International Journal of Veterinary Sciences and Animal Husbandry 2017; 2(2): 01-04

International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
VET 2017; 2(2): 01-04

www.veterinarypaper.com
Received: 01-01-2017
Accepted: 02-02-2017

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Carcass characteristics and serum chemistry of finisher pigs fed enzyme supplemented palm kernel cake based ration in partial replacement for maize

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Abstract
Carcass characteristics and pork quality from finished pigs fed enzyme supplemented palm kernel cake-based diets as replacement for maize was evaluated. Thirty finisher pigs with average initial weight of between 21.5kg - 23.17kg were assigned to five dietary treatments in a Completely Randomized Design which lasted for twelve weeks. The first dietary treatment (T1), which was the control, contained 0%PKC and without enzyme supplementation. The second treatment (T2) contained 40%PKC + enzyme. The third treatment (T3) contained 40%PKC but without enzyme. The fourth treatment (T4) contained 60%PKC + enzyme while the fifth treatment (T5) contained 60%PKC but without enzyme. There were significant ($P<0.05$) differences in weight gain, average daily feed intake and feed conversion ratio. There were significant ($P<0.05$) differences between the mean carcass characteristics of the experimental animals as a result of their different diets containing different levels of PKC (with or without enzyme supplementation) inclusion. There were also significant ($P<0.05$) differences between the dressed weight percentages of the loin, the kidney and the heart. The dressed weight was higher ($P<0.05$) for treatment 3 than other treatments while the loin was higher ($P<0.05$) for treatments 3 and 2. There were also significant ($P<0.05$) differences in the mean of the kidney and the heart. The results of the serum chemistry showed that there were no significant ($P>0.05$) differences between the Serum levels of total protein, cholesterol and the Urea of the experimental animals. However, there were Significant ($P<0.05$) differences between the mean values of albumin and glucose. In conclusion, PKC inclusion of up to 60% did not have any deleterious effect on the serological and carcass characteristics as well as the general performance of finisher pigs. This study therefore provides useful information for farmers, nutritionists, researchers, research institutions and other stakeholders.

Keywords: Carcass characteristics, weaner pigs, meat quality, palm kernel cake

1. Introduction

The use of unconventional feedstuffs especially in monogastric animal feeding continue to attract positive interest among researchers, livestock farmers, animal feed manufactures and other stakeholders in the agricultural and agro-allied industries. According to Iyayi *et al* (2005) [11, 12] 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.

Feed costs and animal competition with humans for feed items suggest strongly that alternative energy sources such as crop residues or agricultural by- products like palm kernel cake (PKC) be used partially or totally to replace maize in livestock diets thereby reducing cost, enabling cheaper meat production and making available major crops for human consumption (Fomunyam, 1981) [7].

About 33% of people in sub-Saharan Africa are undernourished compared to about 6% in North Africa and 15% in Asia (FAO, 2002) [6], while more than 60% of the undernourished are in Eastern Africa. Nigeria's prevalence rate is low but its large population means that the country accounts for 22% of the food insecure in West and Central Africa (IAC, 2004) [10]. This situation is getting worse and it is disheartening to note that most people in the developing countries continues to suffer from nutritional disorders as a result of inability to harness and utilize the available resources at their disposal for the production of much needed animal protein.

The search for least cost formulation has led Animal Nutritionists to investigate the nutritional potential of non-conventional ingredients used for compounding animal rations, and to see the percentage of combination of such ingredient that could give satisfactory performance (Oruseibio, 1985) [16]. One of such ingredients, which do not serve as direct food for human, is Palm Kernel Cake (PKC). It is not expensive and is readily available.

However, it is high in fibre (150g/kg DM) (McDonald *et al.,* 1995) [15], it is not palatable and contains anti-nutritive factors which interfere with digestion and absorption of nutrients when fed especially to monogastrics. The mechanism by which enzymes improve the nutritive value of cereals was discussed by. Their assumption was that enzymes that are added to the diet complete the digestive function of the gastrointestinal tract in monogastric animals, thereby improving the digestion and absorption of nutrients. It has been reported that enzyme supplementation does improve the utilization of fibre feedstuffs.

According to Iyayi *et al., (*2005) [11, 12] there was a significantly higher feed intake in both starter and finisher birds fed enzyme supplemented BDG and PKM diets than those on basal diets with significantly (p< 0.5) higher weight gain of birds on the BDG and PKM supplemented diets than those on the basal diet only at the starter phase. In a study of the effects of PKM on productive performance and carcass characteristics of pigs, Jegede*.et al.* (1994) [13] reported that final weight of pigs decreased linearly as the level of dietary PKM is increased while daily feed intake was not significantly affected by dietary treatments.

