Research Article
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Dietary effect of feed grade enzymes on growth and digestive physiology of broiler chickens fed rice bran-based diet

Abstract

This study was carried out to determine the effect of feed grade enzymes on growth performance and nutrient digestibility of broiler chickens fed rice bran-based diets. The enzymes (cellulase, glucanase, xylanase and phytase) were given through a commercial product (Maxigrain®). A total, 150 day-old Cobb broiler chicks were divided into 5 treatments (T1–T5). The product was incorporated in the diets at 0.0 (control) and 0.01, 0.02, 0.03 and 0.04% for T2–T5 respectively. Each group was replicated three times with 10 birds per replicate. Each group was assigned to the experimental diets in a completely randomized design (CRD). Feed and water were provided ad libitum for 8 weeks the experiment lasted (four weeks each for starter and finisher phases). Results showed that at both the starter and finisher phases final live weight was significantly ($P<0.05$) improved. At the starter phase, only 0.02% improved feed: gain ratio and protein efficiency ratio. Weight gain, protein intake and feed intake were not altered ($P>0.05$) at both phases. Above 0.01% digestibility of fibre and protein was improved while all the levels increased that of ash. In conclusion, the enzymes improved the utilization of rice bran-based diets by broiler chickens and addition of 0.02% of the enzymes is recommended.

Keywords: broiler chickens, commercial product, feed grade enzymes, nutrient digestibility, rice bran

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Introduction

The tremendous increase in human population in world over has brought about increase demand for protein especially that of animal origin, which according to Hodas[1] have become very expensive. The decline in animal protein intake has been attributed to high cost of animal products.[2] An average person in developing countries consumes less protein than his counterparts in Europe and America. Hence Bamino & Dipeow[3] has posited that protein intake in developing country like Nigeria is below the required 75g per person per day estimation by Food and Agricultural Organization (FAO). This is grossly inadequate and presents a treat of serious malnutrition. Talabi[4] however observed that meat protein shortage continues to increase every day in Nigeria despite various efforts to improve its productivity in the field of cattle production. Ayay[5] on the other hand, opined that the awareness of the need for adequate protein in human diet had greatly increased in many developing regions of the world and poultry has been widely acknowledged as a rich source of dietary protein. Feed supply has remained a major constraint in poultry production due to the ever increasing cost of conventional feedstuffs. Hossain et al.[6] observed that poultry feed cost represent about 75% to 80% of the total cost of poultry production. With the progressive increase in the Nigerian population, the demand for animal protein source such as broiler could only be met by improving their performance with readily sourced and non-competitive feedstuffs like rice bran based diets treated with enzymes.

Controlling feed cost with the use of rice bran is critical to the sustainability of the Nigerian poultry industry, since high cost of feed ingredient and finished feeds are one of the important factors that draw back the progress of poultry production in developing economies. Rice bran is a major cereal by-product available for animal feeding in rice growing countries. It contains a good content of protein (13.206-17.13%), fat (14.50-22.70%), carbohydrate (16.10%), fiber (9.50-13.30%) and vitamins and minerals.[7]

Rice bran in the diet does not affect the health of a chicken.[8] In experiment with chicks, cereal grains have been replaced with rice bran and it was found promising.[9] Tiemoko[10] observed that 30% rice bran in broiler diets replacing maize significantly improved live weight gain without affecting feed conversion efficiently. Rice bran consist of the combined aleuronic and pericarp layers of the rice grain and various anti-oxidants that impart beneficial effect on human health.[11] Warren & Farrell[12] emphasized that rice bran has a high level of some important nutrients like lipids, protein, vitamin B and E, trace mineral and amino acid.

