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Morphometry of the Gastro-intestinal Tract in Broiler Finisher Fed Rice Offal Supplemented with Xylanase Enzyme

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Target audience: physiologist, nutritionist, researchers

Abstract

The study was carried out to evaluate the effects of rice offal diets supplemented with xylanase on broiler birds. One hundred and twenty broiler chickens at four weeks of age were randomly allotted to four dietary treatments composed of graded levels of rice offal at 0% (control), 5%, 10% and 15% supplemented with equal levels of xylanase (10g/100kg of feed). Each treatment was replicated three times with 10 birds per replicate. No significant difference (P > 0.05) was observed on the performance of the birds. On the organ weights the crop had better development (P < 0.05) on rice offal diets (35.96, 37.27, and 48.90) as compared to control (35.20). But there was no significant difference (P > 0.05) and no particular trend on the results of all other organs weight. The morphometric analysis showed a significant difference (P<0.05) only in length of the liver with birds on control diet (11.43) having higher mean values. The proventriculus, small intestine and spleen though not significantly different (P>0.05) on both width and length dimensions, however showed a linear increase as the levels of rice offal in the diets increased. Feed cost per kg was reduced on enzyme supplemented diets as the level of rice offal increased. The feed conversion ratio on dietary treatments compared favourably with the control. There was decreased viscosity, increased intestinal transit/rate, reduction of water content in faeces that resulted in a good litter quality on the birds across the treatments. Rice offal supplemented with xylanase can therefore be included up to 15% in the diets of broiler birds without any adverse effect on the performance and gastro-intestinal tract.

Keywords: Exogenous enzymes, Fiber utilization, Growth performance, Poultry diets, Gastro- intestinal morphometry

Description of Problems

High cost of feed ingredients is the major limiting factor of poultry industry. Conventional feed ingredients such as maize, groundnut cake and soya bean are becoming very expensive due to competitive demand for them by both man and animal therefore making them relatively unavailable for feeding poultry. As human population continues to grow there will be need to ensure food safety for all. Unconventional feedstuffs such as maize offal, wheat offal, rice offal and cassava peel do not present major

competition with human food resources and thus makes them an attractive alternative. These feedstuffs are already available in abundance and there is an increasing interest for their use in livestock feeds. Rice offal is an agro industrial by product considred as one of the most promising because of its availability in large quantities in all rice growing areas (1) which makes it a potentially good feed ingredient that can be exploited in order to reduce cost of poultry production. However utilization of rice offal may be limited due to the presence of some anti-nutrients and also their fibrous nature with low digestibility (2). These disadvantages can be averted by the use of exogenous feed enzymes because of their ability to improve digestibility of fibrous feed ingredient and also breakdown anti-nutritional factors that are present in those unconventional feed ingredient. Fibrous feeds contain non starch polysaccharides that cause adverse reaction in the gastro-intestinal tract. Arabinoxylans in grains increase viscosity content of the intestine, reduce nutrient utilization and reduce growth performance (3). Enzyme (exogenous) supplementation reduces intestinal digesta viscosity and improves nutrient utilization and growth performance (4). The enzyme nutrase-xyla or xylanase is a bacterial enzyme (synthetic) that has great potentials towards improving growth and feed conversion ratio in the performance of broiler chicken and it has unique characteristics as a sole enzyme supplement (5).Practical experience have shown its important effects on improving digestibility of grains.

Gastro intestinal histology has also been shown to be affected by barley and wheat based diets with reduction in villa height, increased diameter and damage villi (3).It was discovered that the gut capacity tend to enlarge to enable the birds to detoxify the anti-nutritional factors and also cope with high fibrous volume of the feeds (6), but enzyme supplementation of these diets counteracted some of these effects with supplemented birds having a gut morphology more similar to birds receiving corn/soya diet. Scientific findings established that damage to the gastro intestinal tract may make the organs more susceptible to pathogenic bacterial invasion. Thus it is imperative to evaluate the negative consequences or otherwise of feeding enzyme supplemented rice offal on the gastro-intestinal tract of broiler finishers. The objective of this study therefore was to investigate the effects of supplemented enzyme (xylanase) on the performance, organ weights and morphometric analysis of broiler birds fed graded levels of rice offal diets.

