

Growth and Early Laying Performance of Pullet Chickens Fed Sorghum Based Diets Supplemented with Enzymes

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Abstract

A study was carried out to evaluate the effect of replacing maize with sorghum and supplementation with enzymes, on the growth and laying performance of laying chickens. Four hundred and fifty 12-weeks old Lohmann Brown pullets were distributed randomly into six dietary treatments with three replicates per treatment, each replicate had 25 birds with uniform group weights at the initial stage of the study. The treatments included maize without enzymes (T1) and sorghum without enzymes (T2) as two controls respectively, while T3, T4, T5, and T6 contained sorghum based diets with phytase, protease, roxazyme G2G, and a combination of protease and roxazyme G2G respectively. The experiment lasted from 12 to 32 weeks of age of birds during which data were collected on growth and early egg laying performance of birds. Data obtained were subjected to analysis of variance, using the completely randomized design (CRD). Significant differences among treatment means were compared using the Tukey test. Significant ($p < 0.05$) differences were noted in final weight (g/bird), weight gain (g/bird), daily weight gain (g/bird), total feed intake (g/bird), daily feed intake (g/bird/day), and feed to gain ratio. Final weight and weight gain were significantly ($p < 0.05$) better for birds in T4 (sorghum + protease) compared to the other treatments, but was similar to T1 (control). At the early laying stage, no definite trend was observed among the egg production traits. However, dietary treatment supplemented with phytase (T3) had the highest numerical values for; weight of first egg (54.28g), number of eggs at peak lay (24.00), hen house egg production 78.84%, and hen day egg production, 81.09%. It was concluded therefore, that sorghum with phytase and protease supplementations can be used in layers' diets for optimum egg production. It is recommended that phytase supplementation at 0.02% with sorghum can be incorporated into the diets of egg type chickens for optimum performance.

Keywords: Sorghum, Pullets, Enzymes, Growth Characteristics, Egg Laying Performance

Introduction

Maize has remained the main energy source in compounded diets and constitutes about 50% of poultry ration (Ajaja *et al.*, 2002). According to Etuk (2008), these trends require serious diversification of energy feedstuff for poultry. The fact that feed alone accounts for 70 – 80% of the production inputs in intensive monogastric animal production, makes the utilization of cheaper and alternative feed ingredients expedient. The main aim of using non-conventional feed ingredients is to reduce

the cost of production thus making it possible for an average Nigerian to be able to afford animal protein in their meals (Olabanji *et al.*, 2009).

Sorghum bicolor (L) Moench is widely grown in the semi-arid and arid savannah regions of Nigeria. Maunder (2002) reported that, sorghum is a traditional crop in much of Africa and Asia, and an introduced and hybridized crop in the western hemisphere. In terms of the nutritive value, cost and availability, sorghum grain is the next alternative to

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maize in poultry feed (Subramanian and Metta, 2000). Several varieties of sorghum have been developed and introduced in Nigeria such as PRADHAN, MLSH 296 Gold, MLSH 151, SAMSORG-3, SAMSORG-5, SAMSORG-6, SAMSORG-16, SAMSORG-17, SAMSORG-40, SAMSORG 42, SAMSORG 43, SAMSORG 44 (IAR, 1999). Field observations in Nigeria revealed the inclusion of sorghum in poultry and rabbit diets (Abubakar *et al.*, 2006; Etuk and Ukaejiofo, 2007). Sorghum however, contains some anti-nutritional factors which inhibit the use of important nutrients like protein, energy and minerals in diets. These anti-nutritional factors include trypsin inhibitors (protease inhibitor), saponins, oxalates, tannins haemagglutinins (lectins), phytic acid/phytate, and indigestible carbohydrates such as oligosaccharides and non-starch polysaccharides (Marsman *et al.*, 1997; Graham *et al.*, 2002).

Feed enzymes have the potential to reduce effects of anti-nutritional factors, render nutrients more available for digestion and absorption, increase energy value of feed ingredients and allow for greater flexibility in feed formulation, thus reducing formulation costs and modulating or stabilising gut microflora. Some of the enzymes that have been used over the past several years and have potential for use in the feed industry include cellulase (β -glucanases), xylanases and associated enzymes, phytases, proteases, lipases, and galactosidases. Supplementing poultry diets with these exogenous enzymes can improve digestion of nutrients from feedstuffs, thereby decreasing feed costs and improving bird performance (Silversides and Hruby, 2009; Khusheeba and Sajid, 2013). The aim of this study was to determine the effect of enzymes

supplementation on performance of egg type chickens fed sorghum based diets. The specific objective was to evaluate the growth and early laying performance of pullets fed sorghum based diets supplemented with phytase, protease, and roxazyme G2G.

