THE UTILIZATION OF AGRO – WASTE AS ALTERNATIVE SOURCE OF FIBRE/ ENERGY FOR PIG PRODUCTION

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ABSTRACT

A seven –week feeding trial was conducted to evaluate the potential of utilizing selected agro-industrial wastes as economically viable alternative dietary fibre and energy sources for the production of weaner pig. Twenty four weaner pigs comprising of 12 males and 12 females were randomly assigned to four dietary treatments in a completely randomized design. Each diet was assigned six pigs in three replicates of two pigs per replicate. The different proportion of BDG and PKC were 20% in treatments II and III respectively while, treatment IV had equal weights (10%) of PKC and BDG. However, Diet I (control) contained 20% of wheat bran. During feeding, Parameters such as weekly weight gain (WWG), final weight gain (FWG), feed intake (FI), feed conversion ratio (FCR) and total production cost per pig (naira) were determined. The result showed that average weekly weight gained by the pigs ranged from 2.90 to 3.50kg, final weight gain ranged from 29.80 to 31.40kg, feed intake ranged from 9.0 to 9.19kg and feed conversion ratio ranged from 2.77 to 3.27kg across the treatments respectively. Diet III which contained palm kernel cake performed significantly ($p < 0.05$) better than other treatments in terms of dietary fibre and energy source for weaner pigs. A combination of equal proportion of PKC and BDG in diet IV supported better weight gain in the pigs. Finally, diet IV gave the highest return on investment in terms of total revenue/pig.

Keywords: agro- industrial wastes, weaner pig, dietary fibre.

INTRODUCTION

In recent times, the activities of agricultural industries have increased in order to satisfy the growing population in Nigeria (Ewah and Ekeng, 2009). This has resulted to an increasing amount of waste that is being generated by the agricultural industry and could constitute environmental pollution if not properly managed (Liu *et al*., 2013). Agro industrial by-product varies depending on the type namely, food industry, non-food industry or crop residues and animal wastes from farms. Although large quantities of crop residues produced on private and government farms in Nigeria are still wasted year after year, some are left to rot in the field which may either improve soil fertility or pollute the environment (Mirzaei-Aghsaghali and Maheri-Sis, 2008). In the past, agricultural by-products such as brewers spent grains from the brewing industries, wheat and maize offals from the flour industries and molasses from the sugar industries were either burnt or improperly disposed on land or in water bodies which resulted in environmental pollution (Onyeonagu and Njoku, 2010). In order to mitigate (or alleviate) the negative impact of indiscriminate disposal of these organic materials into the environment, there is a growing need to divert them from the waste stream and employed as a resource for livestock feeding, biofertilizer production, bioenergy generation, etc Kivaisi (2010).

On the other hand, Ani *et al*., (2013) utilized dietary effect of rice milling waste on the performance of broiler chicks, result shows that 20% RMV can be included in broiler starter diet without any adverse effect on growth performance of birds. Dieumou *et al*. (2013) also conducted a research on growth performance of diet on two source of protein (GNC & SBM) and two levels of wheat offal, analysis shows that SBM based diet had significantly higher. Daily feed intake, daily weight gain and better feed conversion ratio that those on GNC base diet, while wheat offal level had no effect on any of the parameter studies. Furthermore, Imonikebe and Kperegbeyi, (2014) in their findings concluded that 20% of substitution of maize with brewer's dried grain produced no negative effect on the production performance of weaner pigs. Agro- industrial by product can be used as alternative sources of dietary fibre to formulate livestock feed (Maneerat *et al*., 2015). This is due to the high cost as well as increasing demand for conventional sources fibre and energy (wheat bran, maize, groundnut cake) by the growing population as food within the country(Balogun *et al*., 2016). Subsequently, the livestock feed industry competes with other sectors for the consumption of conventional ingredients. This competition results in prices increase of finished feed upwards (Iyayi, 2003). A redirection of efforts to the use of agro-by-products has been advocated as a way of solving this problem. Agro-industrial by-products are in large quantity in Nigeria (Adesehinwa, 2007).

This research therefore considers the use of agro-industrial by product to enhance pig's production. Akintunde *et al*. (2011) asserted that pig production remains the fastest means of correction of animal protein shortage in Africa because pigs are prolific, fast growing animal and good converter of feed to meat which is an effort that is geared towards increasing animal protein supply at a reduced cost for human consumption. Virtually all part of pig is used as either human food or animal feeds. The faeces and effluent (waste from both plant and animal) are used in organic farming (fertilizer), fish feed and biogas production (Kiratikarnkul, 2008). Pigs are capable of converting agro-industrial by-products or "wastes" of all kinds (which will normally be discarded by humans) into wholesome animal protein (Tonukari *et al*., 2016).

