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Effect of Palm Kernel Cake Replacement and Enzyme Supplementation on the Performance and Blood Chemistry of Finisher Pigs.

Oluwafemi, R.A[1], Akpodiete, O.J[2] and Bratte, L[2]

[1]*Department of Biological Sciences, College of Basic and Applied Sciences, Samuel Adegboyega University, Ogwa. Edo State, Nigeria. E-mail: oluwbs@gmail.com*
[2]*Department of Animal Science, Delta State University, Asaba Campus, Asaba Delta State, Nigeria.*

Abstract

A feeding trial which lasted for twelve weeks was conducted to study the performance of finisher pigs fed five different levels of palm kernel cake replacement for maize (0%, 40%, 40%, 60%, 60%) in a maize-palm kernel cake based ration with or without enzyme supplementation. It was a completely randomized design experiment involving thirty finisher pigs of the Large White x Duroc cross breed. These animals were assigned to five dietary treatments resulting in six experimental animals per treatment with three replicates. Diet 1(control), contained maize without palm kernel cake and no enzyme, diet 2 contained 40% PKC with enzyme, diet 3 contained 40%PKC but without enzyme, diet 4 had 60%PKC with enzyme while diet 5 contained 60%PKC without enzyme. There were significant (P<0.05) differences in weight gain, average daily feed intake and feed conversion ratio. Enzyme supplementation of PKC had no significant effect on the performance of the finisher pigs. There were significant (P<0.05) differences in the weights of the kidney and the heart. The kidney weights of finisher pigs fed treatment 1 was higher than those fed treatment 5, while the weight of the heart of finisher pigs was higher in treatment 1 and lowest in treatment 2. The white blood cell (WBC) was higher in finisher pigs fed dietary treatment 5 while those on dietary treatment 2 had the lowest. This study revealed that experimental diets containing up to 60% PKC with or without enzyme supplementation had no negative effect on the overall performance of the finisher pigs.

Keywords: Finisher pigs, palm kernel cake, maize, enzyme supplementation, performance, blood chemistry.

Introduction

Agro-industrial by-products (AIBs) have in recent years become important feed components in poultry diets in Nigeria mainly due to the increased competition for the conventional ingredients by humans and the food industries. Those of high fibre contents are being used either as fillers or as energy diluents Iyayi *et al*, (2005). One of such readily available agro-industrial by-products is palm kernel cake.

The palm kernel represents 50% of the weight of the fresh fruit bunch, it contains approximately 50% oil (Beltran, 1986). Palm kernel cake is a by-product after palm oil extraction from the fruits. The processing of the oil from palm fruit (*elaeis guinensis*) gives rise to the palm nut, which is cracked to produce palm kernel. The palm kernel is further crushed and its oil extracted by solvent or expeller method to produce a waste referred to as palm kernel cake (PKC). Palm kernel cake supplies both protein and energy. It can contain from 12 to 28% of crude protein depending upon the efficiency of the process used to extract the oil. According to Chin (2002) its crude protein content of 18% classified it as a protein source of medium grade.

Palm kernel cake is being produced locally in abundance in Nigeria as well as many other Asia and Pacific countries. It has been well documented that Malaysia is the world leading producer (Chin, 2002., Ariff *et al*, 1998., Devendra, 1977 and Anon, 2000) while it is produced in abundance in many tropical countries including Nigeria (Onwudike, 1986a and Jegede *et al*, 1994). According to Ezieshi and Olomu (2006), PKM has been widely used in poultry diets as a protein source to replace conventional protein sources at different levels (Fetuga *et al*, 1977; Amas and Chicco, 1977; Nwokolo *et al*, 1977; Yeong *et al*, 1981; Onwudike, 1986b and Onwudike, 1986c). These investigations and many more were carried out on poultry production with limited effort on swine in spite of the huge potentials of this aspect of monogastric animal production.

