GROWTH PERFORMANCE AND GUT PROMOTING ACTIVITY OF THREE CONVENTIONAL FIBRE FEEDSTUFFS IN DIETS OF GROWING PIGS †

[GANANCIA DE PESO Y ACTIVIDAD PROMOTORA A NIVEL INTESTINAL DE TRES ALIMENTOS FIBROSOS CONVENCIONALES EN DIETAS DE CERDOS EN CRECIMIENTO]

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SUMMARY

Background. The increasing utilisation of fibre feedstuffs in diets of pigs nowadays calls for concerns not only on the growth but also the health status of the animals and the possibility to eradicate the use of in-feed antibiotics for pigs. **Objective.** To evaluate the growth performance and gut promoting activity of three fibre feedstuffs (Palm kernel cake (PKC), Brewers' dried grain (BDG) and Wheat offal (WO)) in diets of growing pigs. **Methodology**. Three dietary treatments containing 40 % each of PKC, BDG and WO were randomly allotted to 24 growing crossbred (Large White x Hampshire) pigs of average initial weight of 30± 0.50 Kg in an 82 d feeding trial. **Results.** There was an influence ($p<0.05$) of sources of fibre feedstuffs for the arabinoxylan- and mannan-oligosaccharide concentrations of the dietary treatments with BDG having comparatively higher values than WO and PKC diets. The short-chain fatty acid (SCFA) concentrations and pH of gut digesta were different ($p<0.05$) across dietary groups with pigs fed BDG diet having higher SCFA concentration in the foregut and hindgut. In the gut flora, BDG and WO promoted the highest ($p<0.05$) *Lactobacillus* population in the small and large intestines respectively. There were significant ($p<0.05$) effects of fibre sources on the final weight, average daily gain and daily intake of pigs fed the different treatments with those fed WO diets showing superior performance over pigs fed either PKC or BDG diet. **Implication.** The WO diet promoted the fastest growth and better gut effects but BDG resulted in the most efficient feed to gain conversion. **Conclusion.** All the diets exhibited prebiotic activity, enhanced the growth of beneficial bacterial in the gut and could reduce the use of in-feed antibiotics for pigs.

Key words: prebiotic effects; wheat offal; brewer's dried grain; palm kernel cake; beneficial bacteria; in-feed antibiotics.

RESUMEN

Antecedente. La creciente utilización de alimentos fibrosos en la alimentación de cerdos genera la necesidad de conocer su impacto no sólo sobre el crecimiento de los animales, sino también sobre su estado de salud y la posibilidad de erradicar el uso de antibióticos en los alimentos para cerdos. **Objetivo.** Evaluar el comportamiento animal y la promoción de la actividad intestinal de tres alimentos fibrosos (torta de palma (PKC), malta de cebada cervecera seca (BDG) y afrechillo de trigo (WO) en dietas para cerdos en crecimiento. **Metodología.** Se utilizaron tres tratamientos que comprendían dietas con 40% de contenido de PKC (T1), BDG (T2) y WO (T3), los cuales fueron asignados aleatoriamente a 24 cerdos mestizos (Large White x Hampshire) en crecimiento. El peso inicial promedio de los animales fue 30 ± 0.50 kg y el ensayo tuvo una duración de 82 días. **Resultados.** Se encontró una influencia ($p<0.05$) de las fuentes de fibra en las concentraciones de arabinoxilano y manano-oligosacáridos en T2, con valores comparativamente más altos que las dietas de los T3 y T1. Las concentraciones de ácidos grasos de cadena corta (SCFA) en el intestino anterior y posterior y el pH de la digesta intestinal fueron superiores ($p<0.05$) en el T2. Respecto a la flora intestinal, T2 y T3 fueron los dos tratamientos que promovieron una mayor población de Lactobacillus ($p<0.05$) en los intestinos delgado y grueso. El peso final, la ganancia diaria de peso vivo y el consumo de alimento fueron mayores ($p<0.05$) en el T3 respecto al T1 y T2. **Implicaciones.** La dieta que contenía un 40% de WO (T3) tuvo un mejor comportamiento respecto al aumento diario de peso vivo y una mayor actividad intestinal. Sin embargo, el T2, que contenía 40% de BDG, permitió obtener una mayor eficiencia de conversión. **Conclusiones.** Todas las dietas presentaron actividad prebiótica, potenciaron el crecimiento de bacterias beneficiosas en el intestino y podrían reducir el uso de antibióticos en el alimento para cerdos.

