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Growth Response and Carcass Yield of Broiler Birds Fed Graded Levels of Enzyme Supplemented Yam Peel Meal

Taiwo, E. A.[1], Tayo, G. O.[1], Olumide. M. D.[1] Adeyemi, O. A.[2] and Oyekale, K. O.[1]

[1]Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria
[2]Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria
Corresponding author's email: queenesther789@gmail.com

Abstract: This study was carried out to determine the extent to which enzyme supplemented yam peel meal could replace maize in a standard broiler diet, its effects on the growth performance and carcass yield of the birds. 150 broiler chicks (Abor Acre) purchased from a reputable hatchery at Ibadan were subjected to a feeding trial for 7 weeks. The chicks were randomly assigned to five dietary treatments at 30birds per treatment (T) and each treatment was replicated thrice at 10 birds per replicate. The treatments comprised of T1 (control, 0% YPM), T2 (50% YPM without enzyme), T3 (50% YPM with enzyme), T4 (75% YPM without enzyme) and T5 (75% YPM with enzyme) involving a completely randomized design. Proximate analysis of YPM and experimental diets was done. The birds were observed and records of growth performance responses were taken. At the last week of the trial, two birds per replicate were sampled for carcass yield. Results obtained from proximate analysis showed that YPM had 3,163.33Kcal/kg metabolizable energy (ME) which is comparable to 3,342kcal/kg ME in maize making it possible for YPM to be a source of dietary energy in broiler diet. YPM also has 11.33% crude protein and 9.06% crude fibre. Growth performance indices showed that at the starter phase broiler chicks fed 50% enzyme supplemented YPM had better response than those on 50% YPM without enzyme supplementation. However, at the finisher phase, broilers on 50% YPM without enzyme supplementation performed better. The carcass yield of broiler chickens revealed that birds fed 50% YPM without enzyme supplementation had live weight (2,033.33g) and eviscerated weight (1,590.00g) comparable (P>0.05) to those of birds on control diet (2,133.33g and 1,601.67g). Also, birds on 50% YPM had the highest dressing percentage. At 75% YPM with or without enzyme supplementation however, performance and carcass characteristics of broilers were negatively affected due to the high fibre content of YPM. Based on the results obtained, enzyme supplemented YPM can replace 50% of maize in a standard broiler starter diet while 50% YPM without enzyme supplementation can replace maize in a standard broiler finisher diet. Feed cost/kg weight of broilers on 50% YPM without enzyme supplementation was ₦223.13 compared to ₦285.65 of birds on control diet. However, at 75% YPM with or without enzyme supplementation growth response and carcass characteristics of broilers were negatively affected due to the high fibre content of YPM. Based on the results obtained, the use of YPM to replace 50% of maize in a standard broiler diet is recommended.
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Introduction

The functionality and effectiveness of modern day intensive poultry production system is based on the manipulation of genetic and environmental factors of birds in order to achieve greater efficiency. Upgrading of the genetic makeup of the poultry stock (Atteh, 2004); provision of good, clean and serene environment, in addition to feeding them with highly balanced and hygienically produced diets will enhance their effective growth, development and productivity. The major objective of modern poultry nutrition according to Broz and Ward (2007) is to fully utilize the genetic potentials of birds by providing them with complete diets covering all the known requirements of the birds according to their species, age, production category and performance level. Conventional feed stuffs like maize, millet, soybeans, groundnut, sorghum, wheat, cassava and yam are major ingredients which when combined appropriately; provide the birds with adequate nutrients required for their growth and development.

However, Nigeria is currently faced with the problem of scarcity of conventional feed stuffs and the available ones are sold at high cost. The poultry feed industry (broilers and layers) dominates the animal feed industry in Nigeria and in the year 2000 it was

recorded to have accounted for approximately two-third (68.2%) of the national livestock feed production (Fagbenro & Adebayo, 2005). The economic importance of poultry feeding becomes even more crucial when it was realized that 55-75% of the cost of producing egg and broiler meat respectively is associated with the cost of feeding (Atteh, 2004). According to Liverpool-Tasie *et al.,* (2016) in just one decade, the volume of feed used in Nigeria skyrocketed from 300 thousand to 1.8 million tons – a 600% climb. As a result of this, there has been a paradigm shift towards the use of unconventional feed ingredients for the formulation of poultry diets. These unconventional resources/materials are mostly agro-industrial by-products and green plants considered not utilizable as food source for humans.