However, the nutrients that are embedded in rice bran cannot be optimally utilized by chickens because of the fibre and non-starch polysaccharide content. Given that so many nutrients are embedded in rice bran, the question is; what can be used to achieve a maximum utilization of the nutrients trapped in rice bran. Allen et al.[13] pointed out that incorporating specific enzymes enable nutritionist optimize the cost and performance of broiler birds by treating rice bran based diets with enzymes. Hence a blend of the most relevant digestive enzymes to serve this purpose is needed.[14] Inborr et al.[15] opined that enzyme addition to monogastric animal feed reduced digesta viscosity in the intestine and showed a marked improvement on various morphological effect of feed fibrous materials to non-ruminants. Therefore the objective of this work was to determine the effect of specific multi enzymes on utilization of rice bran based diet by broiler chickens.

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Materials and method

Experimental site

The study was carried out at Poultry and Laboratory units of the Department of Animal Science, University of Uyo, Uyo, Nigeria. Uyo lies between latitude $4^0$31'E and $45^0$31'N and $4^0$45'N and longitude $7^0$31'E and $45^0$351'E. The altitude of the area is 38m above sea level and a mean rainfall of about 2115mm. The estimated annual relative humidity is 79% and average temperature of 26.86°C (Meteorology Station University of Uyo, Uyo, Nigeria).

Experimental design

A total of one hundred and fifty (150) unsexed day old Cobb broiler day old chicks were used. The birds were divided into five (5) dietary treatments (T). Each treatment was replicated three times and each replicate had ten (10) birds. Treatment one served as control which contained no enzymes. Treatments T2–T5 were diets containing 0.01, 0.02, 0.03 and 0.04% of the commercial blend of enzymes respectively. That translated to 0.0, 0.1, 0.2, 0.3 and 0.4g/kg diet for T1–T5 respectively. The product contained multi-enzymes which were cellulase, β-glucanase, xylanase and phytase. The experiment was arranged in completely randomized design (CRD).

The statistical model was:

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

Where:

Y_{ij} = Single observation

μ = Overall mean

T_i = Treatment effect (Enzymes)

e_{ij} = Random error (~iind(0σ2))

Experimental diets

Two basal starter and finisher diets were compounded (Table 1) which nutrient composition is indicated in Table 2. The enzyme complex was added to the basal diets according to the level of each treatment group.

Management of experimental birds

Two weeks to the arrival of the birds the pens were washed, disinfected and fumigated. Wood shavings were used as the bedding material. On arrival, the birds were randomly allotted to the five dietary groups and their day old weights noted. Glucose D was added to their drinking water to supply immediate energy. On the second day, antibiotic with vitamin-mineral commercial preparation was added to their drinking water for seven days. Heat was supplied using kerosene stoves for the first 21 days. Feed and water were provided ad libitum for eight weeks the experiment lasted. Starter and finisher feeds were given for the first and last four weeks. Vaccinations to prevent Newcastle and gumboro diseases were administered by a Veterinary Officer during the starter phase. Anti-coccidial drug was given at the starter and finisher phases.

Data collection

Live weight of the birds was taken on weekly basis while feed intake was determined daily. Feed intake was taken to be the difference between the quantity of feed given previously and the leftover. Both the average live weight and feed intake were calculated by dividing the total live weight and total feed intake of a replicate by the number of birds in the replicate. The live weight and feed intake were used to calculate the feed: gain ratio, protein intake and protein efficiency ratio.

Table 1 Composition of experimental broiler starter and finisher diets

Ingredients (%)	Starter diet	Finisher diet
Maize	52	53
Soya bean meal	30	26
Rice bran	10	15
Fish meal	4.00	2.30
Bone meal	3.00	3.00
Salt	0.25	0.25
Lysine	0.2	0.1
Methionine	0.2	0.1
Vitamin mineral premix*	0.35	0.25
Total	**100**	**100**

***premix supplied per kg starter diet:** vitamin A 15,000 i.u., vitamin D_3 13000 i.u, thiamine 2mg, riboflavin 6mg, pyridoxine 4mg, niacin 40mg, cobalamine 0.05g, biotin 0.08mg, choline chloride 0.05g, manganese 0.096g, Zinc 0.06g, iron 0.024g, copper 0.006g, iodine 0.014g, selenium 0.24mg, cobalt 0.024mg and antioxidant 0.125g.