Palabras clave: efectos prebióticos; afrechillo de trigo; malta cervecera; torta de palma; bacterias benéficas.

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INTRODUCTION

The spike in global food-feed prices occasioned by the competition between human and livestock especially the bulk feeders such as pigs and poultry for available cereal gains has consistently generated increasing attention of global debate on how to feed the world 9.2 billion population by 2050 (FAO, 2009; Tian *et al.*, 2021). At the same time, livestock production continues to grow in developing nations amidst changing climate (van Zanten *et al.*, 2016; Kang *et al.*, 2017; Kawabata *et al.*, 2020), further increasing pressure on production resources (land and water). One of the suitable pathways to resolve this challenge is the use of agro-industrial byproducts (AIBPs).

In the last two decades, there is continuous interest in the use of AIBPs as feedstuffs in the diets of pigs despite high fibre levels. The sustained interest may be due to its relatively cheap cost, eco-friendly and contributions to development of circular economy (Murray *et al.*, 2017; Toop *et al.*, 2017; Diluccia *et al.*, 2020). On the bases of availability and cost, palm kernel cake (PKC), brewers' dried grains (BDG) and wheat offal (WO) are the AIBPs most investigated by Nigerian pig nutritionists. Evidence from these studies showed variability in nutrient composition, impaired nutrient digestion, inferior growth performance and recently possible prebiotic effects (Amaefule *et al.*, 2009; Akinfala *et al.*, 2014; Akinfala *et al.*, 2017; Ogunjobi *et al.*, 2021). Meanwhile, fibre inclusion in diets of pigs could improve health, reduce cost of production and use of in-feed antibiotics (Jha *et al.*, 2019; Ogunjobi *et al.*, 2021). Nonetheless, its utilization by pigs is variable and depends on inclusion levels, sources and type, processing techniques and the peculiar attributes of the fibre.

To a large extent, fibre feedstuffs are not wholly degraded by endogenous enzymes of the small intestine, but are partially fermented by gut microbiota in the colon of pigs to produce short-chain fatty acids (SCFA) (Hu *et al.*, 2020). Findings have shown that SCFA has important physiological functions including improving the gastrointestinal motility associated with host health by selectively stimulating the growth and activity of the beneficial microbiota (Flint *et al.*, 2012; Koh *et al.*, 2016; Gensollen *et al.*, 2016; Liu *et al.*, 2018). The gut promoting attribute of fibre depends on the extent of fermentation and degradation in the gut, the intensity of microbial balance and structure (Natividad and Verdu, 2013; B¨aumler and Sperandio, 2016; Ogunjobi *et al.*, 2021; Bai *et al.*, 2022).
Earlier studies by Ogunjobi *et al.* (2021) documented the prebiotic activity of conventional fibre feedstuffs for growing pigs with peculiar conditions for inclusion in diets of pigs. Prior to this, there is a growing interest in the fate of different dietary fibre especially with respect to changes in gut microbiota and rate of fermentation in pigs (Feng *et al.*, 2018; Wang *et al.*, 2019). Understanding the gut modulation and performance of different dietary fibre in practical diets for pigs could provide more information for the formulation of functional feeds devoid of antibiotic growth promoter. The study aimed at evaluating the growth performance and gut promoting activity of three conventional fibre feedstuffs in diets of growing pigs.

MATERIAL AND METHODS

Experimental location and collection of test ingredients

The study was carried out at the Swine Unit of the Teaching and Research Farm, Obafemi Awolowo University (OAU), Ile-Ife, Nigeria. The OAU lies on Latitude 7^0 28'N and Longitude 4^0 33'E with an altitude of about 244m above sea level. The test ingredients (palm kernel cake (PKC), brewers' dried grain (BDG) and wheat offal (WO)) were purchased from a commercial feed mill in Ile-Ife, Osun State, Nigeria.

Experimental diets, animals and management

Three experimental diets were formulated using National Research Council (2012) recommendation as guide. Each of the dietary treatments (PKC, BDG and WO) contained 40% PKC, BDG and WO respectively, and were randomly allocated to 12 experimental pens. The composition of experimental diets is shown in Table 1. Twenty-four growing cross bred (Large White x Hampshire) pigs of average initial weight 30±0.50 kg were used in 84-d feeding trial. For each treatment, there were eight animals arranged in two animals per pen on the basis of sex in a completely randomized design (CRD). The animals were weighed at the beginning of the experiment, and thereafter, weekly throughout the experimental period. Feed and water were given *ad libitum* and routine management practices was carried out on the experimental pigs on treatment basis. Daily feed allocation and intake was measured while daily weight gain and feed efficiency ratio were evaluated.

