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Growth Response, Carcass Traits and Cholesterol of Growing-Finishing Pigs fed Different Fibre Feedstuffs based Diets

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Target audience: Pig Farmers, Monogastric Animal Nutritionists

Abstract

The study evaluated the growth response, carcass traits and cholesterol of growing finishing pigs fed different fibre feedstuffs made up of palm kernel cake (PKC), corn bran (CB), rice bran (RB) and brewers dried grain (BDG) for twelve weeks. Sixteen cross-bred (Large White ×Hampshire) growing pigs of average weight 31.25±1.88 kg were randomly distributed into 4 experimental diets of 4 animals per treatment with each animal serving as a replicate. Diet 1 contained 40% of Corn bran (CB), while diets 2, 3 and 4 contained 40% of PKC, BDG and RB respectively. The design of the study was completely randomized design. The growth response of the animals showed significant difference (P < 0.05) on the average final weight and daily weight gain. The average final weight ranged from 55.24 to 72.11 kg with PKC based diet having the highest value and RB based diet having the least. The average daily weight gain was highest for PKC based diet (0.470 kg) and lowest (0.281kg) for RB based diet. The feed conversion ratio (FCR) ranged from 3.39 to 4.66. The carcass cholesterol which was significantly affected (p<0.05) by the dietary treatments ranged from 43.44 to 53.00 mg/100g) with PKC based diet having the least value. It can be concluded from this study that PKC was better utilized by growing/finishing pigs than the other fiber feedstuffs for growth, Carcass trait and low Carcass cholesterol.

Key words: Carcass trait; Carcass Cholesterol; Growth; Fibre Feedstuffs

Description of the Problem

Pig production in the humid tropics has been reported by (1) to be constrained by seasonal feed deficits and high cost, erratic supply of feed ingredients and competition between humans and pigs for available feed resources. As a result of this, most pig farmers in Nigeria resort feeding their stocks with kitchen wastes and agro-industrial by products such as palm kernel cake, brewers' dried grain, wheat offal, rice bran etc.

The continuous use of agro-industrial by products as basal diets by most pig farmers in Nigeria has been attributed to increasing unavailability and consequent high cost of the conventional feeds (2). Although, the feeding value of these agro-industrial by products had been a continuous subject of investigation by monogastric animal nutritionists in Nigeria (3, 4, 5, 6, 7, 8 and

9), however, the effects of their inclusion on carcass traits and cholesterol concentration of the carcass have not been fully documented.

Due to increasing incidence of cardio vascular diseases, most elites in Nigeria who consume pork tend to be cautious of the amount of fat in the pork and this is beginning to have effects on pork demand among them. This decrease in acceptability of pork may adversely affect its market and general pig production especially in Nigeria (10).

Most pig farmers especially in the south-western Nigeria have been using agro-industrial by products such as palm kernel cake, brewers' dried grain, rice bran, wheat offal etc as basal diets without sufficient knowledge on the quality of pork such feeding regime will produce. The intention of these pig farmers was to embark upon intensive production of pigs as an effort geared towards increasing animal protein supply at reduced cost for human consumption (5). Farmers and researchers in Nigeria have been using agro-industrial by products as basal feedstuffs in the diets of growing-finishing pigs with little or no emphasis on the effects of their inclusion on the degree of fattiness on the final product (pork) and also the effects of their inclusion on the leanness of the carcass. It has been reported that there was an urgent need to return to a balanced fatty acid diet by decreasing intake of cholesterol especially the type that have been implicated (low density lipoprotein) and saturated fats (10).

Hence, this study was carried out to further investigate the growth response, carcass cholesterol and leanness of carcass of growing-finishing pigs fed different fibre feedstuffs.

Materials and Methods

Location of the Experiment

The experiment was conducted at the Swine Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile - Ife, Nigeria which lies approximately on Latitude $7^0$28'N and Longitude $4^0$33'E with an altitude of about 244m above the sea level.