Table 2 Nutrient composition of diets (%)

Nutrients	Starter	Finisher
Crude protein	22.50	20.04
Crude fibre	4.32	5.20
Ether extract	4.53	5.01
Ash	8.8	8.54
Calcium	1.25	1.20
Phosphorus	1.10	1.05
Lysine*	1.25	1.02
Methionine*	0.33	0.31
Energy (KcalME/Kg*	2824	2850

*Calculated values

***premix supplied per kg finisher diet:** vitamin A 10, 000 i.u., vitamin D_3 12,000 i.u. vitamin E 20 i.u., vitamin K2.5mg, thiamine 2.0mg, riboflavin 3.0mg, pyridoxine 4.0mg, niacin 20mg, cobalamin 0.05mg, pantothenic acid 5.0mg, Folic acid 0.5mg, Biotin 0.08mg, choline chloride 0.2mg, manganese 0.006g, Zinc 0.03g, copper 0.006g, iodine 0.0014g, selenium 0.24g, cobalt 0.25g and antioxidant 0.125g.

Digestibility analysis

At the end of the experiment, two birds were randomly selected from each replicate and used for digestibility studies by transferring them to individual metabolism cages. The birds were acclimatized for 4 days after which known quantity of their respective experimental diets were given and the droppings voided were collected for 4 days, weighed, dried and stored. Proximate analysis of the faecal samples was carried out according to AOAC.[16]

Data analysis and statistical design

Data collected were analyzed using analysis of variance (ANOVA) using SAS.[17] Significantly different means were separated using Duncan's Multiple Range Test according to Steel et al.[18]

Results

The effect of rice bran based diets containing enzymes on growth performance of starter broilers is shown in Table 3. Enzyme inclusion did not significantly (P>0.05) alter performance of the birds in weight gain, feed intake, and daily protein intake. However, final live weight, feed: gain ratio and protein efficiency ratio were significantly (P<0.05) influenced. All the different levels of inclusion of enzymes increased final live weight compared to the control. There were no significant differences among the different levels.

Feed: gain ratio was improved by addition of 0.02 % over the control but the value did not differ from other levels of inclusion. However, there was no difference between the feed: gain ratio of the control and 0.01, 0.03 and 0.04 % levels. It was observed that the result of protein efficiency ratio followed similar trend as the result of feed: gain ratio where 0.02% gave better feed: gain ratio than the control.

Table 4 is indicating the results on growth performance of finisher broiler chickens. Also at the finisher phase feed intake and daily protein intake were not significantly (P>0.05) influenced. The final live weight was higher in all the groups that consumed enzymes as observed at the starter phase. It was noticed that the daily live gain which was not influenced at the starter phase, was significantly (P<0.05) improved by all the levels of enzyme over the control.

Table 3 Effect of enzymes on growth performance of starter broiler chickens fed rice bran

Parameters	T1(0.0)	T2(0.01)	T3(0.02)	T4(0.03)	T5(0.04)	SEM
Initial live weight (g/bird)	40.00	39.00	40.00	39.00	40.00	-
Final live weight (g/bird)	507.0^{b}	569.0^{a}	587.0^{a}	547.0^{a}	563.0^{a}	45.06
Daily weight gain (g/bird)	16.67	18.57	19.52	18.15	18.69	2.42
Total feed intake (g/bird)	800.0	858.0	860.0	845.0	866.0	212.01
Daily feed intake (g/bird)	28.58	30.65	30.71	30.17	30.72	5.04
Feed: gain ratio (FGR)	1.70^{c}	1.68^{abc}	1.58^{ab}	1.66^{abc}	1.75^{abc}	0.09
Daily protein intake (g/bird)	6.43	6.91	6.91	6.79	6.89	1.08
Protein efficiency ratio	2.59^{c}	2.69^{abc}	2.83^{ab}	2.67^{abc}	2.71^{abc}	0.13

^{abc}means with different superscripts on the same row are significantly (p<0.05) different.