According to Sundu *et al.,* (2005) [17], there is economic incentive to investigate the use of palm kernel meal in broiler diets in four regions of the world (Asia, Pacific, South America and Africa) due to its cost effectiveness compared to conventional feedstuffs. There has been a dramatic increase in global production of PKM with annual growth of 15% over the last two decades (FAO, 2002) [6]. The rising cost of conventional feedstuffs, which are regularly imported into palm kernel meal producing countries, has triggered much pressure on local poultry industries to maximize the use of locally available feedstuffs (Hutagalung, 1980) [9].

2. Materials and Methods

Thirty finisher pigs of the large white x Duroc crossbreed whose average initial live weight ranges from 21.5kg - 23.17kg were randomly assigned to five dietary treatments. Each treatment was replicated thrice in a Completely Randomized Design. The first dietary treatment (T1), which was the control, contained 0%PKC and without enzyme supplementation. The second treatment (T2) contained 40%PKC + enzyme. The third treatment (T3) contained 40%PKC but without enzyme. The fourth treatment (T4) contained 60%PKC + enzyme while the fifth treatment (T5) contained 60%PKC but without enzyme. The diets and water were provided *add-dlibitum* to the experimental animals for the twelve weeks period of the study. These dietary treatments were compounded with Hemicell(R) enzyme added at 600g/ton to some of the treatment diet while the rest did not have Hemicell (R) enzyme according to the design. Standard swine management procedures were strictly applied. Feed intake for each replicate was recorded on daily basis while each experimental animal was weighed on weekly basis and weight gained computed on daily basis.

Feed Conversion Ratio (FCR) was calculated as feed intake divided by weight gain. Feed cost/kg of body weight gain was determined by multiplying the cost per kg of feed by the corresponding feed conversion ratio. At the end of the feeding experiments, two pigs from each group were slaughtered for carcass evaluation. 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 a state of unconsciousness, which allowed easy slaughtering, and complete bleeding

Some of the characteristics that were evaluated include: colour of the meat, fat deposition, lean meat, meat texture and palatability. On the other hand, the Serological parameters were determined as follows; Total Serum Protein by the Buiret technique, Albumin and Globulin by the Colorimetric technique, Urea content by the Berthelot (colorimetric) method, while Glucose and Cholesterol were analyzed through the enzymatic colorimetric method. Data for all parameters measured were processed and analyzed using SPSS (Statistical Procedures for Social Sciences) computer package. Significantly different means were separated using Duncans Multiple Range Test (Duncan, 1955) [4], in the same package.

3. Results and Discussion

The results show significant (P<0.05) differences in weight gain, average daily feed intake and feed conversion ratio. The average final live weight ranged from 35.00 kg to 38.50 kg with the highest (P<0.05) value obtained in Pigs fed dietary Treatment 3. The values for the average total weight gain ranged from 11.00kg in Pigs fed dietary treatment 1 to 13.83kg in finisher Pigs fed dietary Treatment 3 (Table 2). The finisher pigs fed diet 1 which is the control diet without PKC had lower weight gain than those on diets 2 (40%PKC + enzyme), 3 (40%PKC without enzyme), 4 (60%PKC + enzyme) and 5 (60%PKC without enzyme). This is an indication that finisher pigs can perform better and tolerate up to 60%PKC inclusion in their diet with or without enzyme supplementation.

Although there were no significant (P>0.05) differences between the mean carcass characteristics of the experimental animals, there were significant (P<0.05) differences between the dressed weight percentage, the loin, the kidney and the heart. The dressed weight was higher (P<0.05) for treatment 3 than other treatments while the loin measured as a percentage of dressed weight was higher (P<0.05) for treatments 3 and 2. There were also significant (P<0.05) differences in the mean of kidney and the heart (all measured as percentage of dressed weight) with the mean percentage of the kidney higher (P<0.05) for treatment 1 and lowest for treatment 5, while the mean percentage of the heart was higher (P<0.05) in treatment 1 and lowest in treatment 2 (Table 3).

The results of the serum chemistry are presented in Table 4. The Serum levels of total protein, cholesterol and the Urea of the experimental animals were not affected by the experimental diets as there were no significant (P>0.05) differences between the means of the three parameters. However, there were Significant (P<0.05) differences between the mean values of albumin and glucose. The albumin level was highest (P<0.05) for finisher pigs in treatment 2 and lowest (P>0.05) for those in treatment 1. Treatment 2 also had a high (P<0.05) glucose level when compared with the control diet while treatment 4 had the lowest glucose level. Moreover, since there was no mortality as a result of the use of this test ingredient (PKC) during the twelve-week study period, it is therefore suitable energy diluents in formulating finisher pig's ration.

Enzyme supplementation of the test ingredient (PKC) in the second and third experiments of this research became necessary as a result of findings by many researchers (Akpodiete *et al,* 2006, Choct, 2006 [1], Ezieshi and Olomu, 2004, Lenehan, *et al*., (2003) [14], Chen *et al*., (1997) [2] and David *et al*., (1997) among others), 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) [11] 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) [2] 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) [14] 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.

