Effect of supplementation of cassava peel meal based diet with enzyme Maxigrain® on performance, apparent nutrient digestibility and economic indices of broiler finishers

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Abstract

A four-week experiment was conducted to investigate the effect of Maxigrain® enzyme supplementation on performance, nutrient digestibility and economic indices of broiler finishers fed soaked and sun-dried cassava peel meal (CPM) based diet. CPM was included in the diets replacing maize at 0%, 25%, 50% and 75% respectively on a weight for weight basis. Diets with 25%, 50% and 75% CPM were supplemented with Maxigrain® at 100mg/kg. Two hundred (200) Anak, day old broiler chicks were randomly allotted to four dietary treatments in a completely randomized design (CRD) with five replicates containing ten birds each after balancing for live weight. Feed and water were supplied ad-libitum throughout the 4 weeks period of the experiment. Data on the body weight and feed intake were collected on a weekly basis and that of weight gain and feed conversion ratio (FCR) were calculated fortnightly while data on apparent nutrient digestibility was collected towards the end of the experiments in a metabolic trial. Data on feed cost analysis were calculated using the prevailing current market price of feed ingredients. The result shows that average weight gain and feed intake were significantly affected ($P < 0.05$) by dietary treatments. Birds on 50% CPM enzyme diet had a significant ($P < 0.05$) higher weight gain and feed intake followed by those on 75% CPM diet as compared to control group. Enzyme supplementation of the CPM diets produced a slight improvement in feed conversion ratio than the control diet. Feed cost/kg weight gain significantly ($P < 0.05$) decreased with increasing levels of enzyme supplemented CPM. Profit margin generated were higher ($P < 0.05$) in bird fed enzyme treated CPM diet group. Apparent nutrient digestibility of the birds revealed a significant ($P < 0.05$) variation in all parameters with the exception of dry matter. Digestibility values of the birds were observed to increase as the inclusion level of enzyme supplemented CPM increased across the diet. Therefore, it is concluded that enzyme supplemented CPM could replace 75% of maize in broiler finisher diet without any deleterious effect however, supplementing CPM with enzyme Maxigrain® at 50% replacement level for maize resulted in a more profitable performance as well as improved nutrient digestibility and is hereby recommended for poultry farmers.

Keywords: Cassava peel meal, enzyme, Maxigrain®, broiler finishers, performance,

Introduction

Poultry keeping is the most popular livestock enterprise adopted by small and medium scale farmers in the rural and urban areas of Nigeria (Idowu *et al.*, 2005, Afolayan *et al.*, 2014). Among the factors

affecting poultry production in the tropics, feed is undoubtedly the most important and represent 60 – 80% of the total cost of production in intensively reared poultry (Akinfala and Tewe, 2002, Fasuyi, 2005, Abeke *et al.*, 2013). Maize, which is the

predominantly feed ingredient for energy in poultry feed is very costly because of higher demand for it by humans as food and industrial purposes (Salami and Odunsi, 2003, Bot *et al.*, 2013, Etuk *et al.*, 2013). The seasonality and cost of conventional feedstuff are such that some degree of supplementary feeding and alternative energy source is required (Ajasin *et al.*, 2010, Tamburawa and Rano, 2013). One of such alternative for potential replacement of maize in animal feed is the use of processed cassava peel meal (CPM). These peels are regarded as waste and discarded but could be a good source of feed for livestock (Iyayi, 1991, Salami and Odunsi, 2003, Agiang *et al.*, 2004, Udoyond *et al.*, 2010, Midau *et al.*, 2011, Idahor 2012). The use of cassava peel at increased levels in feeding monogastrics will be a significant boost to the livestock feed industry; however, its utilization is limited by its hydrocyanic acid content and presence of moderate to high levels of non-starch polysaccharides (NSPs) (Iyayi and Yahaya, 1999, Salami and Odunsi 2003, Egbunike *et al.*, 2009, Idahor, 2012). The use of enzyme supplementation is one of the important techniques for enhancing the efficiency of feed utilization in monogastric nutrition (Acromovic, 2001, Iyayi and Davis, 2005, Buchanan *et al.*, 2007, Shirmohammad and Mehri, 2011, Ademola *et al.*, 2013, Teniola *et al.*, 2014). Maxigrain® enzyme is a multi-enzyme compound of B-glucanase, xylanase, phytase, arabinoxylanase and a mixture of yeast and minerals produced by Bio-organics Ltd which originates from the bacteria *Aspergillus oryzae* (Esuga *et al.*, 2008, Duru and Dafwang, 2010, Midau *et al.*, 2011, Alu *et al.*, 2012, Bawa *et al.*, 2012). This study was therefore conducted to determine the performance, nutrient digestibility and cost implications of broiler finishers fed diets containing graded levels

of cassava peel meal with enzyme (Maxigrain®) supplementation.

