GROWTH RESPONSE AND ECONOMIC ANALYSIS OF WEANER PIGS FED DIFFERENT COMBINATIONS OF ENZYMES IN A MULTI-ENZYME COMPLEX

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ABSTRACT

The presence of non-starch polysaccharides (NSP) and anti-nutrient in many feedstuffs has limited their utilization in the diet of pigs for enhanced productivity. This study aimed at assessing the effect of different enzyme combination in a multi-enzyme complex on the growth response of weaned pigs. Sixty weaner pigs (male and female Largewhite × Landrace crosses) of average weight of 8.24±0.32 kg were randomly allotted to four dietary treatments (E1, E2, E3 and E4) with three replicates per treatment in a completely randomized design. The animals on diet E1 were fed the control diet without enzymes while those on diet E2, E3 and E4 were fed diets containing multi -enzyme which are B at 300g/tonne, C at 500g/tonne and D at 300g/tonne respectively. The feeding trial lasted for nine weeks. The final body weight of 32.67 kg recorded in E4 was observed to be significantly (P<0.05) higher than the values for the other treatments. The body weight gain also showed similar trend as the significantly (P<0.05) lowest (19.29 kg) and highest (24.40 kg) were observed in E1 and E4, respectively. A feed conversion ratio of 2.578 was obtained in E3 while weaners on E1 had 3.16. The costs of feed (per kg) were ₦169.00 and ₦171.10 in E1 and E3, respectively. The highest cost of feeding was recorded in diet E4 while the least was recorded in E1. The pigs fed diet E4 had the better feed cost per weight gain (₦438.63/kg). It could be concluded from this study that the addition of multi-enzyme complex to the diet of weaner pig improved feed utilization, growth and proved to be economically beneficial.

Keywords*:* ***Enzyme, Growth, Non-starch Polysaccharides, Utilization, Cost***

INTRODUCTION

Non-availability of conventional feed resources like maize, soyabean meal and fish meal coupled with their high prices in the market has resulted in the use of non-conventional feed ingredients/ agro-industrial by-products in the diets of pig (Amaefule *et al.,* 2009; Makinde and Inuwa, 2015). Non-availability of conventional feed resources has led to increased feed cost (65 - 80 % of variable cost of production) and ultimately increased cost of production thereby resulting in low returns for farmers. In an attempt to minimize cost of feed, non-conventional ingredients are included in the diets of different livestock species (Akinfala and Tewe, 2001; Amata, 2014) including pigs at different stages of production ie; weaner, grower and finisher. Weaner pigs which are transitioning from a milk-based liquid diet to a solid and more fibrous diet are mostly affected by the inclusion of these non-conventional feed ingredients in their diets resulting in post weaning stress (Campbell *et al.,* 2013; Pluske, 2016; Torres-Pitarch *et al*., 2017). The effects are more conspicuous with the re-

duction in birth to weaning interval in most commercial farms ranging from 3 - 5 weeks depriving the pigs the opportunity to gradually embrace the solid feed. This stress creates challenges for the pigs in adapting and utilizing the new solid diet, leading to decrease in feed intake (Le Dividich and Sève, 2000; Spreeuwenberg *et al.,* 2001) and alteration in the metabolic process of the animal which may have both short term and long term effects on the subsequent growth and development of the animal (Campbell *et al.,* 2013).

Utilization of these non-conventional feed resources is limited by the presence of anti-nutritional factors and non-starch polysaccharides (NSP) that pig lacks the specific endogenous enzymes to degrade. The inadequate endogenous enzyme production or lack of capacity to produce enzymes for specific substrates among other factors, have adverse effects on nutrient digestibility, absorption rate and thus compromise the performance of the animals (Amata, 2014). Several approaches have been used to improve the utilisation of these ingredients (Le Gall *et al.,* 2009; Lundblad *et al.,* 2011; Rojas and Stein, 2017). These include reduction of the particle size mechanically (Hancock and Behnke, 2001), subjecting the ingredient to chemical or thermal treatment to remove/ deactivate anti-nutritional factors (Herkelman *et al.,*1992; Stein and Bohlke, 2007) and inclusion of additives in the diet to enhance the quality. However, the use of thermal treatment and/or mechanical breakdown of feed particles are not sufficient to release all non-digestible nutrients present in these plant-based feed ingredients. Additives such as anti-biotics, pro-biotics, pre-biotics and enzymes are also added to the diet of pigs to enhance their health status, improve the gastro-intestinal environment for breakdown and absorption, increase feed utilisation efficiency and ultimately improve the production indices of the animals.