Materials and methods

Location of the Study

The study was conducted at the Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria, Nigeria. Zaria is located within the Northern Guinea Savannah zone of Nigeria, latitude, 11° 14' 44' N and longitude 7° 38' 65'E, at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm, occurring between the months of April and September (Ovimaps, 2015).

Experimental birds and other materials used

The Lohmann Brown pullet growers were used. Sorghum (Kaura variety) was purchased from the open market in Samaru, Zaria. The other ingredients for the experiment were purchased from Musphaza Agro Allied Investment Company Limited, Kaduna.

Experimental design

Four hundred and fifty 12-weeks old Lohmann Brown pullets were distributed randomly into six treatments with 3 replicates per treatment, each replicate had 25 birds with all the replicates having uniform group weights, and Completely Randomized Design (CRD) was used. The experiment lasted up to 32 weeks of age of the birds, i.e 20 weeks period.

Experimental diets

The experimental diets were formulated as follows; T1 = maize based diet without enzyme served as the control; T2 = sorghum based diet without enzyme as a second

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control, T3 = sorghum based diet with phytase, T4 = sorghum based diet with protease, T5 = sorghum based diet with roxazyme G2G, T6 = sorghum based diet with Protease and roxazyme G2G.

However, layer's diet was introduced when the birds reached 21 weeks of age. The composition of the diets and calculated analysis are as shown in Table 1.

Data collection

Growth parameters measured included, final weight, weight gain, feed intake, feed conversion ratio. The early egg laying performance parameters measured included weight of birds at first egg, weight of first egg, age at first egg, age at 10% lay, age at 50% lay, and age at peak lay. Other parameters included; number of eggs at peak lay, percentage en day egg production

(HDP), percentage hen housed production (HHP) at peak lay, egg number per hen, and egg mass.

The HDP and HHP were calculated using the following formulae;

HDP%...

$$\text{HDP} = \frac{\text{Total number of eggs produced}}{\text{Number of Hen days}} \times 100$$

Where "Hen days" = Number of hens x Number of days in lay

$$\text{HHP} = \frac{\text{Total number of eggs laid}}{\text{Total number of hens housed at the beginning of laying Period}} \times 100$$

Data analysis

Data generated on growth and early laying performance were subjected to analysis of variance using General Linear Model procedure for statistical analysis, while Tukey Test was used to separate significant differences between means (SAS, 2001).

Table 1: Composition of experimental pullet growers diet

Feed Ingredients (%)	Dietary Treatments					
	T1 (Maize Control)	T2 (Sorghum Control)	T3 (Sorghum +Phytase)	T4 (Sorghum +Protease)	T5 (Sorghum +G2G)	T6 (Sorghum +Protease+G2G)
Maize	52.00	0.00	0.00	0.00	0.00	0.00
Sorghum	0.00	52.00	52.00	52.00	52.00	52.00
Wheat bran	25.50	25.50	25.50	25.50	25.50	25.50
Groundnut cake	18.00	18.00	18.00	18.00	18.00	18.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00	1.00
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Vitamin-mineral Premix	0.30	0.30	0.30	0.30	0.30	0.30
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Phytase	0.00	0.00	0.02	0.00	0.00	0.00
Protease	0.00	0.00	0.00	0.02	0.00	0.02
Roxazyme G2G	0.00	0.00	0.00	0.00	0.02	0.02
Calculated Analysis						
Energy (MEKcal/Kg)	2596.00	2492.00	2492.00	2492.00	2492.00	2492.00
Protein (%)	16.71	17.80	17.80	17.80	17.80	17.80
Crude Fibre (%)	4.64	4.28	4.27	4.27	4.27	4.26
Ether Extract (%)	4.78	4.16	4.16	4.16	4.16	4.16
Ash (%)	3.30	3.51	3.51	3.51	3.51	3.51
Calcium (%)	1.36	1.37	1.37	1.37	1.37	1.37
Phosphorus (%)	0.99	0.99	0.99	0.99	0.99	0.99
Lysine (%)	0.85	0.79	0.79	0.79	0.79	0.79
Methionine (%)	0.44	0.45	0.45	0.45	0.45	0.45