Research information on the use of enzyme supplemented PKC for pigs is relatively limited. Apart from the anti-nutritional properties of palm kernel cake, most pig farmers contended that the gritty texture of this product affected consumption, and therefore performance. However, the awareness about the use of palm kernel cake as a replacement for scarce cereals is on the increase, mainly because it is readily available, relatively inexpensive, and highly nutritious and does not serve as direct food for humans, hence there is no competition. On the other hand, maize is scarce and costly because of its several uses such as food for humans, raw materials for food industries, pharmaceutical industries and livestock feeds (especially monogastrics) among other uses.

The availability of a given nutrient in the diet may be increased by dietary additives, which help convert the nutrient to a more utilizable form, or by adding something to the diet, which counteracts the anti-nutritional effects of other dietary components. One of the newest tools nutritionists have to increase nutrient availability of the diet are enzyme preparations, which can be added to the diet. An enzyme is defined as a protein molecule produced by living organisms that catalyze chemical reactions of other substances without it being destroyed or altered upon completion of the reactions (On-line Medical Dictionary, 1997). Palm kernel cake is high in fibre (150g/kg DM) (Mcdonald *et al,* 1995), it is not palatable and contains anti-nutritive factors which interfere with digestion and absorption of nutrients when fed especially to monogastrics. This therefore necessitates the inclusion of Hemicell in this experiment. Apart from the degradation of *B*-Mannan to mannose with the resultant release of absorbable and metabolizable nutrients for use by monogastric animals, the enzyme will in addition degrade large percentage of non-starch polysaccharide (NSP) and oligosaccharide component of the diet, which are not readily available.

Among african countries, Nigeria is

blessed with enormous livestock resources among which are Pigs. The potential of increased meat production from pigs in Nigeria is enormous when compared with cattle and other ruminants. Pigs have some major advantages such as: - production of meat without contributing to the deterioration of the natural grazing land, conversion of concentrated food to meat twice as effectively as ruminants, highly productive because they are capable of producing large litters after a relatively short gestation period and have short generation interval and grow rapidly, and if confined, maximum use can be made of their manure, among other advantages (Holness, 1991). The present research was conducted to study the performance and blood chemical characteristics of finisher pigs fed diets containing different levels of palm kernel cake with or without enzyme supplementation.

Materials and Methods

Experimental animals and their management

Thirty finisher pigs of the Large White x Duroc crossbreed were used for this study. These animals were made available by the piggery unit of the Teaching and Research Farm, Delta State University, Asaba campus where the research was carried out using the intensive pig production unit of the farm. A total number of 15 pens were used. Experimental animals were individually weighed and were randomly assigned to five dietary treatments comprising of 3 replicates each with 2 pigs per replicate thereby giving a total of 6 pigs per treatment group. Diets and fresh water were made available to the animals under a free and hygienic environment throughout the experimental period.

Experimental design and diets

The experiment was a completely randomized design in which PKC replaced maize at 0, 40 and 60% while enzyme supplemented PKC replaced maize at 40 and 60%. Because of differences in treatments and experimental animals weights, nutrient utilization may not be uniform, hence the need for completely randomized design. Dietary treatments were compounded with Hemicell(R) enzyme supplemented at 600g/ton to treatments 2(40%PKC+EZM) and 4 (60%PKC+EZM) while treatments 1(0%PKC), 3(40%PKC-EZM) and 5 (60%PKC-EZM) were without enzyme supplementation. These diets were properly labeled to indicate with or without enzyme and the percentage PKC level. Experimental diet was formulated to give 16% protein for finisher pigs. The composition of the experimental diets is shown in Table 1.