The aim of this study is to evaluate the potential of utilizing selected agro-industrial waste as economically viable alternative dietary fibre and energy sources for the production of weaner pig.

MATERIALS AND METHODS

The study was carried out in 24 different pens at the Faculty of Agriculture Demonstration Farms, Ambrose Alli University, Ekpoma (Emuado Annex), Edo State. A total of twenty – four weaner pigs consisting of 12 males and 12 females were randomly assigned to four dietary treatments in a completely randomized design. Each diet was assigned six pigs in three replicates of two pigs per replicate.

Table I: **completely randomized experimental design of weaner pigs fed with different diets**

	Dietary treatment			
	Diet I	Diet II	Diet III	Diet IV
Replicate	2	2	2	2
	2	2	2	2
	2	2	2	2

Diet I (control) WB –Wheat bran, Diet II (BDG) – Brewer's dried grain, Diet III(PKC) – Palm kernel cake, Diet IV – equal percentage of Brewer's dried grain and Palm kernel cake.

Test Materials

The weaner pig were procured from the Faculty of Agriculture Demonstration Farms, Ambrose Alli University, Ekpoma(Emuado Annex) Edo State(Nigeria). The weights of the weaner pigs were measured before and after (for seven weeks) using a weighing balances, model (animal weighing scale PCE- PS 75XL). The pigs were housed in a tropical type and open sided pig house roofed with asbestos roofing sheets

Experimental diets

The experimental diets were formulated in such a way that palm kernel cake (PKC) and brewer's dried grain (BDG) served as alternative dietary fibre/energy source to the conventionally used wheat offal in weaner pig diet. Diet I (the control) contained 20% wheat offal, in diets II and III the wheat offal was replaced with 20% of BDG and PKC respectively, while diet IV contained a combination of 10% each of BDG and PKC. The diets were also fortified with bone meal, fish meal, methionine, lysine, vitamin, premix, salts. All the diets were formulated to be iso-nitrogenous and iso-caloric (Table 2).

Table 2: Percentage Compostion of Experimental Diets

Ingredients	Experimental diets			
	Diets I	Diets II	Diets III	Diets IV
Maize	47	47	47	47
Wheat offal	20	-	-	-
Palm kernel cake	-	-	20	10
Brewer's dried grain	-	20	-	10
Soya bean	27	27	27	27
Fish meal	3.0	3.0	3.0	3.0
Bone meal	2.0	2.0	2.0	2.0
Salts	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100
Energy(Kcal/Kg	2862.0	2898.0	2899.6	2898.8

Diet I (control) WB –Wheat bran, Diet II (BDG) – Brewer's dried grain, Diet III(PKC) – Palm kernel cake, Diet IV – equal percentage of Brewer's dried grain and Palm kernel cake.

Data collection

Weekly weight gained (WWG) was calculated using equation I (Mwale *et al*., 2008). Mean Weight Gain (MWG**)** was calculated using equation II. Feed Intake (FI) was obtained using equation III. Feed Conversion Ratio (FCR**)** was calculated using equation IV. To determine the cost benefit of diet production, the cost per kg of each diet the total cost of feed consumed per pig were and feed cost/kg weight gain was estimated using equation V, VI and VII respectively.

$$WWG = Wt_0 - Wt_n \quad \text{.....Equation I}$$

Where: Wt_0 = Initial weight of pig at stocking

Wt_n = weight of pig with respect to time (weeks)

$$MWG = Wt_2 - Wt_1 \quad \text{.....Equation II}$$

Where: Wt_1 = Initial mean weight of pig at stocking (T_1)

Wt_2 = Finial mean weight of pig at the end of the experiment (T_2)

FI (Feed intake) = QI- QII ……Equation III

Where: QI = Quantity of feed offered
QII =Quantity of feed not consumed

This was calculated by dividing the amount of feed (feed intake) by weight.

$$FCR = \frac{feed\ intake}{average\ daily\ gain} \quad \text{……Equation IV}$$

$$Cost/kg = \frac{price\ per\ kg \times \%feedstuff\ compostion}{100} \quad \text{……..Equation V}$$

Total cost of feed consumed = Total feed intake × cost/kg ……Equation VI

Feed cost/kg weight gain = FCR × cost/kg of diet …… Equation VII

Data analysis

Growth performance data obtained were subjected to one way analysis of variance (one-way ANOVA) within SPPS environment (version 20). The differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION
Growth Performance of experimental pigs

The result of growth performance is presented in (table III). The average initial weight of the experimental pigs in Diet I, Diet II, Diet III and Diet IV were 10.30, 9.50, 9.75 and 9.80kg respectively The feed intake and average weight gain of weaner pigs treated with diets I II III and IV were 9.17 and 19.7, 9.0 and 20.3, 9.17 and 21.65 and 9.19 and 21.20 respectively. These resulted to a feed conversion ratio of 3.27, 3.26, 3.03 and 2.77 respectively. This means that the average weight gain of the weaner pigs treated with Diet III had the highest growth performance (31.40 – 9.75) while diet I had the lowest growth performance of 30.00 – 10.30). Statistical analysis showed that there was a significant difference ($P < 0.05$) in the final weight gain. These suggest that PKC had the highest performance in terms of dietary fibre. These result is in accordance with Irekhore *et al*. (2011) who reported in his findings a range of 25.13- 31.88.