Vitamin –mineral premix provide per kg of diet: vit A, 13,340 i.u; vit. D₃, 2680 i.u; vit E, 10i.u; vit. K, 2.68mg; Calcium p antothenate, 10.68mg; vit B₁₂, 0.022mg; Folic acid, 0.668mg; Choline Chloride, 400mg; Chlorotetracycline, 26.68mg; Manganese, 13mg; Iron, 66.68mg; Zinc 53034mg; Copper, 3.2mg; Iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108mg.

Results and discussion

The growth performance is represented in Table 2. There were significant ($p < 0.05$) differences among for final weight, weight gain, daily weight gain, total feed intake, daily feed intake and feed to gain ratio. However, maize control and sorghum plus protease diets were significantly ($p < 0.05$) higher compared to all other dietary treatments for only final weight, weight gain, and daily weight gain. Total feed intake and daily feed intake were similar in maize control, phytase, protease and G2G diets, which were not significantly different ($p > 0.05$).

Significant differences were observed among the dietary treatments fed sorghum supplemented with specific enzyme additions on growth performance of layer hens at age of 12-32 weeks. Higher final weight and consequently average daily weight gain (g/day) observed in birds fed diets supplemented with protease enzyme was comparable with that of the maize based diet. This agrees with reports on the impact of exogenous enzyme supplementation on growth performance of farm animals in general. Such impact as cited was not limited to improvement of the nutritive value of feed stuffs but also reduction in the variability in nutritive value between feedstuffs and improving the accuracy of feed formulations (Pariza and Cook, 2010; Munir and Maqsood, 2013).

This improvement observed in this study may probably be due to an increase in nutrients release from sorghum by the action of the enzyme supplemented especially the protease. The results indicate that the efficiency of dietary utilization especially protein increased in chicken fed protease enzyme-supplemented-diet compared to those fed the control and other enzymes.

Variations in total feed intake among the dietary treatments may be attributed to the

level of the anti-nutritional factors present in the feed, and the form of enzyme supplementation. Also, there were significant differences among all the measured parameters (weight gain, daily weight gain, total feed intake, daily feed intake and feed to gain ratio). Trend obtained from this study is in contrast with the report of Lumpkins *et al.* (2005) who showed no difference in daily feed intake, weight gain and total feed intake for hens fed up to 15 or 20% distillers dried grain.. The reduction in feed to gain ratio due to enzyme supplementation in this study is in agreement with earlier findings (Jackson *et al.*, 2004 and Onu *et al.*, 2011). These researchers reported that exogenous enzymes greatly improved the feed conversion abilities of broiler chicks and growing pullets fed enzyme supplemented diet as observed in this study.

Increase in total feed intake in this study was corroborated by the observation that birds eat more to meet their energy requirements to sustain growth and development. Pettersson and Aman (2007) tested the addition of an enzyme cocktail, to an unpelleted poultry diet containing rye and wheat, and reported a significant increase in body-weight and feed intake. Therefore, the supplementation of the animal feed with suitable enzymes to increase the efficiency of digestion can be seen as an extension of the animal's own digestion process.

The early laying performance of pullets fed sorghum based diets is shown in Table 3. Dietary treatment differed significantly ($p < 0.05$) for weight of birds at first egg, weight of first egg, age of bird at first egg, age at 10% lay, number of eggs at peak lay, %HHP at peak lay, %HDP at peak lay, egg number, egg mass and mortality except for age at 50% lay. Phytase diet had the highest numerical value for weight of first egg (54.28 g/bird), although there was no

Table 2: Growth Performance of Pullets fed Sorghum based Diets supplemented with enzymes (12-32 weeks)