Data Collection

Performance Indices

Performance characteristics measured include: initial live weight (kg), final live weight (kg), average daily gains (kg), average daily feed intake (kg), haematological and serological characteristics of the experimental animals among others. The pigs were weighed at the start of the experiment and subsequently on weekly basis. At the end of the feeding trials, two pigs from each group were slaughtered for evaluation of the carcass, haematological, serological and other performance characteristics. Prior to slaughter, the pigs were fasted for about 16 hours with only drinking water provided. They were stunned with a metal rod in order to subject them into unconsciousness, which allowed easy slaughtering, and complete bleeding. After the removal of the hairs with surgical blade, the head, trotters, tail, intestines and organs were removed. The remaining carcass was weighed with a 100kg capacity weighing scale (Hanging scale) and expressed as a percentage of the live weight to obtain the dressing percentage. The organs as well as the stomach and the intestines (after the removal of the contents) were also weighed using a sensitive top-loading balance and expressed as a percentage of the carcass weight. Back fat thickness was measured using Venier Calipers.

Within the last week of the feeding trial, one pig each from the replicates was selected at random for bleeding. The animals were given only water on the evening preceding the bleeding. The bleeding was done in the morning before feeding. 10ml of blood was obtained from the jugular vein using a sterilized needle and syringe into a sample bottle. EDTA bottle containing anticoagulant and another set of plain bottles without anticoagulants were used for this exercise. About 3ml of the blood sample was put into the EDTA sample bottle while the remaining is put into the plain sample bottle. The samples in the plain bottles were allowed to clot so as to obtain the serum that was used in the determination of some serum metabolites as described by Toro and Ackermann (1975) and Kaneko (1989)

Statistical Analysis

Data for all parameters measured were processed and analyzed using SPSS computer package. Significantly different means were separated using Duncan's Multiple Range Test (Duncan, 1955), in the same package. Proximate analysis of the diets was carried out according to the methods of A.O.A.C (1990).

Results and Discussion

The results of performance of the finisher pigs fed the experimental diets for a period of twelve weeks are presented in Table 2. The results showed significant ($P<0.05$) differences in weight gain, average daily feed intake and feed conversion ratio. Average total weight gain ranged from 11.00kg in pigs fed dietary treatment 1 (0%PKC and without enzyme) to 13.83kg in finisher Pigs fed dietary Treatment 3 (40%PKC - enzyme). The similarities in the average final live weight between the finisher pigs fed the different experimental diets containing palm kernel cake and those on the control diet without palm kernel cake inclusion revealed the ability of finisher pigs to tolerate palm kernel cake incorporation with or without enzyme supplementation in their diet. Although, there were no significant differences in the average final weight of the finisher pigs, those on diets containing different levels of PKC supplementation appeared to have higher numerical final live weight values compared to those on the control diet (0%PKC without enzyme).

Significant ($P<0.05$) effects of enzyme supplementation were also recorded in the weights of the kidney, heart and liver of finisher pigs fed diets containing enzyme. The use of palm kernel cake as replacement for maize in this study did not alter any of the physiological or biochemical functions of the kidney, liver and the heart. No abnormality, malfunctioning or disease condition that could be attributed to changes in the normal functions of these organs was recorded throughout the experimental period.

The results of the haematological characteristics of the finisher pigs fed diets containing different levels of PKC with or without enzyme supplementation (Table 3) showed no significant (P>0.05) effects on the red blood cell (RBC), packed cell volume (PCV), Haemoglobin (Hb), the mean corpuscular haemoglobin (MCH), the mean corpuscular volume (MCV) and the mean corpuscular haemoglobin concentration (MCHC) of the experimental animals. The non- significant (P>0.05) effect of the experimental diets on the RBC indicated that the experimental diets had no detrimental effects on the health status of the finisher pigs; the slightly higher values for pigs fed PKC diets are pointer to a slight improvement in the oxygen carrying capacity of the blood, which shows that there could be a positive effect of enzyme supplementation on the digestibility of nutrients in both ileum and the total tract of the finisher pigs. However, there were significant (P<0.05) differences among the means of the white blood cell (WBC) with finisher pigs in treatment 5 (60%PKC and without enzyme) having the highest (P<0.05) while those in treatment 3 (40%PKC - enzyme) had the lowest. This may be due to dietary differences among the experimental animals. The white blood cell values indicate the immunity status of the animals. The significant (P<0.05) differences notwithstanding, all the experimental animals remain healthy throughout the experimental period.