Feed conversion ratio

The average weekly feed conversion ratio of Diet I, II, III and IV were 3.27, 3.26, 3.03 and 2.77 respectively. Statically the feed conversion ratio of Diet I were not significantly ($P > 0.05$) different from Diet II. However, there was a significantly ($P > 0.05$) different between the feed conversion ratio of Diet I and II from animals fed with diets II and IV respectively. This result suggests that the weaner pigs treated with Diet IV had the highest feed conversion ratio with time. The range of values observed in this finding was in agreement with the range 2.27 – 3.13kg reported by Ani *et al*., (2013).

Growth performance (by weight in kg) of weaner pigs on experimental diets

Parameters	Dietary treatments				
	DI(WB)	DII(BDG)	DIII(PKC)	DIV(BDG/PKC)	±SEM
initial weight(pig/kg)	10.30	9.50	9.75	9.80	
Final weight(pig/kg)	30.00	29.80	31.40	31.00	±0.412
Total weight gain/pig	19.7^{d}	20.3^{c}	21.65^{a}	21.20^{b}	±0.439
Feed intake	9.17^{a}	9.0^{b}	9.17^{a}	9.19^{a}	±0.011
Weekly weight gain	2.94^{c}	2.90^{c}	3.10^{b}	3.50^{a}	±0.114
Feed conversion ratio	3.27^{a}	3.26^{a}	3.03^{b}	2.77^{c}	±0.026

Means within the same row with different superscript "^{a}" are significantly different ($p > 0.05$)
Diet I (control) WB –Wheat bran, Diet II (BDG) – Brewer's dried grain, Diet III(PKC) – Palm kernel cake, Diet IV – equal percentage of Brewer's dried grain and Palm kernel cake.

Cost benefit of production and efficiency of the experimental diets

The cost benefit of production and efficiency of the experimental diets are shown in table 4. The cost of feed per kg was highest in diet I (78.30) and least in diet III (76.10). The average cost of feed per kilogram in Diet I (the control) was highest 253.60 while animals fed with PKC/BDG diet IV had the least value (202.90). Total production cost/pig/kg was highest in the control diet 5224.16 (wheat bran) and least in diet II 4234.58. Total revenue per total live weight gain per pig was highest in diet IV. This result basically suggests that diet III may be more economically viable alternative to the conventionally and more expensive wheat offal in weaner pigs diets. Dietary treatment IV had the highest cost estimated profit per total live weight gain.

Cost benefit of production and efficiency of experimental diets.

Parameters	Dietary treatments			
	Diet I(WB)	Diet II(BDG)	Diet III(PKC)	Diet IV(BDG/PKC)
Feed cost/kg	78.30	76.50	76.10	76.30
Feed cost/tone	78,300	76,500	76,100	76,300
Cost/feed intake	715.88	688.50	697.90	700.87
Feed cost/kg weight gain	253.60	208.60	230.90	202.70
Total production cost/pig	5224.16	4234.58	5010.53	4905.34
Total revenue/pig	7210	7105	7595	8470
Profit/pig	1985.84	2870.42	2584.47	3564.66

Diet I (control) WB –Wheat bran, Diet II (BDG) – Brewer's dried grain, Diet III(PKC) – Palm kernel cake, Diet IV – equal percentage of Brewer's dried grain and Palm kernel cake.

CONCLUSION

This experiment was designed to see if palm kernel cake and brewer's dried grain can successfully replace wheat offal. After subjecting weaner pigs to various source of dietary fibre and energy for 7weeks, it was observed that the experimental diet III (PKC) palm kernel cake perform significantly better than the control (diet I), diet II and diet IV respectively. Further observation showed that diet III may be more economically viable alternative to the conventional and more expensive wheat offal in terms of dietary fibre and energy source for weaner pigs. Moreover, it was observed that a combination of equal proportion of PKC and BDG in diet IV supported better weight gain in the animals. Wheat offal was more expensive

to produce while PKC diet was the cheapest. Finally, the feed that gave the highest return on investment was diet IV having equal combination of PKC and BDG.

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