An example of unconventional feedstuff is yam (*Dioscorea* spp.*)* peel meal which is gotten from the peeling of the outer covering of yam. Yam peel meal (YPM) has a potential of serving as a cheaper source of energy in poultry diets (Adeyemo & Borire, 2002) and its availability in Nigeria was 1,000 tonnes in 1993 and estimated to be 1,700 tonnes in 2000 (Presidential Task Force on Alternative Formulation of Livestock Feed, 1992). Yam peels can be substantially gotten in reasonable quantities from household kitchens, commercial eateries and market. However, the level of it usage in poultry diet is reduced because monogastrics have very limited number of cellulose breaking enzymes in their guts, so they cannot effectively utilize the nutrient in the fibre. There is a bounteous array of products like probiotics, prebiotics, dietary enzymes and herbs available for the poultry industry to help promote gut health and improve bird performance under field conditions without the use of antibiotics and hormones. These products are useful in enhancing food safety (Agbonlahor, 2010). Dietary enzymes are biochemical substances needed in minute quantity to help break down fibre, enhance the utilization of nutrients in the fibre and facilitate the process of digestion in animals. The major enzymes used in animal feeds are usually hydrolytic proteases, phytase, NSP-degrading enzymes, amylases and lipases which are made available commercially (Atteh, 2000).

Research on YPM by Akinmutimi and Onen, (2008); Ekeyem, Madubuike and Dike (2006) showed that it can replace up to 15% of the maize in broiler chicken diets without adverse effects on performance and reduce the cost of production. Results of further study by Inaku, Bawa, Olugbemi and Buba (2010) also revealed that YPM can effectively and efficiently replace up to 40% of dietary maize for broiler chickens without detrimental effect on growth performance and at reduced cost of production. Ezieshi and Olomu (2011) however reported that YPM can replace maize up to 50% in a standard broiler diet but at 75% and above inclusion level (100%), it poses a deleterious effect on the productivity of the birds because of its high fibre content and the presence of anti-nutrients in the ingredient. The aim of this research therefore is to determine the extent to which enzyme supplemented YPM can replace maize in a standard broiler diets and its effects on the performance and carcass characteristics of broilers fed these diets.

Materials and Method

Site of the Study

This research was carried out at the teaching and research farm of the Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria. Ilishan is located in the south-western rainforest belt of Nigeria with annual average rainfall of 1500mm and mean daily temperature of 25-27^{o}C between December 2016 and October 2017 at Long 3° 43'E of the Greenwich and Lat. 6° 52'N of the equator.

Source and Processing of Yam peels

Peels of white yam variety measuring between 0.45-0.55mm thicknesses were used for this study. It was obtained from Babcock University cafeteria. The peels were sun-dried for 2 weeks and milled into yam peel meal before incorporating them into the broiler ration at the stipulated levels of inclusion. Inorganic xylanase enzyme was incorporated into broiler diets at 100ppm.

Chicks Housing and Management

A total of 150 day-old broiler (Abor Acre) chicks, purchased from a commercial hatchery at Ibadan, Oyo State were raised in cages from day old till they were eight weeks old. On arrival, the chicks were weighed and randomly assigned to five dietary treatments at 30 birds per treatment. Each treatment was replicated thrice with 10 birds per replicate. Brooding was carried out during the first three weeks in which all the chicks were fed the starter phase of their treatment diets. During this period, the cages were covered with polythene sheets and each portion of the cage was provided with a 200-watt electric bulb to provide required optimum temperature. The birds were vaccinated according to schedule. From the fourth week to the seventh week, they were fed the finisher phase of their treatment diets. Throughout the experiment, feed and water was supplied *ad libitum*.

Experimental Diets

The compositions of experimental diets are shown in tables 1 and 2. Five dietary treatments which were in two phases (starter and finisher phases) were tested in this experiment. Treatment 1 had maize as the major source of energy for the birds (control diet). In treatment 2, 50% of maize was replaced with yam peel meal (YPM) without enzyme supplementation while Treatment 3 had 50% of maize replaced with enzyme supplemented YPM. 1n Treatment 4, 75% of the maize

was replaced with YPM without enzyme supplementation whereas in Treatment 5, 75% of maize was replaced with enzyme supplemented YPM.