Test Ingredients

All the fibre ingredients were purchased at Ibadan, Oyo State, Nigeria. The palm kernel cake (PKC), corn bran (CB) and rice bran (RB) were bought at Farm support Ltd, Ibadan, Oyo State, while the brewers' dried grain (BDG) was purchased at Egbeda area along Ife-Ibadan express-way, Ibadan.

Management of Experimental Animals

A total of sixteen growing pigs (Large White x Hampshire) with initial average weight of 31.25 ±1.88kg were used in this study. The animals were randomly assigned to 4 experimental diets. There were 4 pigs per treatment and each of them served as a replicate. Before the commencement of the experiment, all the animals were given Ivomectin® and antibiotics. Other routine management practices were strictly adhered to. Feed and water were supplied *ad libitum* to the animals throughout the experiment. The experiment lasted for twelve weeks (84 days).

Experimental Diets

Diets were formulated to contain four different fibre sources at 40% inclusion level. Diet 1 contained 40% of Corn bran (CB), while diets 2, 3 and 4 contained

40% of Palm Kernel Cake (PKC), Brewers' dried grain (BDG) and Rice bran (RB) respectively (Table 1). Experimental diets were fed to the animals on treatment basis *ad libitum*. Water was also supplied *ad libitum* throughout the experimental period.

Data Collection: The animals were weighed on weekly basis and records of weight gain, feed intake and feed to gain ratio were calculated on treatment basis.

Carcass and Organs Weight: At the end of the experiment, three animals per treatment were slaughtered for carcass analysis. The live weight was taken before slaughtering while the dressing weight was taken after slaughtering and the dressing percentage was determined as below.

$$\text{Dressing percentage} = \frac{\text{Dressing weight}}{\text{Live weight}} \times 100$$

The carcass weight, organ weight, back fat thickness, length of the body among others were taken and calculated in relation to their dressing percentages.

Carcass Cholesterol

Meat samples were collected between the second (2^{nd}) and third (3^{rd}) ribs and also between the twelfth (12^{th}) and thirteenth (13^{th}) ribs for the analysis. Cholesterol was separated and quantified by normal phase High Performance Liquid Chromatography (HPLC). Total cholesterol content of each meat sample was calculated in duplicate based on the external standard technique from a standard curve area vs. concentration.

Chemical Analysis

Each treatment diet and test ingredients were analyzed for proximate composition. The analysis for dry matter, crude protein, crude fibre, fat and ash was done according to the method of (11) in the laboratory.

Statistical Analysis

Data obtained was statistically analyzed using one way analysis of variance (ANOVA) and the means were separated using Duncan multiple range test of (12).

Results and Discussion

Proximate Composition of Test Ingredients and Experimental Diets.

The proximate composition of the test ingredients is shown in Table 2 while that of the experimental diets is shown in Table 3. The result showed that BDG had the highest crude protein value (23.32 %) which was higher than the findings from (13) who reported 22.49 % for crude protein while the least value (12.49 %) was found in Corn bran. The differences obtained from all the fibre feedstuffs for crude protein may be due to the differences in source and processing methods which each of the fibre feedstuffs had undergone (9). The dry matter (DM) content was highest in PKC (90.24 %). Rice bran had the least dry matter value of 89.20 %. Similar range of DM was reported (14). Higher dry matter value (90.2 %) was reported for rice bran (15). The differences in the dry matter value may be as a result of differences in the processing techniques.