Chemical analysis of test ingredients and digesta contents

The oligosaccharide (mannan and arabinoxylan-oligosaccharide) contents of different fibre feedstuffs (PKC, BDG and WO) were determined according to the procedure of Radley (1997). The percentage of manna- and arabinoxylan-oligosaccharide was calculated using the equation:

% Arabinoxylan-oligosaccharide = (Absorbance of sample x Average Gradient factor x DF) / (100 x Weight of Sample)

Proximate and cell wall composition of experimental diets were determined following the procedures of AOAC (2006) and Van Soest (1994) respectively.

Table 1. Composition of experimental diets.

Ingredients (%)	PKC	BDG	WO
Maize	45	45	45
Groundnut Cake	10	10	10
Fish Meal	2	2	2
Palm Kernel Cake	40	-	-
Brewers' Dried Grains	-	40	-
Wheat Offal	-	-	40
Bone Meal	2.25	2.25	2.25
*Premix (Vitamin-Mineral)	0.25	0.25	0.25
Salt	0.5	0.5	0.5
Total	**100.00**	**100.00**	**100.00**
Calculated Analysis			
Metabolizable energy (kcal/kg)	2736.5	2658.5	2614.5
Crude Protein (%)	17.64	17.64	17.24
Crude Fibre (%)	6.22	9.42	4.82

Premix (Vit/mm): vitamin A 7,000,000 IU; vitamin D3 1,7000, 000 IU; vitamin E 5,000 IU; vitamin k 1,000 mg; vitamin C 1,000 mg; vitamin B2 3,000 mg; vitamin B6 3,000 vitamin B12 16 mg; biotin 400 mg; folic acid 500 mg; niacin 10,000 mg; pantothenic acid 3,000 mg; choline chloride 130,000 mg; iron 15,000 mg; manganese 70,000 mg; copper 1,000 mg; zinc 20,000 mg; iodine 10,000 mg; cobalt 100 mg; selenium 100 mg; anti-oxidant 1,250 mg

Slaughtering procedures and collection of digesta from the gut

All experimental research procedures conformed with the institutional, national and international guidelines were approved by the Animal Welfare Committee of the Obafemi Awolowo University, Ile-Ife. At the end of the 84^{th} day of feeding, six experimental pigs per treatment were randomly selected, labelled and humanely slaughtered according to the procedure outlined by Close *et al.* (1997). The collection of digesta from both the small and large intestines for the determination of bacterial profile (total heterotrophic bacteria count, *Lactobacillus* count and total coliform count) was carried out by adopting the pour plate techniques. The pH was determined with the aid of a pH meter while short chain fatty acids (SCFAs) were determined using spectrophotometric method following the procedure of Kayol and Borilek (1995).

Data analysis

Data were subjected to Analysis of Variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (2009) based on the following statistical model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

in which Y is the dependent variable; i is for diets PKC, BDG or WO; j is for replicates 1, 2, 3, or 4; μ is the overall/group mean, T_i is the treatment effect of i^{th} diets; and e is the random error associated with completely randomized design. Standard error of the mean is for $n = 4$ and Duncan Multiple Range Test was used to separate means at 5% level of significance.

RESULTS

The oligosaccharide, proximate and cell wall composition of fibre feedstuffs is shown in Table 2. The arabinoxylan- and mannan-oligosaccharide contents of the fibre feedstuffs had significant difference ($p<0.05$) across treatment groups. The WO diet had the highest arabinoxylan-oligosaccharide content while PKC and BDG were 22% and 52% lower. On the other hand, BDG diet gave the better mannan-oligosaccharide content compared to WO and PKC which were 44% and 56% inferior.

There existed significant variations ($p<0.05$) in the proximate (CF, ash and NFE) composition of the different fibre feedstuffs. Higher values were obtained in BDG diet for the CF (7.23%) and ash (8.72%) contents while PKC had the least values (5.39% and 5.14%) respectively. The NFE values also varied between 56.5% and 49.49% for WO and BDG diets respectively. All the different fibre feedstuffs had significant variations ($p<0.05$) in the values obtained for the different cell wall components except the cellulose content. Higher values were found in PKC diets while the least values were obtained in WO.

