feed was offered

daily. The total excreta voided was measured and an average excreta sample (50g) from each of the treatment were collected dried in oven at 65°C for 48 hours. The dried excreta samples were milled and used for proximate analysis using standard method (20).

Carcass Measurements

At the of the experiment, a pig per replicate was selected for carcass and organ weight measurements. Before selection, the pigs were starved for twelve hours prior to ensure emptying of the gastrointestinal tract before slaughtering. The starved pigs were weighed to determine the live-weight and were stunned before severing through the jugular vein. The slaughtered weights were taken and warm water was used to remove the hairs on the pigs before they were eviscerated. The

weights of cut parts and organs were measured with the use of digital gram sensitive scale and were recorded.

Data Analysis

The data collected were subjected to one way analysis of variance in a completely randomized design using SAS statistical package (21). The significant means were separated using Duncan multiple range test (22) in the same statistical package while significance was set at 5% probability

Result and Discussion

The results of the growth performance, apparent nutrient digestibility, carcass and organ weights are presented in Table 3, 4 and 5 respectively.

Table 3: Growth performance of weaned pigs fed diets supplemented with PALM.

Parameters (kg)	PALM supplementation levels				SEM	P-value
	T1 (0.00%)	T2 (0.50%)	T3 (0.75%)	T4 (1.00%)		
Initial weight	8.09	8.10	8.11	8.10	0.68	1.00
Final weight	39.22 ^{ab}	45.39 ^a	37.89 ^b	37.87 ^b	1.30	0.01
Total weight gain	31.13 ^b	37.29 ^a	29.78 ^b	29.77 ^b	1.17	0.03
Daily weight gain	0.45 ^b	0.53 ^a	0.43 ^b	0.43 ^b	0.05	0.03
Total feed intake	87.19 ^b	59.29 ^c	115.27 ^a	114.96 ^a	21.68	0.00
Daily feed intake	1.25 ^b	0.85 ^c	1.65 ^a	1.64 ^a	0.31	0.00
Feed conversion ratio	2.78 ^c	1.60 ^d	3.84 ^a	3.81 ^b	3.03	0.00

^{abc} Means on the same row with different superscript are significantly different ($P < 0.05$)

PALM = *Petiveria alliacea* leaf meal, SEM= Standard error of mean

Table 4: Apparent nutrient digestibility of weaned pigs fed diets supplemented with PALM

Parameters	PALM supplementation levels				SEM	P-value
	T1 (0.00%)	T2 (0.50%)	T3 (0.75%)	T4 (1.00%)		
Dry matter digestibility	79.60 ^b	86.43 ^a	85.89 ^a	81.23 ^b	0.20	0.01
Crude protein digestibility	75.53 ^b	79.24 ^a	77.51 ^{ab}	76.21 ^b	0.01	0.03
Ether extract digestibility	68.75	69.24	69.05	68.84	0.12	0.44
Crude fibre digestibility	68.57	69.19	69.05	68.65	0.03	0.94
Ash digestibility	70.27	71.42	70.35	69.88	0.01	0.56

^{ab} Means on the same row with different superscript are significantly different ($P < 0.05$)

PALM = *Petiveria alliacea* leaf meal, SEM= Standard error of mean

Table 5: Carcass parameters of weaned pigs fed diets supplemented with PALM

Parameters	PALM supplementation levels				SEM	P-value
	T1 (0.00%)	T2 (0.50%)	T3 (0.75%)	T4 (1.00%)		
Live weight (kg)	37.21 ^b	42.30 ^a	36.30 ^b	36.13 ^b	1.49	0.031
Slaughtered weight (kg)	34.56 ^{ab}	40.65 ^a	35.23 ^b	34.89 ^b	1.44	0.020
Dressing percentage (%)	59.62	62.76	59.93	58.57	1.52	0.582
Carcass weight (kg)	22.19	26.55	21.76	21.16	1.29	0.461
Belly	0.70	0.53	0.75	0.50	0.06	0.36
Back	4.14	3.33	3.33	3.12	0.26	0.60
Fore limbs	2.35	2.32	3.30	2.60	0.15	0.05
Hind limbs	3.49	2.87	3.30	2.72	0.13	0.10
Fore trotters	0.30	0.18	0.30	0.22	0.02	0.06
Hind trotters	0.30	0.81	0.30	0.23	0.02	0.07
Loin	1.33	1.20	1.28	1.02	0.08	0.57
Stomach	1.90	1.78	1.55	1.62	0.11	0.74
Kidneys	636.00 ^a	230.67 ^{ab}	198.67 ^b	160.35 ^c	71.66	0.03
Liver	339.00	350.00	363.33	370.00	43.56	1.00
Lungs	684.33	482.67	522.00	655.00	50.36	0.46
Spleen	179.00	353.33	378.67	395.00	61.09	0.64
Heart	304.00 ^{ab}	402.00 ^a	254.67 ^b	379.33 ^{ab}	24.28	0.04

^{abc} Means on the same row with different superscript are significantly different ($P < 0.05$)