The highest crude fibre value was found in BDG (20.57 %) while similar range was found in PKC and Corn bran. Higher value (17.5 %) was reported (15) for rice bran. The variations obtained may be due to the differences in the nutrient profile of ingredient, specie and

Table 1: Gross Composition of Experimental diets for Growing – Finishing Pigs

	DIETS			
Ingredients (%)	**1**	**2**	**3**	**4**
Maize	40.0	40.0	40.0	40.0
Soybean meal	6.00	6.00	6.00	6.00
Groundnut cake	10.0	10.0	10.0	10.0
Corn bran	40.0	-	-	-
Palm kernel cake	-	40.0	-	-
Brewers' Dried grain	-	-	40.0	-
Rice bran	-	-	-	40.0
Bone meal	1.50	1.50	1.50	1.50
Fish meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
*Vits/Mins premix	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated Analysis				
Metabolizable Energy	2852.96	2722.96	2644.96	2996.96
(Kcal/kg) Crude	16.86	19.66	19.66	17.26
Protein (%)	6.51	6.51	9.71	6.71
Crude Fibre (%)				

**Premix supplied the following p er kg diet: Vit. A 10,000,000 IU; Vit. D 32,000,000 IU; Vit. E 6,000 IU; Vit K 2,000 mg; Vit B $_1$ 2,000 mg; Vit. B $_2$ 5,500 mg; Vit. B $_6$ 2,200 mg; Vit. B $_{12}$ 12 mg; Biotin 30 mg; folic acid 600 mg; Niacin 10,000 mg; pantothenic acid 7,000 mg; choline chloride 500 ,000 mg; Vit. C 10,000 mg; iron 60,000 mg; Mn 80,000 mg; Cu 8,00 mg; Zn 50,000 mg; Iodine 2,000 mg; cobalt 450 mg; selenium 100 mg; Mg 100,000 mg; anti- oxidant (BHA) 6,000 mg.*

Diet 1 = Diet with 40% Corn bran (CB) Diet 2 = Diet wi th 40% Palm Kernel Cake (PKC)

Diet 3 = Diet with 40% Brewers' dried grain (BDG) Diet 4 = Diet with 40% Rice bran (RB)

Table 2: Proximate Composition of Test I ngredients

	Fibre ingredients				
Parameters (%)	**Palm Kernel cake**	**Corn bran**	**Rice bran**	**BDG**	**SEM ±**
Dry matter (DM)	90.24	89.40	89.20	89.90	1.72
Ash	3.68	2.25	8.73	6.21	0.95
Crude fibre	10.54	10.55	11.63	20.57	1.41
Ether extract	6.72	2.33	13.14	3.25	1.62
Crude protein	22.53	12.69	13.56	23.32	1.99
Nitrogen Free extract	56.53	81.18	52.94	46.65	5.06

BDG: Brewer's Dried grain SEM: Standard Error of Means

Table 3: Proximate Composition of Experimental Diet s

	Diets				
Parameters (%)	**1**	**2**	**3**	**4**	**SEM ±**
Dry matter (DM)	89.97	88.88	90.33	89.55	1.79
Ash	7.97	9.89	9.54	14.21	0.94
Crude fibre	6.40	7.18	7.93	3.46	0.68
Ether extract	6.65	6.78	3.30	4.55	0.60
Crude protein	16.80	17.00	16.86	17.52	1.17
Nitrogen Free extract	62.18	59.17	62.38	60.27	3.16

Diet 1 = Diet with 40% Corn bran (CB) Diet 2 = Diet with 40% Palm Kernel Cake (PKC)

Diet 3 = Diet with 40% Brewer's dry grain (BDG) Diet 4 = Diet with 40% Rice bran (RB)