Table 1: Gross composition of broiler starter diet using yam peel meal (% Replacement)

Ingredients	0%YPM (Control)	50%YPM Without Enzyme	50%YPM With Enzyme	75%YPM Without Enzyme	75%YPM With Enzyme
Maize	60.000	30.000	30.000	15.000	15.000
YPM	0.000	30.000	30.000	45.000	45.000
Soybean meal	35.000	35.000	35.000	35.000	35.000
Fish meal	2.000	2.000	2.000	2.000	2.000
Bone meal	1.600	1.600	1.600	1.600	1.600
Oyster shell	0.700	0.700	0.700	0.700	0.700
Broiler Premix	0.250	0.250	0.250	0.250	0.250
Salt	0.250	0.25	0.250	0.250	0.250
Methionine	0.100	0.100	0.100	0.100	0.100
Lysine	0.100	0.100	0.100	0.100	0.100
Enzyme (ppm)	0.000	0.000	0.001	0.000	0.001
Total	100.00	100.00	100.001	100.000	100.001
Calculated analysis					
Crude protein (%)	22.416	21.616	21.616	23.456	23.456
Crude fibre (%)	3.378	6.001	6.001	6.963	6.963
Metbolizable Energy (kcal/kg)	2953.28	2899.050	2899.050	2790.610	2790.610

Inorganic xylanase enzyme at 100ppm

Table 2: Gross composition of broiler finisher diet using yam peel meal (% Replacement)

Ingredients	0%YPM (Control)	50%YPM Without Enzyme	50%YPM With Enzyme	75%YPM Without Enzyme	75%YPM With Enzyme
Maize	68.000	34.000	34.000	17.000	17.000
YPM	0.000	34.000	34.000	51.000	51.000
Soybean meal	28.000	28.000	28.000	28.000	28.000
Palm oil	1.000	1.000	1.000	1.000	1.000
Bone meal	1.600	1.600	1.600	1.600	1.600
Oyster shell	0.700	0.700	0.700	0.700	0.700
Broiler Premix	0.250	0.250	0.250	0.250	0.250
Salt	0.250	0.250	0.250	0.250	0.250
Methionine	0.100	0.100	0.100	0.100	0.100
Lysine	0.100	0.100	0.100	0.100	0.100
Enzyme (ppm)	0.000	0.000	0.001	0.000	0.001
Total	100.000	100.000	100.001	100.000	100.001
Calculated analysis					
Crude protein (%)	18.756	19.846	19.846	20.396	20.396
Crude fibre (%)	3.829	6.008	6.008	7.093	7.093
Metabolizable Energy (kcal/kg)	3031.000	2970.290	2970.290	2908.830	2908.830

Inorganic xylanase enzyme at 100ppm

Proximate analysis and Calculations

The proximate analysis was done using the procedures of Association of Official Analytical Chemists, [A.O.A.C], (2001). Metabolizable energy (ME) of YPM and experimental diets as well as the carbohydrate (CHO) contents were calculated based on the method stated by Okubanjo *et al.*, (2012) as;

ME (kcal/100g) = % CP x 4.00 + % EE x 9.00 + % CHO x 3.75

% CHO = 100% - (% moisture + % CP + % EE + % ASH)

PARAMETERS EVALUATED

Growth Performance

The birds were observed daily and data were collected on feed intake and weight gained. The body weight of birds was determined using a measuring scale on weekly basis. Feed intake was determined daily as the difference between the initial feed supplied and the feed leftover in the feeding trough. The values obtained were used to evaluate the feed conversion ratio of the birds as:

$$\text{Feed Conversion Ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gained (g)}}$$

Evaluation of Carcass quality

Carcass quality was assessed according to the method described by Ojewole and Longe (1999) as cited by Akinmutimi and Onen (2008). On the last day of the experiment, two birds per replicate of each treatment (having the closest mean weight) were used to ascertain the carcass characteristics of the broiler birds. The selected birds were fasted overnight and sacrificed in the morning by severing their jugular vein. The birds were bled after which they were scald in hot water and defeathered. The head, neck, shank and visceral organs were removed to have the dressed weight used to calculate for the dressing percentage. There was also the dissection and weighing of the thigh, drumstick and the back cuts. Also, internal organs like heart, liver, intestine and gizzard were removed weighed. The weight of carcass cut-up parts and organs (gizzard, liver, heart, and intestine) were expressed as percentage of the birds' live weight. Dressing percentage was calculated as:

$$\text{Dressing Percentage} = \frac{\text{Dressed weight}}{\text{Live weight}} \times 100$$