Parameters (%)	Dietary Treatments						SEM
	T1 (Maize Control)	T2 (Sorghum Control)	T3 (Sorghum +Phytase)	T4 (Sorghum +Protease)	T5 (Sorghum +G2G)	T6 (Sorghum+ Protease +G2G)	
Initial Wt (g/bird)	736.67	736.67	733.33	736.67	740.00	733.33	3.97
Final Wt (g/bird)	1416.67 ^a	1356.67 ^b	1343.33 ^b	1400.00 ^a	1373.33 ^b	1370.00 ^b	18.13
Weight gain (g/bird)	680.00 ^a	620.00 ^b	610.00 ^b	663.33 ^a	633.33 ^b	636.67 ^b	18.63
Daily Weight gain (g/bird)	5.11 ^a	4.66 ^b	4.59 ^b	4.99 ^a	4.76 ^b	4.79 ^b	0.14
Total Feed Intake (g/bird)	4106.7 ^a	3950.00 ^b	4043.30 ^a	4166.70 ^a	4170.00 ^a	3913.30 ^b	71.07
Daily Feed Intake (g/bird/day)	30.88 ^a	29.70 ^b	30.40 ^a	31.33 ^a	31.35 ^a	29.24 ^b	0.53

^{ab} Means in the same row with different superscripts are significantly different (p<0.05).

SEM= standard error of means

Table 3 : Early Laying Performance of Pullets fed Sorghum Based Diets supplemented with enzymes

Parameters (%)	Dietary Treatments						SEM
	T1 (Maize Control)	T2 (Sorghum Control)	T3 (Sorghum +Phytase)	T4 (Sorghum +Protease)	T5 (Sorghum +G2G)	T6 (Sorghum +Protease +G2G)	
Weight at first egg(g/bird)	1416.00 ^a	1354.67 ^b	1341.33 ^b	1400.00 ^a	1376.00 ^a	1368.00 ^{ab}	26.54
Weight of first egg(g)	50.10 ^{ab}	51.50 ^{ab}	54.28 ^a	50.82 ^a	52.87 ^a	48.98 ^{ab}	2.65
Age at first egg (days)	148.67 ^a	165.33 ^d	160.67 ^d	156.67 ^b	154.67 ^b	153.00 ^c	3.00
Age at 10% lay (days)	158.33 ^a	176.67 ^c	165.33 ^b	160.67 ^b	159.67 ^a	163.67 ^b	3.17
Age at 50% lay (days)	180.33	194.00	186.00	194.33	186.00	188.33	7.59
Age at Peak lay (days)	217.33 ^b	211.33 ^{ab}	217.33 ^b	217.33 ^b	218.00 ^b	208.00 ^a	4.87
Number of Eggs at Peak lay	23.00 ^{ab}	22.00 ^b	24.00 ^a	24.00 ^a	21.00 ^b	21.00 ^b	1.00
%HHP at Peak Lay	75.60 ^{ab}	70.20 ^b	78.84 ^a	77.76 ^a	69.12 ^b	66.96 ^b	3.81
%HDP at Peak Lay	77.67 ^{ab}	71.24 ^b	81.09 ^a	78.84 ^a	70.20 ^b	66.96 ^b	4.12
Egg number/bird	36.00 ^a	24.00 ^c	31.00 ^b	31.00 ^b	34.00 ^{ab}	30.00 ^b	2.00
Egg Mass(g/bird)	867.70 ^a	510.70 ^d	776.00 ^b	765.00 ^b	844.30 ^a	700.00 ^c	108.50
Mortality (%)	4.00 ^b	1.00 ^{ab}	4.00 ^b	1.00 ^{ab}	1.00 ^{ab}	0.00 ^a	1.00

^{abcd} Means in the same row with different superscripts are significantly different (p<0.05).

SEM= standard error of means

significant difference (p>0.05) among the whole treatments in terms of weight of first egg. There was no significant difference (p>0.05) among maize control, phytase, and protease diets with respect to the number of

eggs at peak lay, %HHP at peak lay, and %HDP at peak lay respectively. Maize control diet was significantly (p<0.05) better for age at first egg (148.67 days) and numerically better for egg number (36.00)

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compared to the other treatments.

