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Evaluation of maize-yam peel meal based diets supplemented with exogenous cocktail enzymes on growth performance, nutrient digestibility and metabolisable energy in finisher broiler chickens.

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Abstract

This study was conducted to investigate the effect of maize and yam peels meal based diets with and without enzyme supplementation on the growth performance and nutrient digestibility of broiler chickens at finisher phase. One hundred and eighty (180), one day-old broiler chicks were fed six diets in two groups. The experiment was arranged in a 2 × 3 factorial experimental layout of two levels of enzyme (0g/100kg diet and 50g/100kg diet) and three levels of yam peels inclusion (0kg, 15kg and 30kg). Each treatment was replicated 3 times consisting of 10 chicks per replicate. The experiment lasted 4 weeks. Main effect of graded levels of yam peel meal and enzymes supplementation on growth performance of starter broiler chickens showed significant (P □ 0.05) influence on final weight, total weight, total weight grain and daily weight grain. Birds fed 0% YPM recorded higher statistical value of 2549.00g for final weight. Interaction effect of YPM and enzyme showed significant (<0.05) effect on growth performance of finisher broiler chickens. Final weight, total weight gain and daily weight gain were significantly (<0.05) influenced by interaction of YPM and enzyme. Birds fed control diet (T_1) recorded higher significant (P<0.05) values for final weight of comparative level. Least value of 2220.00g was recorded for final weight in the birds fed 15% YPM without enzyme (T_2). Varying levels of YPM as a partial replacement for maize had no significant (P>0.05) effect on nutrient digestibility. Higher values were recorded for birds fed 0% inclusion level of YPM across the parameter determined with the exception of ether extract and ash. Inclusion of YPM with enzyme supplementation had significant (P<0.05) interaction effects on percentage dry matter digestibility, crude protein digestibility and crude fibre digestibility. Dry matter digestibility decreased with increased level of YPM with or without enzyme. Inclusion of yam peels meal up to 30% level of replacement for maize with or without enzyme supplementation could be recommended for appreciable nutrient digestibility and improved growth performance of finisher broiler chickens.

Keywords: Yam peel, enzyme, performance, nutrient digestibility, broiler chickens.

Introduction

The main problem of poultry in sub-saharan countries today is the cost of feed ingredients. This challenge has reduced the rate of expansion of poultry industry and has added to low level of animal protein intake of the populace. Attempts to reduce the high cost of feeds and therefore high cost of production have brought about feed formulation from available and cheap unconventional feedstuffs. There is the need to harness the potential of agro-industrial by-products and other unconventional feed sources (Edache *et al*., 2005). High price of maize has forced farmers to seek yam peel as an alternative to maize in livestock feeding. Several scientists in Nigeria have shown that yam peel can be used in diet for livestock (Akinmutimi and Onen 2008; Lawal *et al.,* 2017; Tewe, 1992).

Some agro by-products have been used in the diets of broiler chicks, including wheat offal and citrus pulp in broiler chicken diets (Faniyi, 2002), palm kernel cake to replace

soya bean meal as a protein source in broiler chicken production (Oruseibio and Smile, 2002) and the results were encouraging. Yam peels are basic wastes or by-products when yam is peeled during processing for cooking and other purposes. Yam peels are however, fed to animals such as goats and sheep and largely sourced from yam processing centres, or kitchens. Yam peels may be fed directly soon after peeling, or sun dried for 4 – 7 days depending on ambient temperature, to dehydrate it thereby preventing microbial fermentation of the product or fungal infestation. Constraints on the use of by-products and crop residues according to El Hag and Kurdi (1986) include: bulkiness, location in areas with lower animal population density, poor nutritive value and unsuitability for direct animal use. In Nigeria today, the issue of the bulkiness and location in areas far from those where the materials are needed has been partially solved by the development of a good network of roads and the opening up of the rural areas for development