Economics of Production Using Enzyme Supplemented YPM

Feed cost/kg was calculated by summing the cost of each ingredient included to make the diets and dividing it by the total kg of feed formulated. This was calculated based on the current prices of the feed ingredients used at the time of the research. Feed cost of raising 1kg of broiler was calculated by multiplying feed cost/kg with the average feed intake of birds (g) and dividing all by the average weight gained (g).

$$\text{Feed cost/kg weight gained} = \frac{\text{Feed cost/kg} \times \text{Average feed intake (g)}}{\text{Average weight gained (g)}}$$

Statistical Analysis

The experimental design is a completely randomized design. ANOVA (Analysis of Variance) was done using SPSS (version 23) software at 5% confidence level and Duncan's New Multiple Range Test (DNMRT) was used to separate significantly different means.

Results and Discussion

Proximate Composition of YPM and Experimental Diets

Table 3 shows the proximate composition of YPM and experimental diets at starter and finisher phases. The chemical composition of YPM presents this feed resource as a good source of dietary energy for monogastric birds as its metabolizable energy (ME) value (3,163.33Kcal/kg) is well comparable to that of maize (3,342 Kcal/kg) (Atteh, 2002). The ME of YPM according to this research is slightly higher than what Ezieshi and Olomu, (2011) reported. This difference could be as a result of variations in the sources of the yam peels. This study showed that YPM has crude protein (CP) 11.33% content higher than that of maize (8.90%) and this aligned with the reports of Akinmutimi and Onen (2008); Ezieshi and Olomu, (2011). The ME and CP content of YPM makes this ingredient a potential feedstuff for poultry birds. The high CF value (9.06%) of YPM indicated that for effective broiler production; it must not replace maize totally in the birds' diet. The EE content of YPM (1.05%) is low presenting it as a good feed resource for raising broiler chickens with low body fat content. The ash content (8.37%) of YPM indicated that it as an ingredient with moderate level of minerals needed for productive performance of broiler birds.

The proximate composition of experimental diets for starter and finisher phases had CP range between 22.42%-23.19% (starter) and 18.76%- 19.61% (finisher). The highest CP value was recorded for the

diet with 75% YPM at the starter and finisher phases. This is a proof that YPM had a CP value higher than that of maize. The ME content of the diets at both phases is adequate for raising of productive broiler birds. The CP and ME values obtained are in accordance with the NRC (1994) recommended range for broiler production from chick to chicken. CF content in the diets increased as the dietary level of YPM increased, because of the high fibre content of YPM. In all the diets and at both phases, the calculated nutrient values and the proximate chemical composition values of the diets were closely related. This is an indication of good mixing of the various feed ingredients used to compound the diets.

Table 3: Proximate Composition of YPM and Experimental Diets

Parameters	YPM	Starter Diet			Finisher Diet		
		0% YPM	50%YPM	75% YPM	0% YPM	50%YPM	75% YPM
CP (%)	11.33	22.42	22.82	23.19	18.76	19.20	19.61
CF (%)	9.06	4.08	5.83	6.78	4.83	6.10	6.90
EE (%)	1.05	4.50	3.20	2.97	4.78	3.32	3.10
ASH (%)	8.37	5.50	6.50	5.70	7.40	7.60	8.60
CHO (%)	69.75	60.69	60.98	61.09	62.12	63.28	61.48
NFE (%)	70.19	63.50	61.65	61.36	64.23	63.78	61.79
DM (%)	90.50	93.11	93.50	92.95	93.06	93.40	92.79
ME(Kcal/kg)	3,163.33	3,577.68	3,487.55	3,485.78	3,510.10	3,439.80	3,364.91

CP – Crude Protein, CF – Crude Fibre, EE- Ether Extract, CHO – Carbohydrate, NFE- Nitrogen Free Extracts, DM – Dry Matter, ME- Metabolizable Energy.