Table 3 show the effects of different sources of fibre diets on digesta pH and short chain fatty acid (SCFA) profile in the gut of growing pigs. The different fibre sources had significant effects ($p<0.05$) on the digesta pH measured in the small and large intestines of growing pigs. Higher pH values (7.08 and 6.48) were found in the digesta of pigs fed BDG diet in both the small and large intestines while those fed PKC had the least pH values (6.08 and 5.49) in both regions of the gut.

Similarly, all the SCFA components were significantly different ($p<0.05$) for all treatment groups in the small and large intestines of pigs fed fibre diets. The pigs fed BDG diet produced significantly ($p<0.05$) higher values for the different SCFAs (acetic, propionic and butyric acids) and the total SCFA concentrations in the small and large intestines. On the other hand, the digesta from pigs fed PKC diet gave comparatively lower values for individual and total SCFA concentrations.

Table 4 shows the bacterial population in the gut of growing pigs fed fibre diets. The total aerobe count obtained from the digesta in the small intestine of pigs fed fibre diets had significant ($p<0.05$) variations, which is associated with fibre source. The highest value was found in pigs fed WO diet while those fed PKC and BDG diets were 30% and

88% lower. Contrarily, the total lactic acid bacteria population in the digesta of pigs fed BDG was comparatively higher (p<0.05) than those fed PKC and WO, which were -24% and -99% respectively.

In the large intestine, there was significantly (p<0.05) higher total aerobe in the digesta of pigs fed BDG than either of those fed WO or PKC. The WO fed pigs promoted the highest total lactic acid bacteria population while PKC performed the poorest. The total coliform count was significantly (p<0.05) higher in the digesta of pigs fed BDG diet while those fed PKC had the least population (2.75 $x10^4$ CFU/g digesta).

The performance of growing pigs fed experimental diets is shown in Table 5. There were significant differences (p<0.05) in the final weight (FW), average daily gain (ADG) and daily feed intake (DFI) of pigs fed the different fibre diets. The final weight of pigs fed experimental diets increased across treatment groups from those fed PKC diet to WO. The heaviest (63.25 kg) and lightest (55.50 kg) pigs were found in WO and PKC diets respectively. The WO fibre diet promoted the fastest growth (63.25 kg), ADG (397 g/d) and highest DFI (1.50 kg/pig/d) while those on PKC diet had the poorest FW (55.50 kg), ADG (299 g/d) and least DFI (1.13 kg/pig/d). Pigs on BDG diet were the most efficient feed converter compared with those on PKC and WO diets.

Table 2. Oligosaccharide contents, proximate and cell wall composition of fibre feedstuffs.

Parameters	PKC	BDG	WO	SEM	p-value
Oligosaccharide contents					
AX-oligo	0.68^b	0.42^c	0.87^a	0.065	<0.0001
Mannan-oligo	0.60^c	1.38^a	0.77^b	0.119	<0.0001
Proximate composition					
Dry Matter	93.09^a	90.45^c	91.61^b	0.387	<0.0001
Crude Protein	18.59	19.03	19.47	0.618	0.8797
Crude Fibre	5.99^b	7.23^a	5.39^c	0.283	0.0006
Ether Extract	5.53	5.98	5.12	0.354	0.6714
Ash	5.96^b	8.72^a	5.14^c	0.547	<0.0001
NFE	57.02^a	49.49^b	56.5^a	1.362	0.0086
Cell wall composition					
NDF	45.43^a	45.11^a	36.94^b	1.566	0.0096
ADF	8.93^a	7.53^{ab}	5.61^b	0.581	0.0312
Lignin	2.60^a	2.12^a	1.16^b	0.252	0.0256
Cellulose	6.33	5.41	4.45	0.459	0.2761
Hemicellulose	36.50^a	32.58^b	31.33^b	1.296	0.0109

^{a,b,c} means in the same row having different superscripts differ at p < 0.05; SEM− Standard Error of Means, AX-Arabinoxylan, Oligo-Oligosaccharide, NFE-Nitrogen Free Extract, NDF-Neutral Detergent Fibre and ADF-Acid detergent fibre.

Table 3. Digesta pH and short chain fatty acid (SCFA) profile in small intestine and large intestine of growing pigs fed experimental diets.