Table 1: Percentage composition of experimental diets

Ingredients	Dietary Treatments				
	1 (0%PKC - EZM)	**2 (40%PKC + EZM)**	**3 (40%PKC - EZM)**	**4 (60%PKC + EZM)**	**5 (60%PKC - EZM)**
Maize	34.17	20.50	20.50	13.67	13.67
PKC	0	13.67	13.67	20.50	20.50
Wheat bran	20	20	20	20	20
Cassava peel	23.1	23.1	23.1	23.1	23.1
Groundnut Cake	16.73	16.73	16.73	16.73	16.73
Local fish waste	2.0	2.0	2.0	2.0	2.0
Bone meal	3.0	3.0	3.0	3.0	3.0
Salt	0.5	0.5	0.5	0.5	0.5
Methionine	0.25	0.25	0.25	0.25	0.25
Vit. Min. premix	0.25	0.25	0.25	0.25	0.25
TOTAL:	100.	100.	100.	100	100.

** Vitamin/mineral premix to supply the followings per2.5 kg of the final diet;Vitamin A – 8,000 iu, Vitamin D3 – 2,000 iu, Vitamin E – 8,000 mg, Vitamin K 3 – 2,000 mg, Vitamin B1 – 1,500 mg, Vitamin B2 – 4,000 mg, Vitamin B6 – 1,500 mg, Vitamin B12 – 10 mcg, Niacin – 15,500 mg, Panthothenic acid – 5,000 mg, Folic acid – 500 mg, Biotin – 20 mcg, choline chloride – 100,000 mg, Magnese – 75,000 mg, Zinc – 45,000 mg, Iron – 20,000 mg, Copper – 4,000 mg, Iodine – 1,000 mg, Selenium – 200 mg, Cobalt – 500 mg, Antioxidant – 125,000 mg.*

Table 2: Effects of experimental diets on the performance of the animals.

Parameters	Treatments 1 (0%PKC - EZM)	2 (40%PKC + EZM)	3 (40%PKC - EZM)	4 (60%PKC + EZM)	5 (60%PKC - EZM)	SEM
Average Initial live weight (kg)	24.00	23.33	24.67	24.83	23.33	0.37
Average final live weight (kg)	35.00	35.83	38.50	37.83	36.67	0.71
Average total weight gain (kg)	11.00^{c}	12.50^{ab}	13.83^{ab}	13.00^{b}	13.33^{ab}	0.50
Average daily feed intake (kg)	1.10^{a}	1.07^{ab}	1.06^{b}	1.07^{ab}	1.09^{ab}	0.05
Average daily weight gain (kg)	0.13	0.14	0.16	0.15	0.16	0.05
Feed : gain	8.24	7.43	6.61	7.03	6.96	0.26

^{abc,} Mean within rows with different superscripts are significantly (P<0.05) different.

Table 3: Effect of dietary PKC level and enzyme supplementation on blood chemistry.

Parameters	TREATMENTS 1 (0%PKC - EZM)	2 (40%PKC + EZM)	3 (40%PKC - EZM)	4 (60%PKC + EZM)	5 (60%PKC - EZM)	SEM
WBC (x10^{3})	14.13^{ab}	13.00^{ab}	8.73^{a}	13.17^{ab}	14.17^{ab}	0.70
RBC (x10^{6})	6.07	6. 01	6.06	6.85	5.70	0.23
PCV (%)	40.83	39.40	40.37	43.80	35.23	1.54
Hb (g/dl)	11.00	11.03	10.93	12.00	10.30	0.45
MCH (Pg)	17.97	18.30	17.80	18.27	17.07	0.28
MCV (%)	65.37	65.47	65.77	66.87	63.80	0.74
MCHC (%)	27.37	27.90	27.10	27.33	26.80	0.16

^{abc,} Mean within rows with different superscripts are significantly (P<0.05) different.