In view of the above findings, Hemicell[R] was used to supplement the test ingredient (PKC) in two of the five dietary treatments used in this study. Hemicell is a patented fermentation product of *Bacillus lentus*. The active ingredient in the fermentation product is *B*-mannase (Lenehan *et al*, 2003) [14]. In conclusion, PKC inclusion of up to 60% did not have any deleterious effect on the haematological, serological, carcass and organ characteristics as well as the general performance of the finisher pigs.

Finally, this study reveals the potentials of pig production towards meeting human protein requirement, job creation,

Rural development, poverty alleviation and overall economic development among others as well as providing another basis for further research on the utilization of PKC for sustainable pig production.

Table 1: Percentage Composition of Experimental Diets for Finisher Pigs.

Ingredients Dietary Treatments					
	1	2	3	4	5
	(0%PKC- EZM)	(40%PKC+ EZM)	(40%PKC- EZM)	60%PKC+ EZM)	(60%PKC- EZM)
Maize	34.17	20.50	20.50	13.67	13.67
PKC	-	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 (65%)	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.

Table 2

Calculated Composition					
Crude Protein %	16.75	18.10	18.10	18.78	18.78
Crude fibre %	6.02	7.15	7.15	7.73	7.73
Metabolizable Energy (kcal/kg)	3,478.57	3,361.43	3,361.43	3,403.02	3,403.02

Table 3: Performance Characteristics of Finisher Pigs fed Experimental Diets

Treatments						
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
	0%PKC- EZM)	**(40%PKC+ EZM)**	**(40%PKC- EZM)**	**(60%PKC+ EZM)**	**(60%PKC- EZM)**	
Average Initial live weight (kg)	24.00	23.33	24.67	24.83	23.33	0.37
Average final live weight (kg)	35.00	33.83	38.50	37.83	36.67	0.71
Average total weight gain (kg)	1100[ab]	12.50	13.83	13.00[b]	13.33[c]	0.50
Average daily feed intake (kg)	1.10[a]	1.07	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,] Means within rows with different superscripts are significantly (P<0.05) different.

Table 3: Carcass Characteristics and Organ Weights of Finisher Pigs fed

Treatments						
Parameters	1	2	3	4	5	SEM
	(0%PKC - EZM)	(40%PKC + EZM)	(40%PKC - EZM)	(60%PKC - EZM)	(60%PKC - EZM)	
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[c]	77.88[ab]	82.56[a]	73.87 [b]	76.79[ab]	1.18
Carcass length (cm)	90.50	85.00	92.50	84.00	94.50	2.16
Wholesale Cuts (% DW)						
Trimmed ham	3.71	3.88	4.38	4.10	4.25	0.18

Loin	6.62^{ab}	6.88^{b}	7.75^{a}	4.89^{c}	5.15^{ac}	0.39
Picnic shoulder	3.29	3.57	3.63	3.95	3.33	0.16
Trimming (% DW)						
Neck bone	4.82	5.62	4.66	4.88	5.30	0.19
Kidney	0.89^{a}	0.55^{ac}	0.73^{ab}	0.55a^{c}	0.60^{ac}	0.05
Trotters	3.54	3.57	3.78	4.25	4.24	0.15
Retail cuts (% DW)						
Head	12.72	12.50	12.00	13.61	11.07	0.41
Heart	0.95^{a}	0.72^{ac}	0.78^{ab}	0.60^{ac}	0.63a^{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,} Means within rows with different superscripts are significantly (P<0.05) different.

Table 4: Serum Chemistry of Finisher Pigs fed Experimental Diets

	Treatments					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
	(0%PKC- EZM)	**(40%PKC+ EZM)**	**(40%PKC- EZM)**	**(60%PKC+ EZM)**	**(60%PKC -EZM)**	
Total Protein (g/dl)	46.17	57.10	47.60	52.67	54.17	1.63
Albumin (mg/dl)	26.90ab	38.40a	29.70ab	30.20ab	30.77ab	1.32
Glucose (mmol/dl)	14.37ab	15.17a	11.40ab	9.03 ab	6.27 b	1.31
Cholesterol (mmol/dl)	2 83	3.37	3.00	2.83	2.87	0.18
Urea (mmol/dl)	6.57	6.60	5.90	6.20	7.03	0.21

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

4. Competing interests
I hereby declare that there is no conflicting interest.

5. Author's contribution
Prof. O.J Akpodiete was my supervisor and he contributed immensely to the success of this research. Dr. L.Bratte also contributed.

6. Acknowledgement
I hereby wish to acknowledge the management and staff of the teaching and research farm unit of the department of Animal Science, Delta State University, Anwai Campus. Asaba. Nigeria, where the research was carried out. The contributions of Prof. O.J. Akpodiete and Dr. L. Bratte are highly appreciated.

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