As regards the poor nutritive value and non-suitability for immediate animal use, research results have shown that physical (grinding and pelleting) treatments improve the nutritive value and intake and hence the response of animals to some of agro by-products. El Hag and Kurdi (1986) concluded that physical treatment was more useful in improving the nutritive value of agro by-products and was also economically more feasible than the chemical treatment. Agro-industrial by-products and crop residues represent a vast animal feed resource, which is as yet largely unexploited. Yam belong to the Genius; Discoreae, species; (*D. rotundata, D. alata*). Yam peels are wastes or by- product of processing when the tubers are being prepared by human. Yam peel is however, fed to animals such as goats and sheep and largely sourced from yam processing centers or yam sellers. Ekenyem and Madubuike (2006); Faniyi (2002) had rated feeds as constituting 70 – 80% of the cost of poultry production, of which maize constitutes major costs. There is therefore urgent need to explore cheaper alternative feed resources. Yam peel is readily available in all parts of Nigeria with little or no cost. One of the challenges of yam peel meal (YPM) is present of anti-nutritional factors such as: Oxalate, tannin, phytate and saponin (Akinmutimi and Onen 2008). Sun drying and enzyme treatments are some of methods adopted for treating anti-nutritional factors in feed ingredients. This feeding trial is aimed at evaluating the nutritional value of maize-yam peels based diets supplemented with exogenous xylanase, amylase and protease multi-enzyme on growth performance, nutrient digestibility and metabolizable energy in finisher broiler chickens with a view to ascertaining its potentials for reducing the cost of chicken production.

Materials and methods

Experimental diets

A total of six isonitrogenous diets were formulated for broiler chickens to meet NRC (1994) minimum nutrient requirement. The diets were formulated such that maize was replaced by yam peels on weight to weight basis. The replacement is in order of 0, 15 and 30 kg of yam peels meal (YPM) with 0 and 50 g/kg levels of enzyme supplementation. Dietary treatments consist: Maize based diet contained 0kg YPM without enzyme (T1), Maize based diet contained 15 kg YPM without enzyme (T2), Maize based diet contained 30 kg YPM without enzyme (T3), Maize based diet contained 0 kg YPM with enzyme (T4), Maize based diet contained 15 kg YPM with enzyme (T5) and Maize based diet contained 30 kg YPM with enzyme (T6), respectively as presented in Table 1.

Table 1: Percentage composition of broiler finisher diets (5-8 weeks)

Enzyme	0g/kg			50g/kg		
YPM levels (kg)	**0**	**15**	**30**	**0**	**15**	**30**
	T1	**T2**	**T3**	**T4**	**T5**	**T6**
Ingredients:						
Maize	60.00	45.00	30.00	60.00	45.00	30.00
YPM	0.00	15.00	30.00	0.00	15.00	30.00
Palm oil	2.00	2.50	2.50	2.00	2.50	2.50
Soya bean meal	14.20	14.20	14.20	14.20	14.20	14.20
Groundnut cake	12.40	12.40	12.40	12.40	12.40	12.40
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Rice offal	4.50	4.50	4.50	4.50	4.50	4.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50	1.50	1.50
DL-Methionine	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Supplementation						
Enzymes (50g/100kg)	-	-	-	+	+	+
Calculated analysis:						
ME (kcal/kg)	3019.15	2989.61	2928.11	3019.15	2989.61	2928.11
Crude protein (%)	19.41	19.24	19.11	19.41	19.24	19.11
Crude fibre (%)	3.17	4.07	5.02	3.17	4.07	5.02
Ether extract (%)	4.01	3.52	3.07	4.01	3.52	3.07
Ca (%)	1.19	1.19	1.19	1.19	1.19	1.19
P (%)	0.43	0.42	0.41	0.43	0.42	0.41
L-Lysine (%)	0.92	0.88	0.85	0.92	0.88	0.85
DL-Methionine (%)	0.59	0.56	0.53	0.59	0.56	0.53

- No enzyme supplementation, + Enzyme supplementation, YPM = yam peels meal

Table 2: Proximate composition of yam-peels meal

Constituents	Percentage (% DM)
Dry matter	87.40
Crude protein	4.38
Crude fibre	9.80
Ether extract	4.43
Ash	6.50
Nitrogen free extract	74.89
Energy (kcal/kg ME)	3,179