The G2G diet was comparable to the maize control diet for weight at first egg, weight of first egg, age at 10% lay, egg number, and egg mass. Dietary treatment differed significantly for weight at first egg, age at first egg, age at 10% lay, number of eggs at peak lay, %HHP at peak lay, %HDP at peak lay, egg number, egg mass, and mortality. However, there were no significant differences among the treatments for weight of first egg, and age at 50% lay. These results are similar to values obtained by Lumpkins *et al.* (2005) and Roberson *et al.* (2005). Both authors conducted experiments with laying hens incorporating up to 15% DDGS with no negative effects on egg production. Typically, enzymes added to layer feed appear to have little effect on egg mass but improve feed efficiency (Vukic Vranjes and Wenk, 1993; Benabdeljelil and Arbaoui, 1994), and energy utilization (Wyatt and Goodman, 1993). Wyatt and Goodman (1993) reported that corn-fed layers exhibited better feed efficiency than those fed enzyme supplemented barley-based diets. Nevertheless, enzyme supplementation improved the utilization of sorghum diets in the present study such that the egg mass was not similar among dietary treatments. Mathlouthi *et al.* (2003) reported no effect of a multi-enzyme complex on early laying egg performance, and their results were contrary to the observations in the current trial. These differences could be due to environmental differences such as enzyme types, climatic conditions and experimental set up of the birds. Furthermore, Gunawardana *et al.* (2009), using Hy-Line W-36 hens, found no significant effect of a multi-enzyme blend (Robavio™) on hen feed intake and performance. Harms *et al.* (2000) also reported no significant effect of multi-enzyme supplementation in

producing hens.

Egg weight was affected by enzyme supplementation in this study. Wu *et al.* (2005) reported that diets supplemented with β -mannanase, a part of the multi-enzyme Rovabio, significantly increased egg weight in some weeks only. However, no definite pattern was observed for most of the egg production traits. Egg production did not have a definite pattern when layers were fed diets with sorghum supplemented with enzyme or when sorghum was the sole cereal in the diet (Parthasarathy *et al.*, 2005). However, phytase supplementation in pullet diet effectively increased the weight of first egg and % HDP at peak lay, hence, phytase has practical advantages and it may be strongly recommended for use in sorghum based diets. Age at first egg, age at 10% lay, age at peak lay and number of eggs at peak lay was not influenced by enzyme supplementation as compared with the maize based diet without enzyme supplementation that had earliest lay. Age at 10% egg production was 150 to 178 days for commercial layers in data reported by Ryan *et al.* (1998) and result from this study was within the value of 148.67-165.33 days.

The results from this study indicated that enzyme supplementation significantly affected egg mass compared to the control group. These results are contrary with the report of Jalal *et al.* (2007), who reported that Avizyme® supplementation did not have a significant effect on egg mass. On the other hand, most recent research with laying hens has shown improved egg mass among varying laying hen strains when Avizyme® of different enzyme form was used (Douglas *et al.*, 1990; Sohail and Roland, 1999, and Scheideler *et al.*, 2005). The results showed that Kemzyme® did not significantly affect egg mass compared to the control group in Matrouh hens.

However, when Avizyme® and Kemzyme® were added together, the egg mass was enhanced than the control group or Kemzyme® group. Hen day production was best for dietary treatment supplemented with protease and phytase. Roberts and Choct (2006) however, reported that phytase supplementation caused a significant increase in hen-day egg production but egg weight at the same time decreased significantly.

Higher numerical egg weight was obtained in hens of phytase, protease, and G2G diets compared to the control groups (maize and sorghum diets), likely because of an improvement in the digestion and utilization of protein by the hens resulting from phytase and protease supplementation in the diet. Hen house production differed and showed the superiority of phytase and protease based diets over the other diets as also evidenced in the mortality ratio where the control and singular enzyme supplementation diets had the highest mortality accounting for reduction in HHP. The ranges of 69.12% - 78.84% agreed with the report of 69.00% - 81.67 % as reported by Tuleun *et al.* (1998) in laying hens.

Although the age at first egg, age at 10% lay, and age at peak lay were not significantly better in Phytase and Protease diets, and also the number of eggs at peak lay, %HHP, and %HDP were all significantly better, which translates to the effectiveness of phytase and protease as phytate degrading enzyme and protein degrading enzyme respectively.

Conclusion

Supplementation with protease enzyme improved the utilization of sorghum for growth performance while both phytase and protease improved utilization for egg performance traits. Sorghum supplemented with phytase and protease can therefore be incorporated in growers and layers diets of

egg type chickens, without negative effect on growth and early laying performance.

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