Growth Response of Broiler Chickens Fed Graded Dietary Levels of Enzyme Supplemented YPM at Starter and Finisher Phases

The effects of enzyme supplemented YPM on the growth performance of broiler birds at both starter and finisher phases are shown in Tables 4 and 5. There was significant effect of enzyme supplementation on feed intake (FI), weight gained (WG) and feed/gain ratio (FCR) ($P<0.05$) of broilers at the starter and finisher phases. Inclusion levels of sun- dried YPM in broiler diets also significantly affected ($P<0.05$) FI, WG and FCR of the starter chicks and the finisher chickens.

Table 4: Effect of Dietary Levels of YPM and Enzyme Supplementation on the Growth Performance of Broiler Starter Chicks (0-3 Weeks)

Parameters	Dietary Levels					SEM
	0% YPM (control)	50% YPM	50% YPM+enz	75% YPM	75% YPM+enz	
Feed Intake (g)	681.67^{a}	672.67^{b}	676.00^{ab}	623.29^{c}	636.67^{c}	6.39
Weight Gained (g)	461.9^{a}	409.47^{b}	411.03^{b}	330.33^{c}	341.40^{c}	12.39
Feed Conversion Ratio	1.47^{a}	1.64^{b}	1.64^{b}	1.89^{c}	1.86^{c}	0.39

Means across each row having the same superscripts are not significantly different ($P>0.05$).

Table 5: Effect of Dietary Levels of YPM and Enzyme Supplementation on the Growth Performance of Broiler Finisher Chickens (3-7 Weeks)

Parameters	Dietary Levels					
	0%YPM (control)	50%YPM	50%YPM+enz	75%YPM	75%YPM+enz	SEM
Feed Intake (g)	2731.67[a]	2613.00[b]	2585.33[b]	2469.33[c]	2486.33[c]	25.63
Weight Gained (g)	1607.53[a]	1386.81[b]	1156.08[c]	900.17[e]	1025.00[d]	69.24
Feed Conversion Ratio	1.70[a]	1.849[b]	2.24[c]	2.75[e]	2.44[d]	0.10

Means across each row having different superscripts are significantly different

At the starter and finisher phases, the feed intake of broiler birds reduced with increasing level of YPM in their diets. This could be as a result of the increasing level of fibre content of the diets, causing a bulking effect in the gut of the birds. Birds on enzyme supplemented YPM consumed more than birds on diets without enzyme supplementation at the starter phase. This could be as a result of endogenous fibre degradation activity of the enzyme in the diets which enhanced ease of nutrient digestibility in the birds' system. However, at the finisher phase, broiler chickens fed 50% YPM without enzyme supplementation consumed more than those fed 50% enzyme supplemented YPM, because birds usually eat to satisfy their energy requirements if fed *ad libitum* (Atteh, 2004).

Weight gained decreased with increasing level of YPM. This could be as a result of anti-nutritional factors present in YPM which inhibited/depressed the growth of the birds. Birds fed 50% YPM without enzyme supplementation at the finisher phase gained more than those fed 50% enzyme supplemented YPM, because of their increased feed intake. The reverse is the case for birds on 75% YPM as birds fed enzyme supplemented diet consumed and gained more weight than those fed diet without enzyme supplementation.

The FCR of birds fed graded levels of YPM with or without enzyme supplementation was poor when compared to the FCR of birds fed the control diet. This is because of the smaller body weight gained relative to feed consumed which could have been due to the presence of anti-nutrients (growth inhibitors) in YPM. According to Akinmutimi and Onen (2008) the anti-nutrients in YPM is 0.87% saponin, 0.57% tannin, 1.19% oxalate, 0.89% phytase and 0.00% trypsin inhibitor. Anjola *et al.*, (2016) also reported a downward trend in the feed intake and weight gain of broiler birds as the level of brewer spent grain (a fibrous feed stuff) in their diet increased.

The results obtained on growth performance of broilers fed enzyme supplemented YPM was contrary to the findings of Aguihe, Kehinde, Ilaboya and Ogialekhe (2016) who reported that birds on enzyme supplemented cassava peel meal diets had better performance responses than birds fed the control diet without enzyme supplementation. This variability could be as a result of difference in the diets tested in each study. Also, some fibre degrading enzymes improved the major performance parameters (dry matter intake, average daily gain, and feed efficiency) in beef cattle, but did not improve dry matter intake or milk production in dairy cattle (Mehmet & Mohammed, 2015). Furthermore, one enzyme may improve fibre digestion in alfalfa but not in corn silage probably due to the nature of the fibre in the feedstuffs e.g. cellulose versus hemicellulose or lignin (Colombatto *et al.*, 2003).