processing methods involved in the production (8). The ether extract values ranged from 2.33 to 13.14 %, BDG value was the highest and Corn bran had the least value (2.33). The differences obtained may be due to variation in the quantity of monounsaturated fatty acids and low saturated fatty acids present in these feedstuffs (16). The Nitrogen Free Extracts (NFE) values ranged from 33.49 to 61.58 %. BDG had the highest NFE while Corn bran had the least value. All these values were within the range of values in literature (13). The differences obtained for all the parameters measured for each of the fibre feedstuff may be due to changes in the variety of crops and methods of industrial processing (13). The crude protein of the diets ranged from 16.80% in diet 1 to 17.52% in diet 4 while the crude fibre ranged from 3.46% in diet 4 to 7.93% in diet 3. The ether extract was lowest in diet 3 (3.30%) while highest value (6.78%) occurred in diet 2. The ash was highest in diet 3 (14.21%) and lowest (7.97%) in diet 1. The differences in the proximate values of the diets may be due to variations in the nutrient profile of the test ingredients. The calculated Metabolizable Energy (ME) value ranged from 2,644.96Kcal/kg in BDG based diet to 2,996.96Kcal/kg in RB based diet. The difference in ME values of the diets may be due that the variation in the ME concentration of the test ingredients. The ME values were within range reported (18).

Growth Response of the Experimental Animals

The result from growth response of the experimental animals is shown in Table 4. There were significant differences ($P < 0.05$) across all the treatments for average final body weight and average daily weight gain. The final weight ranged from 55.24 to 72.11 kg with highest value found in diet 2 (72.11 kg) while the least value was found in diet 4 (55.24 kg). The average daily weight gain was highest in diet 2 (0.470 kg) while the least value was found in diet 4 (0.281 kg). The finding on daily weight gain is lower than 0.50 kg/d reported (8, 17). The value obtained for corn bran based diet 1 (0.413 kg/d) was higher than the value (0.351 kg/d) reported by (18) who fed pigs 30 % corn bran. The range of value (0.281 to 0.470 kg/d) obtained from the study was higher than value reported by (9) who reported (0.20 to 0.39 kg/d) when pigs were fed 25 % of the different fibre feedstuffs. The superiority in final body weight and average daily weight gain of the animals on PKC based diet may be due its being

Table 4: Growth Response of the Experimental Animals

	Diets				
Parameters	**1(CB)**	**2 (PKC)**	**3 (BDG)**	**4 (RB)**	**SEM ±**
Average Initial weight (kg)	31.25	32.63	31.83	31.50	1.88
Average Final Weight (kg)	65.95^{b}	72.11^{a}	61.81^{bc}	55.24^{c}	2.08
Average Daily Weight Gain (kg)	0.413^{ab}	0.470^{a}	0.357^{ab}	0.281^{b}	0.03
Average Daily Feed Intake (kg)	1.36	1.59	1.46	1.31	0.06
Feed Conversion Ratio (FCR)	3.39	3.87	4.13	4.66	0.29

^{abc} *Means in the same row having different superscripts differ at* $p \leq 0.05$ *SEM = Standard error of mean.*
Diet 1 = Diet with 40% Corn bran (CB) Diet 2 = Diet with 40% Palm Kernel Cake (PKC)
Diet 3 = Diet with 40% Brewer's dry grain (BDG) Diet 4 = Diet with 40% Rice bran (RB).

more efficiently utilized for growth by growing/finishing pigs than the other test ingredients in this study. Besides, the 19.66% crude protein and 2,722.96 Kcal/kg of ME in the PKC based diet may have been the best for growing/finishing pigs compared to others in this study. Also, the differences in values obtained for all the growth parameters monitored in this study may be due to the variations in crude fibre and crude protein contents of the test ingredients. The average daily feed intake ranged from 1.31 to 1.59 kg with highest value occurring in diet 2 (1.59 kg). The differences in feed intake may be due to variations in the crude fibre content of the diet because pigs may eat more to compensate partially for lower digestible energy value (19). The feed conversion ratio (FCR) ranged from (3.39 to 4.66). Diet 4 had the highest value (4.66) while diet 1 had the least value (3.39). The differences in the FCR may be due to the variations in the feed intake and weight gain of the experimental animals.