Table 4 Effect of enzymes on growth performance of finisher broiler chickens fed rice bran

Parameters	T1(0.0)	T2(0.01)	T3(0.02)	T4(0.03)	T5(0.04)	SEM
Initial live weight (g/bird)	507.0^{b}	569.0^{a}	587.0^{a}	547.0^{a}	563.0^{a}	45.06
Final live weight (g/bird)	1940^{b}	2292^{a}	2317^{a}	2337^{a}	2279^{a}	125.04
Daily weight gain (g/bird)	51.19^{b}	61.90^{a}	61.79^{a}	63.93^{a}	61.43^{a}	10.02
Total feed intake (g/bird)	3430	3722	3568	3620	3687	301.01
Daily feed intake (g/bird)	123	133	127	129	132	25.82
Feed: gain ratio (FGR)	2.40^{a}	2.15^{b}	2.06^{b}	2.02^{b}	2.15^{b}	0.24
Daily protein intake (g/bird)	24.65	26.65	25.45	25.85	26.45	3.23
Protein efficiency ratio	2.08^{c}	2.32^{b}	2.83^{a}	2.47^{b}	2.32^{b}	0.22

^{a,b,c}means with different superscripts on the same row are significantly (P<0.05) different.

Similarly the feed: gain ratio was improved (P<0.05) by all the levels of the enzymes. Nevertheless the protein efficiency ratio of group that consumed 0.02 % enzymes was the best followed by those that consumed 0.01, 0.03 and 0.04 % compared to control. It was further observed that the protein efficiency ratios of 0.01, 0.03 and 0.04 % were similar.

The influence of enzymes on apparent nutrient digestibility of broilers fed rice bran based diets is indicated in Table 5. Digestibility of ether extract was the same in all the dietary treatment groups. Crude protein, crude fibre and ash were influenced significantly (P<0.05). Inclusion of the enzymes at the level of 0.02, 0.03 and 0.04 % increased crude protein and fibre digestibility compared to the control and 0.01 % which had similar values. All the inclusion levels of the enzymes produced higher ash digestibility.

Table 5 Effect of enzymes on apparent nutrient digestibility of broiler chickens fed rice bran

Parameters	T1(0.0)	T2(0.01)	T3(0.02)	T4(0.03)	T5(0.04)	SEM
Crude protein (%)	57.30[b]	64.97[b]	73.48[a]	79.78[a]	72.36[a]	6.54
Ether extract (%)	72.86	76.51	77.63	79.63	73.72	6.11
Crude fibre (%)	34.24[b]	35.71[b]	42.86[a]	47.37[a]	46.30[a]	5.05
Ash (%)	54.70[b]	65.34[a]	65.42[a]	70.08[a]	65.28[a]	5.89

[a,b]means with different superscripts on the same row are significantly (P<0.05) different.

Discussion

Quality of feed is important for growth performance of broilers. The result which showed that at both the starter and finisher phases there was significant increase in the final live body weight of broilers placed on diets containing different enzymes shows the importance of enzymes in diets containing rice bran. It is important to note that the increase in final live weight was not due to quantity of feed consumed but it could be due to the amount of nutrients available to the birds that were utilized. This is because feed intake was not significant. The enzymes tested (cellulase, glucanase, xylanase and phytase) are known to break down cellulose, non-starch polysaccharides and phytic acid to release more energy, protein and minerals which are essential for better productivity. The feed: gain ratio and protein efficiency ratio of 0.02% which was adjudged the best signifies the optimal level for better productivity. The result agrees with the findings of Farrell[19], Biwas et al.[20] and Swain et al.[21] who reported better growth rate due to enzyme supplementation. Also Maisonier et al.[22] indicated that supplementation of diets with enzymes may reduce dietary problems associated with feeding of poor quality feeds. The improvement in the parameters in this study also confirmed earlier assertion[23] that enzyme supplementation improves performance of birds by breaking down of fibrous materials in the rice bran meal by the enzymes which enabled the birds to acquire more nutrients thus depositing the nutrients as tissues in the body.