Carcass Yield of Broilers Fed Graded Dietary Levels of Enzyme Supplemented YPM

Weights and cut-up parts of broilers fed dietary levels of enzyme supplemented YPM are shown in Table 6. Dietary inclusion levels and enzyme supplementation, had significant effects($P<0.05$) on live weight(g), defeathered weight(g), eviscerated weight(g), dressing percentage(%), head(%), wings(%), breast(%), back(%), drumstick(%), gizzard(%), heart(%), intestine(%) and liver(%) of broiler chickens. There were no significant variation ($P>0.05$) on shank (%), neck (%) and thigh (%) of the birds.

Table 6: Carcass Yield of Broilers Fed Graded Dietary Levels of Enzyme Supplemented YPM

Parameters	Dietary Levels					SEM
	0% YPM (Control)	50% YPM	50% YPM+enz	75% YPM	75% YPM+enz	
Weights						
LV WT (g)	2133.33^{a}	2033.33^{a}	1600.00^{b}	1300.00^{c}	1333.33^{c}	94.21
DFWT (g)	1933.33^{a}	1833.33^{a}	1400.00^{b}	1100.00^{c}	1133.33^{c}	94.21
EVWT(g)	1601.67^{a}	1590.00^{a}	1170.00^{b}	894.43^{c}	924.55^{c}	83.88
DRS (%)	75.08^{ab}	78.20^{a}	73.13^{ab}	68.80^{cd}	69.34^{cd}	1.27
Cut-up Parts						
Head	3.91^{bc}	4.59^{abc}	5.00^{a}	3.87^{c}	4.88^{ab}	0.17
Shank	5.26	4.75	5.83	4.83	5.03	0.13
Neck	4.34	4.27	4.79	4.12	4.58	0.19
Wing	9.19^{ab}	8.86^{b}	10.00^{a}	10.19^{a}	9.99^{a}	0.50
Breast	20.31^{a}	22.14^{a}	18.75^{bc}	19.23^{b}	18.79^{bc}	0.46
Back	18.76^{a}	18.01^{a}	15.00^{c}	15.34^{bc}	17.08^{ab}	0.45
Thigh	11.35	11.79	12.50	11.89	11.24	0.22
Drum Stick	9.93^{c}	11.48^{ab}	11.67^{ab}	11.97^{a}	10.27^{bc}	0.27
Internal Organs						
Emptied Gizzard	2.38^{b}	2.21^{b}	3.13^{a}	3.05^{a}	3.24^{a}	0.12
Heart	0.89^{c}	0.93^{bc}	0.63^{d}	1.08^{b}	1.24^{a}	0.09
Intestine	6.58^{b}	5.90^{c}	6.46^{b}	8.78^{a}	8.47^{a}	0.33
Liver	3.28^{a}	2.13^{c}	2.50^{bc}	2.90^{b}	2.40^{bc}	0.11

Means across each ow having different superscripts are significantly different (P<0.05). LVWT- Live weight, DFWT- Defeathered weight, EVWT- Eviscerated weight, DRS- Dressing Percentage

The live weight of birds fed YPM decreased as the level of YPM increased in their diet. This is a proof that YPM has growth depressing factors (anti-nutrients) which inhibited the growth of the monogastric birds. The live weight (2133.33g), defeathered weight (1933.33g) and eviscerated weight (1601.67g) measured for birds fed the control diet was not significantly different from those of birds fed diet containing 50% YPM without enzyme supplementation (2033.33g live weight), (1833.33g defeathered weight), (1590.00g eviscerated weight). This showed that without enzyme supplementation, YPM can be used up to 50% and there will be no negative effect on the productive performance of broiler chickens. However at 75% inclusion level with or without enzyme supplementation, weight gained was highly depressed.

The dressing percentage, which was best in birds fed 50% YPM without enzyme supplementation (78.20%), showed that the crude fibre content of the diet at that inclusion level was adequate for the birds' growth as it allowed the normal development of the internal organs of the birds. On the basis of development of carcass choice parts, birds on 50% YPM without enzyme also had the highest value for breast (%) while those on 50% YPM with enzyme supplementation had the best thigh (%) value and birds fed 75% YPM without enzyme supplementation had the highest value for drumstick (%).