Design and management of experimental birds

A total number of 180, one day-old unsexed broiler chicks of commercial strain (Anak 2000) were purchased from a reputable hatchery. The chicks were weighed and allotted to six dietary treatment groups of three replicates each in a 2x 3 factorial arrangement of a Completely Randomized Design. Each replicate consist of 10 chicks and 30 birds per treatment group. The experiment was arranged in a 2 × 3 factorial experimental layout of two levels of enzyme (0g/100kg diet and 50g/100kg diet) and three levels of yam peels inclusion (0kg, 15kg and 30kg). The birds were brooded for two weeks. Birds were reared on deep litter housing system for four weeks (0-4 weeks). Routine vaccinations and medications were strictly followed and feed and water were provided *ad libitum*.

Data collection

Growth performance characteristics

The initial weights of the birds were taken on arrival. The live weights of the birds as well as the feed consumption of each

replicate were measured weekly. Feed conversion ratio for each replicate was determined by dividing the feed intake by the weight gain.

Feed intake/bird(g)=Quantity of feed fed - Quantity of feed left over
Number of bird x 28 day

Daily weight gain (g)= Final live weight - Initial weight
Number of bird x 28

Feed conversion ratio= Quantity of feed consumed
Weight gain

Nutrient digestibility

Metabolic trial was conducted at the 8th week of the study. A bird per replicate was randomly selected and housed separately in appropriate metabolic cage fitted with feeder and drinker. The birds were allowed to acclimatize for two days before the commencement of 4 days feeding and excreta collection. A known weight of feed was given and excreta collected per bird per day were sun dried and use for analyses. Proximate composition of the feed and dried excreta were analyzed for dry matter, crude protein, ether extract, crude fibre and ash using standard method of AOAC (2000).

Energy metabolizability

A bird per replicate was randomly selected and housed separately in appropriate metabolic cage fitted with drinker. Birds were starved of diets, given unrestricted access to clean water for 24 hours during which the excreta voided was discarded. After the expiration of 24 hours starvation, each bird were dosed with glucose solution (30g of glucose/50ml of warm water at 40°C) to reduce stress and deprived of feed for another 24 hours making a total of 48 h starvation period. Total excreta collection per bird during the last (24 hour) phase of feed starvation was used for the estimation of endogenous losses. Gross energy of excreta samples (from fed and starved birds) was estimated using the adiabatic bomb calorimeter (Model 1261; Parr Instrument Co., Moline, IL, US). The apparent metabolizable energy (AME), nitrogen corrected AME (AMEn), true metabolizable energy (TME), and nitrogen corrected TME (TMEn) were computed using the equations as described by Sibbald (1989).

AME/g of the feed = [(Fi X GEf) - (E X GEe)]/Fi

Where: Fi is the feed intake (g on dry matter basis), E is quantity of excreta output (g on dry matter basis),

GEf is gross energy MJ/kg of the feed and GEe is gross energy MJ/kg of the excreta.

AMEn/g of the feed = {[(Fi X GEf) - (E x GEe)] - (NR x 36.5)}/Fi

Where: nitrogen retention (NR) = (Fi × Nf) – (E × Ne), Nf is nitrogen content (g/kg) of the feed, Ne is nitrogen content (g/kg) of the excreta.

TME/g of the feed = {[(Fi x GEf) - (E x GEe)] + (FEm + UEe)}/Fi

Where: FEm is metabolic faecal energy (KJ) from endogenous loss and UEe is endogenous urinary energy (KJ) (This is assumed to be zero in birds).

TME/g of the feed = {[(Fi x GEf) - (E x GEe)] - (NR x K)}+ [(FEm + UEe) + (NRo x 36.5]}/Fi

Where: NR and NRo are estimate of nitrogen retention for fed and starved birds respectively.

Statistical analysis

Data were subjected to analysis of variance using the SPSS software (2012). Where analysis of variance indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (DNMRT) (SPSS, 2012).