Enzymes have been used as additive in the diet of livestock for more than 20 years and it is becoming more popular in overcoming the challenges pigs have in digesting the NSP in their diets (Kerr and Shurson, 2013; Mireles-Arriaga *et al.,* 2015). Its addition to the diets of pigs ordinarily increases the unit cost of the diet, however the potential benefits could reduce the effect of the increase in price. Adding exogenous NSP-degrading enzymes to the diet of swine has the potential of improving nutrient availability by breaking down the nutrient encapsulating cell wall as well as ameliorating viscosity problems (Recharla *et al*., 2019) Exogenous enzymes commonly used in the diet of pigs include protease, lipase, xylanase, cellulase, phytase, glucanase, pectinase, mannanase, carbohydrase, among others. An exogenous enzyme can be added singly to a diet in order to degrade a targeted anti-nutritional component that impairs utilisation of nutrients in a diet. Enzymes are specific in action i.e an enzyme has a particular substrate it can act on. This is why additives containing just an enzyme may not be sufficient in maximizing the benefit of adding exogenous enzyme in the diet of pigs. However, different combination of enzymes in a product known as cocktail/multi enzyme complex are now used in the diet of pigs to improve feed utilisation.

The concept of adding cocktail of exogenous enzymes or multi-enzyme complex in the diet of pigs however present an opportunity to target different chemical components of feed ingredients leading to better nutrient utilization and growth performance than the use of single enzyme type Kerr and Shurson, 2013). Omogbenigun *et al*. (2004) reported improvement in feed utilisation in weanling pigs fed three different combination of enzymes in a multi-enyme complex. Emiola *et al.* (2009) also reported the improvement in the growth of pigs fed 30 % wheat distiller dried grains with soluble supplemented with a carbohydrase enzyme blend. This study aimed at assessing the effect of different enzyme combination in a multi-enzyme complex on the growth response of weaned pigs.

MATERIALS AND METHODS

This study was carried out at AK Research Farm Eleyele, Ibadan situated on N 07.43093° and E 003.84910°. A total of 60 weaned pigs (Large White × Landrace crosses) of mean weight 8.24±0.32 kg (± SE) were used for this study. These animals were randomly allotted into 4 dietary treatments labeled E1, E2, E3 and E4 respectively in a completely randomised design. Each treatment was replicated thrice with 5 animals per replicate. Pigs on diet E1 were fed the

control diet (basal diet) which is without the addition of any enzyme. The composition of the control diet is shown in Table 1. The feed was formulated following the National Research Council (NRC, 2012) nutrient requirement recommendations for weaner pigs raised in a tropical environment.

Three commercially available exogenous enzyme cocktails labelled B, C and D were used in this study and each was added to the control diet to make diet E2, E3 and E4 respectively. Cocktail enzyme B in diet E2 contains a mix of lipase cellulase, xylanase, protease, phytase, β-glucanase, pectinase and α-amylase and was included in the diet at the rate of 300g/tonne. Cocktail enzyme C in diet E3 is made up of β-glucanase, pectinase and protease and it was added to the diet at the rate of 500g/tonne. The multi-enyme D comprises of protease, phytase, mannanase, carbohydrase and lipase and the use rate was 300g/tonne of feed. The rates of inclusion of the enzymes in the diets were as specified by the manufacturers.

The animals were housed in open sided pens where they were given good management practices. Water was made available *ad libitum* and each feed was supplied without restriction. The weights of the animals were taken weekly with the use of a walk-through digital scale while the feed intake was measured daily. The feed intake was measured as the difference between the feed given and the remnants. The weight gain was estimated as the difference between the final weight and the initial weight while the feed conversion ratio was calculated as the ratio of feed intake to weight gain. The experiment lasted 63 days.

Data collected were subjected to the general linear model of analysis of variance and significant means were separated using the Duncan's Multiple Range Test (DMRT) of SAS (2002).

Table 1: Ingredients and nutrient composition of the experimental diets

INGREDIENTS	**E1**	**E2**	**E3**	**E4**
Maize	45.00	45.00	45.00	45.00
Soybean meal	24.00	24.00	24.00	24.00
Fishmeal	3.00	3.00	3.00	3.00
Palm kernel cake	7.34	7.34	7.34	7.34
Maize bran	5.00	5.00	5.00	5.00
Wheat bran	10.00	10.00	10.00	10.00
Palm oil	2.00	2.00	2.00	2.00
Bone meal	1.60	1.60	1.60	1.60
Limestone	0.80	0.80	0.80	0.80
Methionine	0.03	0.03	0.03	0.03
Lysine	0.45	0.45	0.45	0.45
Threonine	0.03	0.03	0.03	0.03
Premix	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Enzymes	-	0.03	0.05	0.03
Total	100.00	100.03	100.05	100.03
Calculated values				
Metabolizable energy (Kcal/kg)	2909.62	2909.62	2909.62	2909.62
Crude protein (%)	20.09	20.09	20.09	20.09
Crude fibre (%)	5.08	5.08	5.08	5.08
Lysine (%)	1.48	1.48	1.48	1.48
Methionine (%)	0.40	0.40	0.40	0.40