However, the present result did not agree with[24] who reported that the inclusion of exogenous enzymes did not significantly (P>0.05) improve body weight of broiler chicks. In contrast to feed intake Biwas et al.[20] revealed that though feed intake was significantly (P<0.05) lowered in rice bran enzyme supplemented dietary groups than the control live weight was improved. They opined that it could be as a result of the breakdown of fibre in rice bran diets and subsequent nutrient availability aided by the use of enzyme. They concluded that birds could consume less feed yet their energy requirement is met if their diet is supplemented with enzymes. Earlier Ani et al.[25] reported that reduction in feed intake was due to enhancement of feed digestibility and nutrient availability.

Increase in apparent crude protein, fibre and ash digestibility of broilers fed enzyme diets shows that the enzymes were able to unlock the nutrients from their matrix forms. This could have been linked to the growth performance of the birds as the nutrients were made available and utilized by the birds for various metabolic activities. This assertion is supported by Udoyong et al.[26] that enzymes addition to broiler diets improved nutrient digestibility. Adejoro[27] stressed the importance of nutrients availability for better performance of poultry and noted the need to formulate poultry feeds with ingredients and other substances that will support nutrient utilization and reduction of nutrient wastage such as phosphorus to the environment.[28] Martins[29] also pointed out that supplementing broilers diet with enzymes allowed rice bran to be used without detrimental effects. He reported that Phosphorus excretion was reduced by 9.6% and significant decrease of manganese, copper and zinc were also noted. The non-significant effect of diets on ether extract could be because fats and oils do not occur in matrix form and also the commercial product did not contain lipase to improve the digestibility of ether extract.

Conclusion

Inclusion of cellulase, glucanase, xylanase and phytase supplied through addition of different levels of a commercial multi-enzyme product in rice bran-based diets improved the productivity of the broiler chickens in many areas. The live weight was increased even when there was no increase in the quantity of feed consumed by the birds that were exposed to enzymes. Going by this result, it has been proved that the effect of rice bran-based diet for broilers could be improved by addition of these enzymes at 0.02%.

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None.

Conflicts of interest

The authors declare there is no conflict of interest.

References

1. Hodas D. Biodiversity and climate change laws: a failure to communicate. *SSRN*. 2008:1–28.
2. Obioha FC. *A guide of poultry production in the tropics*. Nigeria: Acena Publishers; 2002.
3. Bamino E, Dipeolu BF. Economic analysis of broilers product in Ogun State, Nigeria. *Trop J Anim Sci*. 2010;1(76):13–17.
4. Talabi FS. Integrated poultry-cum-fish culture in NIFER annual report, Department of Fisheries and Aquaculture. University of agriculture, Makurdi, Nigeria. 2004.
5. Ayayi B. Effect of three sources of fibre and period of feeding on the performance, carcasses measure, organ relative weight and meat quality in broilers. *Int J Poult Sci*. 2005;4(9):695–700.
6. Hossain MA, Islam AF, Mubarak PA. Energy utilization and performance of broiler chickens raised on diets with vegetable proteins or conventional feeds. *Asian J Poult Sci*. 2012;6(4):117–128.
7. Aljasser M, Mustapha A. Quality of Hassawi Rice Bran. *Annual Agric Sci J*. 2006;(4):677–880.