PALM = *Petiveria alliacea* leaf meal, SEM= Standard error of mean

The result of growth performance is presented in Table 3 which shows that the supplementation of PALM at different levels influenced all the growth parameters measured ($P < 0.05$). This is contrary to the report of Odetola *et al.* (23) who reported no significant difference in the growth parameters of broiler chicken when fed diets supplemented with graded levels of PALM. Pigs fed diet supplemented with PALM at 0.50% had higher ($P < 0.05$) FW than those fed control diets and those fed 0.75 and 1.00% supplemented PALM diets had similar FW. Total weight gain (TWG) and daily weight gain (DWG) was higher ($P < 0.05$) for pigs fed diet supplemented PALM at 0.5% compared to other treatments. The increased weight gain observed in this study could be associated with the potent bioactive constituents of PALM which

exhibits inhibitory properties against harmful intestinal microbes. However, Oanh *et al.* (24) reported no significant difference in average final weight and weight gain of growing pigs fed diet supplemented medicinal plant mixtures (60% *Bidens Pilosa* L., 15% *Urena lobata* L., 15% *Pseuderanthemum palatiferum*, 5% *Ramulus cinnamomi*, and 5% *Star anise*). The result obtained in the current study could be due to the potent constituent of PALM which is capable of positively influencing weight gain. Higher ($P < 0.05$) total feed intake (TFI) and daily feed intake (DFI) was observed for pigs fed diets supplemented 0.75 and 1.00% PALM than other treatments while those fed diet supplemented 0.5% PALM had the lowest TFI and DFI. The increased FI observed at higher inclusion level indicates the enzyme stimulatory properties of PALM

and it has been reported that phytogetic plants including herbs and spices stimulate appetite and enhances secretions of endogenous enzymes (25). However, it was noted that despite the increased FI at 0.75 and 1.00% inclusion levels it did not translate to increased WG which implies that inclusion at higher levels may not be necessary. The FCR revealed that pigs fed diet supplemented 0.5% PALM had the best FCR and this can be attributed directly to the low FI and higher WG observed for the group of pigs.

Table 4 shows the apparent nutrient digestibility of pigs fed diets supplemented with PALM. Dry matter digestibility (DMD) and crude protein digestibility (CPD) were influenced ($P < 0.05$) by PALM supplementation while other parameters were not affected ($P > 0.05$). The DMD was higher for pigs fed diets supplemented PALM at 0.50 and 0.75 than other treatments. The increased DMD can be attributed to the function of inherent bioactive components of *Petiveria alliacea* which are known to improve gut function and nutrient utilization through the suppression of harmful intestinal pathogens and maintenance of healthy gut microflora (26, 27). This is similar to the report of Cheng *et al.* (28) who reported increased digestibility of feed nutrients for pigs fed diet supplemented with oregano essential oil at 200 g/kg diet. Djoumessi *et al.* (29), also reported improved DMD and CPD for guinea pigs fed diet supplemented with *Curcuma longa* at 0.25%. Higher ($P < 0.05$) CPD was obtained for pigs fed diet supplemented at 0.50% than those fed 0.75% PALM and those fed diet supplemented with PALM at 1.00% and the control diet. This finding is contrary to the report of Sobayo *et al.* (30) who observed increased CPD for broilers fed diet supplemented with PALM at

1500 mg/kg. It has also been reported that the secondary metabolites in phytogetic plants at lower levels of inclusion promotes the activity of pancreatic digestive enzymes, increases bile flow resulting in improved nutrient absorption (31).

The carcass parameters and organ weights of pigs fed diet supplemented with PALM is presented in Table 5. The result indicated that the live weight (LW) and slaughtered weight (SW) were affected ($P < 0.05$) by PALM supplementation while dressing percentage (DP) and carcass weight (CW) were not affected by PALM supplementation ($P > 0.05$). Pigs fed diet supplemented with PALM at 0.50% had higher ($P < 0.05$) LW and SW than other treatments. It is evident that the studies on the influence of PALM dietary supplementation in pigs are rare in literature, however the report of the study by Yan *et al.* (32) shows that fattening pigs fed diet with herbal mix of turmeric, black pepper, thyme, ginger and buckwheat had increased LW. Rabelo-Ruiz *et al.* (33) reported that dietary supplementation of garlic for pigs resulted increased weight gain and improved nutrient digestibility. The higher LW and SW achieved is associated with the regulatory effect of phytogetic plants on gut microflora and inhibition of pathogenic bacteria causing diarrhoea (34). The belly, back loin and stomach weights were not affected ($P > 0.05$). The limbs and trotters were not significantly affected There was no effect ($P > 0.05$) of PALM supplementation on liver, lungs and spleen weights. Increased ($P < 0.05$) weight of kidney was observed for pigs fed the control diet while those fed PALM supplemented diets at 0.75 and 1.00% had reduced kidney weights which indicated that this additive improves the health status of the kidney. In line with the outcome of the

current study, Sampath *et al.* (35) reported reduced ammonia emissions in faeces of pigs which suggests efficient detoxification of ammonia into urea which is connected to the proper functioning of the kidney. The heart weight of pigs fed PALM supplemented diet at 0.50% increased ($P < 0.05$) and higher than those fed PALM supplemented diet at 0.75%, however similar to other treatments which implies that the increased weight does not suggest a disease condition but could rather be attributed to higher weight of gain of the pigs.

Conclusion

From the result of this research, it could be inferred that supplementing weaned pigs' diets with 0.50% PALM improved dry matter digestibility, crude protein digestibility, weight gain, feed conversion ratio, live weight and dressing percentage of pigs. The supplementation of PALM in the diet of pigs up to 1.00% does not have hazardous effect on the organs of pigs.

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