Parameters	PKC	BDG	WO	SEM	p-value
pH					
Small intestine	6.80^b	7.08^a	6.94^{ab}	0.046	0.0168
Large intestine	5.49^c	6.48^a	5.94^b	0.156	0.0041
SCFA Concentration (mmol/100ml)					
Small intestine					
Acetic acid	82.30^b	104.28^a	100.96^a	3.600	<.0001
Propionic acid	75.37^b	88.50^a	83.83^a	2.631	0.0003
Butyric acid	59.58^b	74.01^a	67.23^{ab}	3.646	0.0115
Total SCFA	217.25^c	266.79^a	252.02^b	9.287	<.0001
Large intestine					
Acetic acid	96.93^b	117.20^a	112.34^a	3.597	0.0198
Propionic acid	87.54^b	98.13^a	95.03^a	2.518	0.0041
Butyric acid	72.67^b	83.43^a	80.04^a	2.296	0.0009
Total SCFA	257.14^c	298.76^a	287.41^b	7.856	<.0001

^{a,b,c} means in the same row having different superscripts differ at p < 0.05; SEM− Standard, Error of Means, SCFA − volatile fatty acid.

Table 4. Bacterial population in the gut of growing pigs fed different fibre-based diets.

Parameters (CFU/g digesta)	PKC	BDG	WO	SEM	p-value
Small intestine					
Total aerobic count (x 10^6)	11.25^b	2.00^c	16.25^a	1.96	0.0004
Total lactic acid bacteria count (x 10^4)	0.25^b	37.5^a	28.5^a	5.49	0.0016
Large intestine					
Total aerobic count (x 10^6)	9.50^{ab}	29.25^a	3.75^b	2.99	0.0502
Total lactic acid bacteria count (x 10^4)	6.25^c	20.75^b	31.50^a	10.97	0.0002
Total coliform count (x 10^4)	2.75^b	24.00^a	7.50^b	0.75	0.0031

^{a,b,c} *means in the same row having different superscripts differ at p < 0.05; CFU − Colony forming unit*

Table 5. Growth performance of growing pigs fed experimental diets.

Parameters	PKC	BDG	WO	SEM	p-value
Initial weight (kg)	30.38	30.00	29.88	0.828	0.9733
Final weight (kg)	55.50^b	59.25^{ab}	63.25^a	1.231	0.0161
Daily weight gain (kg/pig)	0.299^b	0.348^{ab}	0.397^a	0.015	0.0121
Daily feed intake (kg/pig)	1.13^c	1.30^b	1.50^a	0.050	0.0003
Feed conversion ratio	3.78	3.73	3.78	0.106	0.9333

^{a,b,c} *means in the same row having different superscripts differ at p < 0.05*

DISCUSSION

Fibre feedstuffs particularly WO, BDG and PKC have been studied for their high contents of non-digestible oligosaccharides especially the arabinoxylan and mannan (Jay *et al.*, 2008; Iyayi and Adeola, 2015; Rajendran *et al.*, 2017). Iyayi (2008) reported 63.4% of NSP in WO as arabinoxylan, findings by Jaworski *et al.* (2015) were consistent with our results while Ogunjobi *et al* (2021) obtained higher values than those reported in this study. The observed variations in the oligosaccharide contents are possibly due to the differences in diet composition, processing methods, variety and environmental condition. Also, BDG has been reported to contain exceptionally low arabinoxylan due to variations in extent of extraction during the beer-brewing process (Izydorczyk and Dexter, 2008; Lao *et al.*, 2020).

The proximate and cell wall composition of the fibre feedstuffs were within the range observed by Fatufe *et al.* (2016) and Akinfala et al. (2017) for the proximate parameters. Jaworski *et al.* (2014); Rhule (2015) and Ogunjobi *et al.* (2021) reported lower values for the CF, ash, NDF, ADF and lignin contents, while Fatufe *et al.* (2016) and Ghodrat *et al.* (2017) obtained higher values. The differences that occurred in the respective cell wall and proximate contents of the different fibre feedstuffs could be due to varietal differences, soil type and the highly fibrous nature of the outer covering of the fibre feedstuffs.