Carcass Traits and Cholesterol of Growing – Finishing Pigs Fed Experimental Diets

The result for carcass trait and cholesterol of the experimental animals is shown in Table 4. There were no significant differences ($P > 0.05$) across all the treatments for all the carcass traits measured except for liver weight. However, the carcass cholesterol was significantly affected ($P < 0.05$) by the dietary treatments. The dressing percentage ranged from 72.39 to 75.52 %. Pigs fed corn bran based diet had the highest value (75.52 %) while pigs fed rice bran based diet had the least value (72.39 %). Lower value range (64.52 to 68.00 %) was reported by (18) who fed pigs with 30% of fibre feedstuff. Likewise (20) reported a lower range of (68.41 to 70.89 %) when PKC and BDG were fed to growing pigs. The back fat thickness ranged from (2.33 to 3.23 cm) with highest value found in CB based diet (3.23 cm) and least found in BDG based diet. Lower range (1.17 to 2.43 cm) was reported by (18). The back fat thickness values suggest that the pigs might have used the test ingredients used in this study for fat deposition differently. Also it may be due to variations in the fibre content of the diet.

The heart weight was highest in CB and BDG based (0.53 %) while the least value (0.43 %) was found in PKC based diet. Higher range (0.50 to 0.71 %) was reported by (18). The empty stomach weight was highest (1.45 %) in PKC based diet while least was found in BDG based diet. The small intestine length was highest (1640.70cm) in CB based diet and least (1481.00 cm) in RB based diet. The differences obtained from this study may be due to the differences in the crude fibre content of the diet.

There were significant differences ($P< 0.05$) across the treatments for liver weight and carcass cholesterol. The liver weight was highest in PKC based diet (2.66 %) while the least value was found in diet 4 (1.93 %). The Carcass cholesterol was highest in RB based diet (53 mg/100g) while the least value was found in PKC based diet (43.44 mg/100g). The PKC showed a significant decrease ($P<0.05$) in carcass cholesterol content when compared with CB, BDG and RB by 10.12%, 0.53% and 18.04% respectively. The variations

Table 5: Carcass Traits and Cholesterol of the Experimental Animals

	Diets				
Parameters	**1 CB**	**2 PKC**	**3 BDG**	**4 RB**	**SEM ±**
Live weight (kg)	65.94[b]	72.11[a]	61.81[bc]	55.24[c]	2.08
Dressing %	75.52	74.01	74.04	72.39	1.09
Back fat thickness (cm)	3.23	3.00	2.33	2.67	0.26
Heart (%)	0.53	0.43	0.53	0.49	0.02
Empty stomach weight (%)	1.44	1.45	1.24	1.41	0.06
Liver (%)	2.21[ab]	2.66[a]	2.33[ab]	1.93[b]	0.10
Length of small intestine (cm)	1640.70	1251.70	1580.00	1481.00	97.06
Length of large intestine (cm)	463.33	407.33	565.00	403.33	31.65
Carcass length (cm)	73.67	72.33	72.67	73.00	0.53
Carcass Cholesterol (mg/100g)	48.33[ab]	43.44[b]	43.67[ab]	53.00[a]	1.00

abc Means in the same row having different superscripts diff er at p ≤ 0. 05 SEM = Standard error of mean.

Diet 1 = Diet with 40% Corn bran (CB) Diet 2 = Diet with 40% Palm Kernel Cake (PKC)
Diet 3 = Diet with 40% Brewer's dry grain (BDG) Diet 4 = Diet with 40% Rice bran (RB)

obtained in the cholesterol of the carcass may be due to the differences that exist in the ether extract content of the test ingredients which had been reported by (21) to have influence on the cholesterol content of the muscle. However, the range of the cholesterol content of the pork longissimus muscle in this study fell within the one obtained (30 – 81 mg/100g) by (22).

Conclusion and Application

It can be concluded that:

1. All the animals fed the different fibre feedstuffs performed satisfactorily on all the parameters monitored.
2. However, PKC was better utilized by growing pigs than the other fiber feedstuffs for growth, Carcass trait and low Carcass cholesterol.

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