On the basis of effect of diet with or without enzyme on internal organs, the weight of heart, gizzard and intestine increased with increasing levels of YPM. This could be as a result of the extra effort it took these organs to ensure the fermentation and digestion of the fibrous feed stuff, hence their increased surface area. This agreed with the findings of Adeniji (2005); Ibiyo and Atteh (2005); Salami and Odunsi (2017).

Economics of Substituting Maize in Broiler Diet with Dietary Levels of Enzyme Supplemented YPM

Table 7 shows the economics of raising broiler birds from chicks to chickens using graded dietary levels of enzyme supplemented YPM. Dietary levels of YPM and enzyme supplementation significantly influenced (P<0.05) the cost of experimental diets fed to broiler chicks at the starter phase and broiler chickens at the finisher phase. The control diet had the highest feed cost while the diet with 75% YPM had the least cost at both phases. Also on the basis of feed cost of raising 1kg of broiler chicken, significant variations (P<0.05) exist among all dietary treatments.

Table 7: Economics of Raising Broiler Chickens Using Graded Dietary Levels of Enzyme Supplemented YPM

	Starter Diets					Finisher Diets				
Diets	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Cost of producing feed (₦/kg)	180.53[a]	132.54[c]	142.54[b]	108.55[e]	118.52[d]	179.61[a]	121.73[c]	131.74[b]	92.85[e]	102.84[d]
SEM	0.06	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cost saved relative to control diet (₦)	-	47.99	37.99	71.98	62.01	-	57.88	47.87	86.76	76.77
Feed cost of raising 1kg of broiler (₦)	266.09[e]	216.86[b]	235.30[d]	197.61[a]	221.10[c]	305.21[e]	229.40[a]	294.61[d]	254.70[c]	249.48[b]
SEM	0.33	0.04	0.02	0.32	0.01	0.01	0.01	0.01	0.01	0.01
% reduction in raising 1kg of broiler	-	18.50	11.57	25.74	16.91	-	24.84	3.47	16.55	18.26

Means in the same row with different superscripts are significantly different (P<0.05). 1- Control (0%YPM), 2 – 50% YPM, 3 – 50% YPM+ enz, 4 – 75% YPM, 5 – 75% YPM +enz

In the starter as well as the finisher diets, cost of feed decreased with increase in dietary level of YPM, because the cost of one kg of maize is about eight times that of yam peels at the time of this study. This is in agreement with the report of Ezieshi and Olomu, (2011) who reported that the cost of maize was about four times that of yam peels at the time of the study. Supplementing enzymes on YPM however increased the cost a bit but not as high as the cost of the control diet.

Cost saved relative to the control diet was higher in the diet having 75%YPM without enzyme supplementation at both the starter and the finisher phase. The feed cost of raising one kg of broiler, (feed cost/kg of broiler weight), was most economical when the diet with 50% of YPM without enzyme supplementation was fed to broilers at both starter and finisher phase. Although the percentage reduction obtained, when birds were fed 75%YPM without enzyme supplementation, was highest at the starter phase, still it is not economical when compared to the body weight gained by the birds fed this diet.

So far no profit-oriented farmer/ agri-business investor would embark on any agricultural production activities without thinking first on the; likely inputs needed for such production venture(s), the available /target market for the product(s) and the possible income that will be generated. From this experiment therefore, diet 2 which has 50%YPM without enzyme supplementation is the best. This observation is in line with the findings of Akinmutimi and Onen (2008) who recorded the least economy of feed cost/kg weight when broilers were fed diets with 10% YPM.

Conclusion

Result obtained on the proximate analysis of YPM revealed that it is an ingredient with moderate nutrient content that could enhance the productive performance of broiler birds. Furthermore, growth response and carcass yield showed that YPM can replace 50% of maize in a standard broiler diet without any detrimental effect on performance at a reduced production cost. However at 75% inclusion level with or without enzyme supplementation, YPM had a detrimental effect on the growth response and carcass yield of broiler birds due to the anti-nutrients it contains.

It is therefore recommended that farmers can use YPM up to 50% replacement of maize in a standard broiler diet. However at the starter phase the YPM based diet should be supplemented with fibre degrading enzyme.

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