Results and discussion

The main effect of varying levels of yam peel meal (YPM) and enzyme

supplementation on growth performance of finisher broiler chickens is summarized in Table 3. Graded levels of YPM had significant (P<0.05) effect on final weight, total weight gain and daily weight gain. This observation was at variance with report of Akinmutimin and Onen (2008) that inclusion of graded levels of YPM had no significant (P>20.05) effect on all parameters measured. Birds fed 0% YPM recorded higher final weight of 2548.50g while. Least values of 2309.00 and 2332.00g were recorded for birds fed diets containing 15% and 30% YPM inclusion, respectively. Similar trend was observed for total weight gain and daily weight gain. This observation is in contrast to the observation of Lawal *et al*. (2017) that inclusion of YPM at 30% recorded highest value for final weight and weight gain in broiler chickens when compared to lower levels of inclusion in other dietary treatments. Reduction in growth performance recorded with increased level of YPM could be attributed to fibrous content of the diet as there is a negative correlation between energy content and fibrous content of the feed (Jasen and Cawe, 1985). Similarly, Yunusa *et al*. (2014) attributed decreased growth performance of broiler chicken with increased YPM to high fibre content which could accelerate the transit of ingested feed through the gastro-intestinal tract of the birds and consequently limited time for proper digestion and absorption of nutrients. Findings in this study corroborated the report in literature (Ezieshi and Olomu, 2011) on decreased value in final weight and weight gain with increased level of YPM as a replacement for maize.

Main effect of enzyme supplementation had no significant (P>0.05) effect on all parameters measured. Though elevated numerical values were recorded with enzyme supplementation across all the parameters measured. This observation corroborated the report in literature (Aguibe *et al*., 2015) on higher numerical values for final weight and weight gain when birds were fed YPM supplemented with enzyme.

Result in Table 4 showed interaction effect of YPM and enzyme on growth performance of finisher broiler chickens. Final weight, total weight gain and daily weight gain were significantly (<0.05) influenced by interaction of YPM and enzyme. Birds fed control diet (T_1) recorded higher significant (P<0.05) values for final weight at comparative level. Least value of 2220.00g was recorded for final weight in birds fed 15% YPM without enzyme (T_2). Similar trend was observed for total weight gain and daily weight gain in which birds fed control diet recorded higher values and least values for birds fed T_2. Observation in this study disagreed with reports in literature (Apodiete *et al*., 2006; Mojtaba *et al*., 2014) on higher weight gain in birds fed enzyme supplemented diet in comparison to birds fed diet without enzyme.

Table 3: Main effects of yam peels meal and enzyme supplementation on growth performance of finisher broiler chickens (5 – 8 weeks)

Parameter	Yam Peels Meal				Enzyme		
	0 %	15 %	30 %	SEM	0g	50g	SEM
Initial weight (g)	957.17	957.50	957.33	0.67	957.22	957.44	0.55
Final weight (g)	2548.50[a]	2309.00[b]	2332.00[b]	66.86	2355.00	2437.00	54.59
Weight gain (g/bird)	1592.00[a]	1351.00[b]	1375.00[b]	66.75	1398.00	1480.00	54.51
Daily weight gain (g/bird)	56.84[a]	48.24[b]	49.10[b]	2.38	49.93	52.85	1.95
Feed intake (g/bird)	3334.00	3990.00	3986.00	380.01	3549.00	3992.00	310.27
Daily feed intake (g/bird)	142.57	143.79	142.56	1.21	142.38	142.55	0.43
Feed conversion ratio	2.53	2.98	2.94	0.14	2.92	2.71	0.12

[ab] Mean on the same row having different superscripts were significantly (P<0.05) different.

Table 4: Interaction effects of yam peels meal and enzyme supplementation on growth performance of finisher broiler chickens (5 – 8 weeks)

Enzyme	Without Enzyme (0g)			With Enzyme (50g)			
Yam Peels Meal	0%	15%	30%	0%	15%	30%	
Parameters	T1	T2	T3	T4	T5	T6	SEM
Initial weight (g)	957.33	957.33	957.00	957.00	957.67	957.67	0.95
Final weight (g)	2560.30^{a}	2220.00^{b}	2286.10^{ab}	2537.50^{ab}	2397.20^{ab}	2377.80^{ab}	94.55
Weight gain (g/bird)	1603.00^{a}	1262.70^{ab}	1329.10^{ab}	1580.00^{ab}	1430.00^{ab}	1420.00^{ab}	94.41
Daily weight gain (g/bird)	57.25^{a}	45.09^{b}	47.47^{ab}	56.44^{ab}	51.40^{ab}	50.71^{ab}	3.37
Feed intake (g/bird)	2673.00	3990.00	3983.00	3996.00	3990.00	3989.00	537.41
Daily feed intake (g/bird)	142.42	142.48	142.25	142.71	142.49	142.47	2.22
Feed conversion ratio	2.52	3.17	3.06	2.54	2.79	2.81	0.20