8. Mujahid A, Asif M, Haq I, et al. Nutrient digestibility of broiler feeds containing different levels of variously processed rice bran stored for different periods. *Poult Sci*. 2003;82(9):1438–1443.
9. Dafwang II, Shwarmen EB. Rice effect in finishing diets for broilers. *J Anim Prod Res*. 2006;16(1&2):131–135.
10. Tiemoko Y. Effects of using rice polishings in broiler diets. *Bull Anim Health Prod Africa*. 1992;40:161–165.
11. Gallinger CI, Suárez DM, Irazusta A. Effects of rice bran inclusion on performance and bone mineralization in broiler chicks. *J Appl Poult Res*. 2004;13(2):183–190.
12. Warren BE, Farell DJ. The nutritive value of full fat and defatted Australian rice bran. I. Chemical composition. *Anim Feed Sci Technol*. 2005;27(3):219–228.
13. Allen CM, McCracken KJ, Bedford MR. Effect of fat type, rate of wheat inclusion and enzyme supplementation on diet metabolisability and broiler performance. *British Poult Sci*. 1997;38:306–310.
14. Allen C, Bedford M, McCracken K. Effect of rate of wheat inclusion and enzyme supplementation on diet metabolisability and broiler performance. *British Poult Sci*. 1996;37:S44.
15. Inbore J, Ogle RS. Effect of enzyme treatment of piglet feeds on performance and post-weaning diarrhoea. *Swedish J Agric Res*. 2008;18:129–133.
16. AOAC. *Association of Analytical Chemist. Official Methods of Analysis*. 15th ed. Australia: Arlington Victoria; 1990.
17. SAS. Statistical Analysis Software SAS /STAT User's Guide, New York; 2002.
18. Steel RG, Torrie JH. *Principle and Procedure of Statistics. A Biometric Approach*. 2nd ed. New York; 1980:633.
19. Farrell D. Strategies to improve the nutritive value of rice bran in poultry diets. III. The addition of inorganic phosphorus and a phytase to duck diets. *Br Poult Sci*. 1998;39(5):601–611.
20. Biswas T, Mandal L, Sarker SK. Studies of enzymes supplementation and herbal preparation at different levels of energy on the performance of broilers. *J Interacad*. 1999;3(1):53–58.
21. Swain BK, Johri TS, Shrivastav AK, et al. Performance of broilers fed on high or low fibre diets supplemented with digestive enzymes. *J Appl Anim Res*. 1996;10:95–102.
22. Maisonnier S, Gomez J, Carré B. Nutrient digestibility and intestinal viscosities in broiler chickens fed on wheat diets, as compared to maize diets with added guar gum. *Br Poult Sci*. 2001;42(1):102–110.
23. Iyayi EA, Davies BI. Effect of enzymes supplementation of rice bran meal and brewer's dried grain on the performance of broilers. *Int J Poult Sci*. 2005;4(2):76–80.
24. Lamid M, Puspaningsih NNT, Asmarani O. Potential of phytase enzymes as biocatalysts for improved nutritional value of rice bran for broiler feed. *J Appl Environ Biol Sci*. 2014;4(3):377–380.
25. Ani G, Choct M. Antinutritions activities of ceral non starch polysaccharides in broiler diets and strategies minimizing their effects. *World Poult Sci J*. 2008;47(3):232–241.
26. Udoyong AO, Kibon A, Yahaya SM, et al. Haematologial responses and serum biochemistry of broiler chicken fed graded levels of enzyme (maxigrain) supplemented cassava peel meal diets. *Global J Biotech and Biochem*. 2010;5(2):116–119.
27. Omojola AB, Adesehinwa AO. Performance and carcass characteristics of broiler chickens fed diets supplemented with grade level of roxaxyme G. *Int J Poult Sci*. 2007;6(2):335–339.
28. Classen IJ. Effect of Enzyme supplementation on performance of pullet chicksfed different level of dietary fibre proceedings. 35th Annual Conference of Nigeria Society for Animal Production Ibadan, Nigeria; 2008:453–453.
29. Martin EA. Improving this utilization of rice bran in diets for broiler chickens and growing ducks. Ph.D. Thesis, University of New England, Amidala, Australia; 2005.

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