RESULTS AND DISCUSSION

The growth response of weaner pigs fed different combination of enzymes in the multi-enzyme complexes is as shown in Table 2. There were significant (P<0.05) differences in the final weights among the treatments. Weaner pigs fed diet E4 had the highest final weight of 32.67 kg while the lowest final body weight of 27.33 kg was recorded for the animals on the control diet (E1). The body weight gain (19.29 kg) in the control group was observed to be the least among the treatments and was significantly (P<0.05) different from the 23.50, 23.00 and 24.40 kg recorded for pigs on diet E2, E3 and E4 respectively. However, no significant (P<0.05) differences were observed among the body weight gains of pigs on diet E2, E3 and E4 fed different types of the enzyme cocktails. This corroborates the work of Wang *et al.* (2018) who reported improvement in the weight gain of weanling pigs as a result of inclusion of multi-enzyme in a corn-soyabean meal-based diet. A trend similar to what was observed in the total body weight gain was observed in the average daily weight gains among the treatments. Diet E1, with the lowest average daily weight gain of 0.31 kg, was found to be significantly (P<0.05) different from the 0.373, 0.365 and 0.387 kg reported in weaner pigs fed diets E2, E3 and E4 respectively. The average daily weight gain reported in this study is similar to that of Recharla *et al.* (2019).

Average daily feed intakes of 0.828, 0.970, 0.924 and 0.979 kg were recorded in diet E1, E2, E3 and E4 respectively. No significant differences were observed in the feed conversion ratios (FCR) of the weaner pigs feed different types of enzyme cocktails. The FCR ranged between 2.578 in diet E3 and 3.163 in diet E1. The decrase in the FCR of E2, E3 and E4 compared to that of the control diet indicates that inclusion of multi-enzyme to the diets non-significantly improved nutrient digestibility and utilization. The enzyme combinations used in this study is similar to those used in the work of Lu *et al*. (2016), Wang *et al.* (2018) and Recharla *et al.* (2019). The economic analysis of feeding weaner pigs with the different multi-enzyme complex is as presented in Table 2. The cost of feed per kg ranged between ₦169.00 and ₦171.10 in diet E1 and E3 respectively. The total cost of feeding was observed to be highest in E4 (₦10,466.99) and least in E1 (₦8,818.77) and the average cost of feeding per day also followed a similar trend. The feed cost per weight gain was found to be highest (₦534.55/kg) with the pigs fed the control diet. The increased feed cost arising from inclusion of multi-enzyme complex was justified by the reduced cost per weight gain recorded in diet E2 (₦456.56), E3 (₦441.10) and E4 (438.63)

Recharla *et al.* (2019) studied the effects of a multi-enzyme complex comprising of xylanase, α-amylase, β-glucanase, and protease supplementation on the dry matter digestibility of feed and reported that the multi-enzyme complex has

Table 2: Growth response of weaner pigs fed different types of multi-enzyme complex

Parameters	E1	E2	E3	E4	SEM	P-value
Initial body weight (Kg)	8.047	8.633	8.000	8.267	0.3178	0.8973
Final body weight (Kg)	27.333[b]	32.133[a]	31.000[a]	32.667[a]	0.4548	<.0001
Body weight gain (Kg)	19.287[b]	23.500[a]	23.000[a]	24.400[a]	0.5433	0.0031
Daily weight gain (Kg)	0.306[b]	0.373[a]	0.365[a]	0.387[a]	0.0086	0.0031
Daily feed intake (Kg)	0.828	0.970	0.924	0.979	0.0306	0.2848
Feed conversion ratio	3.163	2.691	2.578	2.584	0.1562	0.5097

[ab] Means within the same row with different superscripts are significantly different (p<0.05)
SEM; standard error of mean

Table 3: Cost benefit analysis of supplementation of multi-enzyme complex in the diet of weaner pigs

Parameters	E1	E2	E3	E4
Cost of feed (₦/Kg)	169.00	169.66	171.10	169.75
Total cost of feeding (₦)	8818.77	10373.11	9961.57	10466.99
Average cost of feed/day (₦)	139.98	164.65	158.12	166.14
Feed Cost/Weight Gain (₦/Kg)	534.55	456.56	441.1	438.63

the potential to improve nutrient digestibility and modify the microbial communities in the hind-gut. This is because, the negative impact of the substrates in the feedstuff when undigested, is ameliorated by the intervention of the exogenous multi-enzyme complex. In a similar study carried out by Lu *et al.,* (2016), the combination of xylanase, β-glucanase, and phytase in one enzyme mix improved the body weight and the average daily weight gain of the weaned pigs.

CONCLUSION

The use of multi-enzyme complex in this study to supplement the diet of weaned pigs improved the utilization and growth characteristics of the pigs and it was economically beneficial.

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