Materials and methods

Experimental site

The experiment was conducted at the Poultry Teaching and Research Farm of the Department of Animal Production Technology, Federal College of Wildlife Management, New Bussa, Niger State, Nigeria. The college is geographically located on latitude 7°3'N and longitude 4°33'W, which covers an area of 2.5km² with the vegetation described as Northern guinea savanna zone of Nigeria. The average temperature is 28°C to 40°C with a relative humidity of 60% and mean annual rainfall of 650mm-1300mm.

Preparation of the cassava peels meal

Fresh cassava (*Manihote sculenta*) peels were collected at a site of local cassava processing centers in New Bussa, Niger State. The cassava peels were soaked in water inside a metal drum for three (3) days after which they were removed and drained with a basket and followed by sun-dried for five (5) days before milling to fine particles of 2mm in diameter using a hammer mill into meals, and used to formulate the test diets.

Management experimental birds and design:

A total of two hundred and twenty (220), day old Anak broiler birds were obtained from a reputable commercial hatchery at Ibadan, Oyo State. They were brooded and raised on commercial broiler starter diet (Guinea feeds, 23% CP, 3200kcal/kg ME) for four weeks and supplied drinking water *ad-libitum*. At four weeks of age, two hundred birds were selected to be uniform in size and body weight; randomly allocated to four (4) dietary treatments with five replications of ten birds each in a completely randomized design

(CRD). Lighting source was provided using electricity bulbs during the night. The birds were administered anti-stress vitamin/mineral premix orally at the recommended dosage after randomization before the commencement of the experiment. The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation. Medications, vaccinations and other routine management practices were strictly followed. The birds were fed with experimental diets *ad-libitum* together with the supply of clean water throughout the four weeks period of the experiment.

Experimental diets:

Four (4) experimental broiler finisher diets were formulated, using the soaked and sun-dried cassava peel meal (CPM) to replace dietary maize at 0%, 25%, 50% and 75% respectively as shown in Table 1. Diet 1 (T₁) serves as the control diet and it was formulated with maize as a major source of energy without enzyme and CPM. Diet T₂ to T₄ had graded levels of CPM with the inclusion of Maxigrain[®] enzyme at 100mg/kg diet.

Data collection

The parameters measured for the performance response of the birds were average body weight gain, average feed intake and feed conversion ratio (FCR). Birds were weighed at the beginning of the trial and weekly thereafter. Weight gain was computed by subtracting initial weight from final weight. Left over feed was collected and weighed weekly, and subtracted from the quantity offered to obtain weekly feed intake per replicate. Feed conversion ratio was computed by dividing the average feed consumed per bird with the average weight gain per bird. The prevailing market price of feed ingredients at the time of study was used to

calculate the cost of feed per kg and cost per kg weight gain of the broiler finisher birds.

Metabolic cage trial

At the end of 28 days, 2 birds per replicate making a total of 10 birds per treatment were randomly selected from the four (4) treatment groups for metabolic cage study which lasted for 5 days after an adjustment period of two (2) days. A known quantity of feed was given and feces voided were collected daily for a period of 5 days. Dropping trays were covered with aluminum foil paper for total excreta collection. The feed intake over the 5 days trial was recorded. The fecal droppings from each replicate were sun-dried to remove the moisture content to bring the feces to a constant weight, after feather and contaminant were removed. The total collection of the feces was pooled, weighed, ground and representative samples were taken for chemical analysis. The results were used to calculate the digestibility as:

Apparent Digestibility Coefficient

$$= \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

Chemical analysis

The proximate composition of the test ingredient (CPM) and experimental diets as well as the fecal samples were determined using the procedures of the Association of Analytical Chemist (AOAC, 2006).

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) using SAS (2002) and where significant, treatment means were compared using Duncan Multiple Range Test (Duncan, 1995).