The observed decrease in digesta pH along the gut from the small intestine/foregut to the large intestine/hindgut reflected a positive inverse relationship with short chain fatty acids, which is occasioned by an increase in fibre fermentation. Our results agree with those of earlier studies by Ngoc *et al.* (2012); Besten *et al.* (2013); Ndeh and Gilbert (2018); Chen *et al.* (2019) and Ogunjobi *et al.* (2021) who found similar trends. Iyayi and Adeola (2015) indicated that the important determinants of the nature and quantity of fermentation products are the type and amount of fibre as well as the available substrate in the fermentation medium. For instance, BDG and WO contain significantly higher mannan-oligosaccharide than PKC which are substrate for the production of SCFA (Michlmayr *et al.* 2013; Rivière *et al.* 2014; Chen *et al.* 2019) Also, BDG and WO contain lesser lignin than PKC which are more rapidly fermented in the hindgut than foregut to produce SCFA. The findings of this study agree with the observations of Rodrigues *et al.* (2017) that the bulk of microbial fermentation and production of SCFA in pig occurs in the hindgut while partial digestion of the components of dietary fibre in the small intestine is solely for production of fermentation substrate.

The type of dietary fibre and its degree of fermentation within the gut could be the causes of the observed variations in gut microbiota. Also, the proportion of fermentable fibre were higher in BDG and WO than in PKC, which not only influenced the concentration of SCFA but also the composition of gut microflora. The results of this study agree with the findings of Zijlstra *et al.* (2012); Haenen *et al.* (2013); Hamaker and Tuncil (2014); Jha *et al.* (2019); Ogunjobi *et al.* (2021); Ma *et al.* (2022) that revealed types and contents of dietary fibre change the species and their abundance in the gut. Also, increased production of butyric acid has inhibition effects on the growth and proliferation of intestinal pathogenic/aerobic bacteria as well as promotes colonization and development of beneficial *Lactobacillus* species. This was observed in our results of the amount of gut aerobic and *Lactobacillus* count and supports the earlier findings by Montagne *et al.* (2010); Gerritsen *et al.* (2012); Bach Knudsen *et al.* (2013); Liu *et al.* (2017);

Ogunjobi *et al.* (2021) that fibre feedstuffs promoted gut health by enhancing the growth and proliferation of beneficial bacterial population in growing pigs.

The differences in final body weight and daily gains of pigs fed fibre diets are associated with daily intake and digestive efficiency in the use of absorbed nutrients (Sevillano *et al.*, 2018; Deru *et al.*, 2021). This is a possibility for BDG and WO diets containing lesser lignified contents that are more digestible. The daily weight gain reported in the study falls within the range (0.281 to 0.470kg/day/animal) reported by Akinfala *et al.* (2017) when different fibre feedstuffs were included at 40% in diets of growing pigs. Mwesigwa (2012) and Mukasafari *et al.* (2017) reported lower range (0.130 to 0.230 kg/d/pig and -0.153 to 0.317 kg/d/pig) in diets for sow and weaner pigs fed brewers' dried grain, and by-products of maize-wheat processing respectively. The change in gut microbiota and reduction in intestinal pH could also contribute to improving the activity of digestive enzymes for better nutrient utilisation. This agrees with the findings of the studies by Carre *et al.* (2008); Sekirov *et al.* (2010) that dietary fibre improves the activity of gut microbiome for improved nutrient use.

However, higher inclusion of dietary fibre contents is related with lower growth performance and feed efficiency in pigs (Quiniou and Noblet, 2012; Sevillano *et al.*, 2018). The reduced performance may be explained by the negative impact of increased fibre content on digestibility of nutrients in growing pigs (Le Gall *et al.*, 2009; Le Goff *et al.*, 2002; Mauch *et al.*, 2018). Our results found similar trend and agrees with the reports of Akinfala *et al*. (2014); Imonikebe and Kperegbeyi (2014) who observed higher feed conversion ratio for weaner and growing pigs fed different fibre diets.

CONCLUSION

All the fibre feedstuffs (PKC, BDG and WO) contained nondigestible-oligosaccharides, produced short-chain fatty acids and promoted the growth of *Lactobacilli* in the gut of growing pigs and could eradicate the use of in-feed antibiotics. For better growth performance and gut effect, WO is the suitable fibre feedstuff but BDG diet was the most efficiently used by growing pigs.

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Conflict of interest statement. The authors declare there is no conflict of interest.

Compliance with ethical standards. The experimental procedures were presented and approved by the Animal Welfare Committee of the Obafemi Awolowo University, Ile-Ife, Nigeria.

Data availability. Data are available with Esther O. Towoju (towojuesther19@gmail.com) upon reasonable request.

Author contribution statement (CRediT)
Esther O. Towoju – Investigation, Methodology, Writing – original draft. **Maxwell A. Adeyemi** – Conceptualization, Formal Analysis, Writing – original draft, review, editing and final draft. **Emmanuel O. Akinfala** – Conceptualization, Funding, Supervision and editing.

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