Key

WBC = White Blood Cell
RBC = Red Blood Cell
PCV = Packed Cell Volume
Hb = Haemoglobin
MCH = Mean Corpuscular Haemoglobin
MCV = Mean Corpuscular Haemoglobin Volume
MCHC = Mean Corpuscular Haemoglobin Concentration

Table 4: Organ Weights of Finisher Pigs fed Experimental Diets.

Parameters	Treatments 1 (0%PKC - EZM)	2 (40%PKC + EZM)	3 (40%PKC - EZM)	4 (60%PKC + EZM)	5 (60%PKC - EZM)	SEM
Live weight (kg)	41.50	36.50	43.50	36.00	43.00	1.79
Dressed weight (kg)	31.00	28.50	36.00	26.00	33.00	1.60
Dressing percentage	74.71^{b}	77.88^{ab}	82.56^{a}	73.87^{c}	76.79^{ab}	1.18
Carcass length (cm)	90.50	85.00	92.50	84.00	94.50	2.16
Kidney	0.89^{a}	0.55^{c}	0.73^{b}	0.55^{c}	0.60^{c}	0.05
Heart	0.95^{a}	0.72^{c}	0.78^{b}	0.60^{c}	0.63^{c}	0.05
Liver	2.28	1.85	2.58	2.29	1.82	0.17
Lungs	1.28	1.42	1.38	1.50	1.21	0.05

^{abcde,} Mean within rows with different superscripts are significantly (P<0.05) different.

Conclusion

Mechanically extracted PKC was used in this study due to the fact that it is more abundantly available all the year round. Enzyme supplementation of the test ingredient (PKC) in this research became necessary as a result of findings by many researchers (Akpodiete *et al,* 2006, Choct, 2006, Ezieshi and Olomu, 2004, Lenehan, *et al*, 2003, Chen *et al*, 1997 and David *et al*, 1997), which confirmed the presence of *B* mannan in palm kernel cake. According to Lenehan *et al* (2003), a variety of non-starch polysaccharides (NSP) are present in the cell wall structure of many feedstuffs, and they have been shown to diminish growth performance and inhibit nutrient absorption in swine.

In the same vein, Iyayi and Davies (2005) stated that the inclusion of high levels of some of the Agro Industrial By-products or the use of high fibre containing ones in poultry diets is limited due to their effect on reduced performance in birds. Chen *et al* (1997) reported that growth rate of broilers, ducks and geese were significantly increased by 10%, 12-18% and 10-21% respectively by adding enzymes to cereal-based diets, while Lenehan *et al* (2003) also reported that studies by Oklahoma State University have suggested that *B*-mannanase may improve growth performance in weanling and grow-finish pigs, but has minimal effect on nutrient digestibility.

The inclusion of Palm kernel cake with or without enzyme supplementation in the diet of finisher pigs in this study did not record any negative effect on the performances of the experimental animals both in terms of health status and growth. This showed that up to 60%PKC (with or without enzyme supplementation) could be incorporated in finisher pig's diets as a replacement for maize (weight for weight) without any problem. This also is in agreement with the submission of Adesehinwa (2007) that PKC can effectively and efficiently replace maize, weight for weight, in diets of growing pigs as energy source without depressing the performance of the growing pigs. Moreover, since there was no mortality as a result of the use of PKC during the twelve-week study period, it is therefore a suitable ingredient for use in formulating finisher pig's ration.

The use of graded levels of palm kernel cake (with or without enzyme supplementation) in replacement for maize in finisher pigs diets resulted in the production of good quality lean pork with low fat. PKC inclusion level of up to 60% with or without enzyme supplementation is therefore recommended. However, because it is high in fibre and low in energy, incorporation of other ingredients with high energy and low fibre contents should be considered.

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