^{ab} Mean on the same row having different superscripts were significantly (P<0.05) different.

Main effect of yam peel meal (YPM) and enzyme supplementation Nutrient digestibility and energy metabolizability in finisher broiler chickens showing the is presented in Table 5. Varying levels of YPM as a partial replacement for maize showed no significant (P>0.05) influence on all the parameters determined. Though not significant (P>0.05), elevated values were recorded for birds fed 0% inclusion level of YPM across the parameter determined with the exception of ether extract and ash. This observed numerical decrease with increasing level of YPM could be attributed to the effect of partial replacement of highly digestible source of carbohydrate, maize by yam peel meal which is of low digestibility. The YPM inclusion had no significant (P>0.05) effect on energy metabolisability. Decreased numerical values were recorded for energy metabolizability. The AMEn, TME and TMEn decreased numerically with increased level of YPM. The relative reduced metabolizable energy obtained in this study could be attributed to fibrous content of the diet since birds lack endogenous enzyme to digest fibrous feed (Bedford and Classen, 1992).

Main effect of enzyme supplementation showed no significant (P>0.05) effect on parameters determined. Though not significant (P>0.05), elevated values were recorded for dry matter, crude fiber and TME in the birds fed enzyme supplemented diet. This observation could be attributed to ability of exogenous enzyme to increase crude fibre digestibility. Enzyme act on cellulose, glucoxylans and arabinoxylans thereby reducing the dietary fibre content and consequently increase the energy content (Aya *et al.*, 2013).

Interaction effect of yam peel meal with enzyme supplementation on nutrient digestibility and energy metabolizability of finisher broiler chicken is presented in Table 6. Significant (P<0.05) interaction effects were observed for percentage dry matter digestibility, crude protein digestibility and crude fibre digestibility. This observation corroborated the report in literature (Ezieshi and Olomu, 2011) who reported significant (p< 0.05) effect on dry matter, crude protein and crude fibre digestibility when broiler chickens were fed diet with varying levels of yam peel meal as a partial replacement for maize. In similar trend, Aguibe *et al*. (2015) reported significant (p<0.05) influence of YPM on crude protein, crude fibre, ether extract and ash digestibility. Dry matter digestibility decreased with increased level of YPM with or without enzyme. Presence of fibre could speed up the transit time of ingesta through the gastrointestinal tract of the birds thereby leaving limited time for proper digestion and intensive absorption of nutrient (Yunusa *et al*., 2014). High significant (P<0.05) values were recorded for dry matter digestibility in the birds fed enzyme supplemented diet at comparative level to

birds on diet without enzyme. Birds fed 0 % YPM with enzyme supplementation (T4) recorded highest value 76.00 % for dry matter digestibility.

Improved dry matter digestibility with enzyme supplementation as observed in this current study might be due to better utilization of nutrient from non-starch polysaccharides (NSP) as influenced by the exogenous enzyme. Enzyme supplementation aid disruption of plant wall thereby enhancing nutrient availability through solubilisation and disappearance of fibre (Olukosi *et al*., 2015). Crude protein digestibility decreased linearly with increased level of YPM with or without enzyme supplementation. This observation supported report in literature (Iyayi and Davies, 2005) that fibrous feeds decreased digestibility of crude protein. This could be as a result of reduction in transit time of the ingesta due to fibrous nature of YPM which consequently caused limited time for proper digestion and absorption of nutrient (Yunusa *et al*., 2014).