Results and discussion

Table 2 shows the proximate composition of the CPM. The result showed that CPM

Table 1: Ingredient composition of experimental broiler finisher diets

Ingredient	T ₁ (0%CPM)	T ₂ (25%CPM)	T ₃ (50%CPM)	T ₄ (75%CPM)
Maize	59.0	45.7	30.4	15.1
Cassava Peel Meal (CPM)	-	15.3	30.6	45.9
SBM	28	28	28	28
F/M	3	3	3	3
Wheat offal	6	4	4	4
Bone Meal	2.0	2.0	2.0	2.0
Limestone	1.0	1.0	1.0	1.0
Premix	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2
Methonine	0.3	0.3	0.3	0.3
Salt	0.2	0.2	0.2	0.2
Maxigrain®	0.00	++	++	++
Total	100	100	100	100
Determined Analysis (DM basis)				
CP %	20.60	19.95	19.84	19.20
ME Kcal/kg	2980.66	2975.54	2977.14	2903.93
CF %	4.54	5.89	7.55	9.13
EE %	3.80	3.64	2.98	2.57
Ash%	4.85	5.20	5.93	6.36

Supreme vitamin-mineral premix contains the following: Vitamin A,15000000i.u; Vitamin D3 3,000000i.u, Vitamin E, 30,000i.u, Vitamin K, 2,500mgr, Thiamin, B1,2,000mgr, Riboflavin, B2, 6,000mgr;Pyridixine B6 4,000 Niacin, 4,000mgr; Vitamin B12,20mgr; Pantothenic Acid,10,000mgr; Biotin,80mgr;Cholin ChlOride 500mgr; Antioxidant, 125gr;Manganese 96gr; Zinc, 60gr; Iron 24gr; Copper 60gr; Iodine 1.4gr;Selenim 240gr; Cobalt 120gr.

++ Maxigrain enzyme at 100mg/kg of feed.

used in this study contained 5.75% crude protein, 14.83% crude fiber, 1.47% ether extract, 5.68% ash and 70.1% NFE. The observed crude protein (5.75%) of CPM in this study was higher than 3.5% reported by Idahor (2012), 5% by Salami and Odunsi (2003) and 5.46% (Udoyong *et al*, 2010, Midau *et al*, 2011). Moreover, the crude fiber was observed to be lower than 18.81% reported by Udoyong *et al*, (2010)

and Midau *et al*, (2011) as well as 15.5% by Idahor (2012). The cassava varieties, storage conditions, peeling methods and durations in storage before processing may have resulted in these differences. The nutrient composition of the experimental diets were adequate and within the recommended range for finisher birds (NRC, 1994, Oluyemi and Roberts, 2000). Data on the performance response are

Table 2: Proximate composition of cassava peel meal (CPM)

Constituents	CPM
Dry matter %	82.66
Crude protein%	5.75
Crude fiber %	14.83
Ether Extract%	1.47
Ash%	5.68
NFE %	70.10

presented in Table 3. The result revealed a significant ($P < 0.05$) difference in average final body weight and average weight gain, while average feed intake and feed conversion ratio (FCR) were not significantly ($P > 0.05$) affected among the birds fed experimental diets. Birds on T_3 and T_4 had similar ($P > 0.05$) average body weight and weight gain but differed significantly ($P < 0.05$) from birds on control (T_1). Birds on T_4 had similar ($P > 0.05$) feed intake with those on T_3 diet which recorded high feed intake. Birds on T_3 recorded the lowest value of FCR. The performance of broiler birds on enzyme supplemented cassava peel meal based diets was superior to those birds on the control diets. This could be probably due to the fact that the birds effectively utilize their feed components. The improvement in weight gain and feed utilization could be attributed to enzyme supplementation in the diets (Acamovic, 2001, Iyayi and Okhankhuele, 2002, Esuga *et al.*, 2008, Makanjuola and Iyayi, 2010, Ademola *et al.*, 2013). This is an indication that Maxigrain® being a cocktail of enzymes might have improve the overall feed digestibility and utilization of the test diets by hydrolyzing the effect of non-starch polysaccharide (NSP) present in the cassava peel thereby reducing its fiber level, consequently leading to increase in feed intake and weight gain (Iyayi and Yahaya, 1999, Sunduet *et al.*, 2005, Akpodite *et al.*, 2006, Midau *et al.*, 2011, Bawa *et al.*, 2012c).

Result of economic indices is shown in Table 3. The result revealed that Maxigrain® supplementation had a significant ($P < 0.05$) effect on economic parameters measured. It was observed that as inclusion level of enzyme supplemented CPM diets increased, the cost/kg feed and cost/kg weight gain decreased across the dietary treatments. This has showed that cost

decreased with increasing levels of enzyme supplemented CPM and also significant savings were achieved with the use of Maxigrain® treated CPM diets in replacing maize up to 75% inclusion level. This observation agrees with the previous findings (Salami *et al.*, 2003; Peng *et al.* 2003; Makanjuola and Iyayi, 2010, Midau *et al.*, 2011). Birds on T_3 and T_4 diets had similar ($P > 0.05$) profit margin which was significantly ($P < 0.05$) higher than those on control diet. Addition of Maxigrain® to CPM based diet resulted in the maximum profit which is probably connected with the ease to which broilers were able to utilize the CPM and gained higher body weight. This observation agrees with the findings of Ademola *et al.* (2013).

Data obtained on apparent nutrient digestibility are presented in Table 4. Significant differences ($P < 0.05$) occurred in all the parameters evaluated with the exception of dry matter. In all parameters measured, highest values occurred on birds fed 50% CPM-enzyme supplemented diet as compared to the control group that recorded the lowest values. The improved nutrient digestibility of birds with enzyme supplemented cassava peel meal based diets could be attributed to the versatile multi-enzyme (Maxigrain®) adopted which is capable of degrading the feed anti-nutritional compounds and fiber components of the diets which subsequently release trapped nutrients, thereby making more nutrients available for utilization by the birds (Dusterhoff *et al.*, 1992, Salami and Odunsi, 2003, Akpodiete *et al.*, 2007, Sekoni *et al.*, 2008). The improvement in feed utilization could be due to the action of the enzyme in the diet and it has been reported that enzyme enhance the efficiency of feed utilization by improving the nutrient digestibility (Makanjuola and Iyayi, 2010, Ani and

Table 3: Performance and economic indices of broiler finishers (4-8 weeks old) fed enzyme supplemented graded levels of cassava peel meal (CPM) based diet.

Performance indices	T1 0%CPM	T2 25% CPM	T3 50% CPM	T4 75% CPM	SEM
Ave. initial weight (g)	857.00	856.00	857.50	856.50	8.20
Ave final weight (g)	1812.50 ^c	1895.00 ^b	2001.50 ^a	1915.50 ^{ab}	4.82
Ave. weight gain (g)	955.50 ^c	1039.00 ^b	1144.00 ^a	1059.00 ^{ab}	3.67
Ave feed intake (g)	2745.00	2765.00	2880.00	2864.00	10.14
FCR	2.87	2.66	2.52	2.70	0.26
Cost/kg feed (₦/kg)	107.42 ^a	96.51 ^{ab}	85.03 ^{bc}	73.56 ^c	1.26
Cost/kg weight gain (₦/ kg)	308.30 ^a	256.71 ^b	214.28 ^c	198.61 ^b	16.94
Profit margin (fi /kg)	490.08 ^c	656.76 ^b	984.08 ^a	986.43 ^a	6.22

^{abc}: Means with different superscript within the same row are significant ($P < 0.05$).

Nnamani, 2011, Bawa *et al.*, 2012c, Teniola *et al.*, 2014). This implied that the enzymatic profile in Maxigrain® preparation could hydrolyze the non-starch polysaccharide (NSP) of cassava peel meal diet so as to make nutrients and minerals more available for the birds.

Conclusion and Recommendation

Addition of Maxigrain® enzyme to CPM diets has clearly showed the beneficial effect of feed enzymes in poultry production. Therefore, the result of this study showed that birds on the enzyme supplemented CPM diets performed

significantly better than those on the control diets in all the parameters investigated. Hence, cassava peel meal can be made a better feedstuff by improving the digestibility of the high fiber component and degrade its anti-nutritional effects with the aid of an enzyme. Nevertheless, the findings has shown that 75% inclusion level of CPM with Maxigrain® enzyme supplementation can be incorporated in broiler finisher diets without any adverse effect on a normal healthy broiler chicken at a lower cost of production. However, diet containing 50% CPM inclusion level

Table 4: Apparent nutrient digestibility of broiler finishers (4-8weeks old) fed graded levels of cassava peel meal (CPM) with supplementary enzyme (Maxigrain®)

Nutrient Digestibility %	T1 0%CPM	T2 25% CPM	T3 50% CPM	T4 75% CPM	SEM
Dry matter	75.89	74.84	75.86	74.17	3.81
Crude Protein	66.34 ^b	68.39 ^b	75.86 ^a	74.67 ^a	1.41
Crude Fiber	51.50 ^b	58.58 ^a	58.79 ^a	52.81 ^b	2.69
Ether Extract	63.85 ^b	68.58 ^b	75.33 ^a	71.14 ^a	0.76
Ash	53.00 ^b	52.54 ^b	68.67 ^a	53.14 ^b	0.82

^{abc}: Means with different superscript within the same row are significantly different ($P < 0.05$)

elicited an improved performance and nutrient digestibility and is hereby recommended. Thus, the use of cassava peel meal should be encouraged not only to reduce dependence on maize but also to reduce cost of feed for a profitable broiler production.

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