Similar trend was observed for crude fibre digestibility which decreased with increased level of YPM. Higher significant value 67.21 % was recorded for crude fibre digestibility in the birds fed enzyme supplemented diets T4 at comparative level to birds fed diets without enzyme. This corroborated the findings of Soltan (2009) and Ojewola *et al*. (2003) who reported improved fibrous digestibility in diet with exogenous enzyme supplementation. Exogenous enzyme supplementation improves digestibility of fibrous agricultural products (Rotter *et al*., 1990; Viveros *et al*., 2000).

Though not significant ($p>0.05$), values recorded for energy metabolizability decreased with YPM inclusion at comparative level to birds fed diets with 0% YPM. Insignificant relative reduction in metabolizable energy observed in this study could be attributed to presence of some deleterious factors contained in yam peel which limits its utilization. Yam peel was reported to contain tannin bound with fibre which had potential to inhibit digestive enzyme and reduce nutrient digestibility (Mariscal-Landin *et al*., 2004). Oduguwa *et al*. (2007) reported that indigestible fibre increased ileal viscosity and depressed nutrient digestibility. Birds fed enzyme supplemented diet (T4) showed high non-significant ($p>0.05$) numerical values for parameters determined for energy metabolizability. Previous study showed significant improvement in energy metabolizability of feed ingredients followed enzyme supplementation (Adeola and Bedford, 2004; Meng and Slominski, 2005).

Table 5: Main effect of yam peels meal and enzyme supplementation on nutrient digestibility and energy metabolizability of finisher broiler chickens (8 weeks)

	Yam Peels Meal				Enzyme		
Parameter	**0 %**	**15 %**	**30 %**	**SEM**	**0g**	**50g**	**SEM**
Dry Matter	75.25	71.25	71.0	0.612	71.66	73.33	0.50
Crude Protein	70.98	69.04	68.00	0.193	69.60	69.08	0.15
Ether Extract	72.53	73.00	73.75	0.447	73.52	72.66	0.36
Crude Fibre	66.47	62.77	62.16	0.939	63.26	64.33	0.76
Ash	59.99	59.88	61.36	0.428	60.32	60.50	0.34
AME	13.50	12.28	12.33	0.336	12.64	12.84	0.27
AMEn	13.32	12.28	12.11	0.335	12.43	12.71	0.27
TME	13.71	12.75	12.52	0.035	12.92	13.06	0.29
TMEn	13.37	12.16	11.99	0.357	12.44	12.58	0.29

Table 6: Interaction effects of yam peels meal and enzyme supplementation on nutrient digestibility and energy metabolizability of finisher broiler chickens (8 weeks)

Enzymes (kg)	Without Enzyme (0g/100kg)			With Enzyme (50g/100kg)			
Yam peel meal (%)	0	15	30	0	15	30	
Parameters	T1	T2	T3	T4	T5	T6	SEM
Dry Matter	74.50^{ab}	70.50^{c}	70.00^{c}	76.00^{a}	72.00^{b}	72.00^{b}	0.86
Crude Protein	72.07^{a}	68.97^{c}	67.76^{d}	69.90^{b}	69.11^{bc}	68.25^{d}	0.27
Ether Extract	72.57	73.50	74.50	72.50	72.50	73.00	0.63
Crude Fibre	65.72^{a}	62.86^{abc}	61.21^{c}	67.21^{a}	62.68^{bc}	63.11^{abc}	1.33
Ash	59.49	60.25	61.23	60.50	59.51	61.49	0.61
AME	13.26	12.21	12.44	13.74	12.56	12.21	0.47
AMEn	13.53	12.07	12.19	13.62	12.49	12.04	0.47
TME	13.53	12.59	12.65	13.89	12.90	12.39	0.50
TMEn	13.26	11.97	12.09	13.49	12.36	11.89	0.50

Conclusion

This study revealed that Yam peel meal as a partial replacement for maize in the ration of finisher broiler chickens significantly affected growth performance. Inclusion of yam peels meal and enzyme as partial replacement for maize in the ration of finisher broiler chickens resulted in decreased dry matter digestibility with increased level of YPM with or without enzyme. Inclusion of yam peel meal up to 30% level of replacement for maize with or without enzyme supplementation could be fed to broiler chickens for improved growth performance.

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