Materials and Methods

One hundred and twenty anak 2000 broiler chickens were procured and brooded for four weeks period within which routine management practices were observed. At four weeks of age the birds with initial live weight of 530g were randomly allotted in groups of 30 to four(4) experimental diets comprising graded levels of rice offal at 0%(control),

5, 10 and 15% supplemented with equal levels of the enzyme xylanase(10g/100kg of feed) as presented in Table 1. Each treatment was replicated three times with 10 birds per replicate. The proximate analysis of the diets and the test ingredient (Table 2) were done according to AOAC (7). A conventional poultry house with deep litter floor pens was used, and the treatments were arranged in a completely randomized design (CRD). Feed and water were provided ad libitum. Feeding trial lasted for five weeks. At the end of the experiment three birds were selected from each treatment based on average weight for morphometric analysis .The organs weight and morphometric dimensions were recorded using weighing balance and metric ruler/tape respectively. Mortality was recorded as it occurred. The data were subjected to analysis of variance using the General Linear Model Procedure of SAS (8).The difference in means was separated using Duncan's Multiple Range Tests(9).

Table 1: **Percentage Composition Of Experimental Diets(Broiler Finisher)**

	Dietary levels of rice offals			
Ingredients	0.00	5.0	10.0	15.0
Maize	65.43	59.88	34.58	49.27
Soya bean meal	20.40	20.92	21.22	21.53
Rice offal	0.00	5.00	10.00	15.00
Wheat bran	6.00	6.00	6.00	6.00
Fish meal	3.25	3.25	3.25	3.25
Palm oil	1.50	1.50	1.50	1.50
Vitamin-mineral*	0.30	0.30	0.30	0.30
premix	0.50	0.50	0.50	0.50
Salt	2.45	2.45	2.45	2.45
Bone meal	0.20	0.20	0.20	0.20
Enzyme	0.00	0.01	0.01	0.01
Total	100	100	100	100
Calculated Analysis	3024.03	2929.60	2837.45	2745.18
ME Kcal/kg	19.00	19.00	19.00	19.00
Crude protein (%)	3.74	3.68	3.99	3.87
Crude fiber (%)	1.25	1.26	1.27	1.28
Calcium (%)	0.66	0.68	0.71	0.73
Phosphorus (%)	0.55	0.54	0.83	0.53
Methionine (%)	1.00	1.00	1.00	1.00
Lysine (%)				

*Vitamin A, 1000 IU; Vitamin D, 3000 IU; Vitamin E, 8.0 IU; Vitamin K, 2.0mg; Vitamin B1, 2.0mg; Vitamin B6, 1.2mg; Vitamin B12, 0.12mg; niacin, 1.0mg; Pantothenic acid, 7.0mg; Mg, 1000mg; Cu, 8.0mg; Co, 0.45mg and Se, 0.1mg per kg of diet.

Table 2: Proximate Analysis of Finisher Ration

Parameters	Dietary levels of rice offals %				Rice offal
	0.0	5.0	10.0	15.0	
Dry matter (%)	94.43	94.38	93.84	95.72	95.81
Crude Protein (%)	20.31	20.31	20.60	20.00	14.69
Crude Fiber (%)	3.88	3.79	4.01	3.99	34.67
Oil (%)	4.99	5.07	4.98	4.33	2.39
Ash (%)	6.02	8.59	7.89	6.59	27.92
NFE (%)	64.98	62.24	62.52	65.09	29.33

NFE= Nitrogen free extract

Results and Discussion

Results of performance, organs weight and morphometric analysis are shown in Table 3, 4 and 5, respectively. There was no significant difference on the performance of the broiler chickens. This was supported by the report of (10) who observed that feeding lower energy and protein diets supplemented with enzymes provided broiler chickens a similar performance to those fed diets with normal nutrients levels without affecting their performance. Thus, the values recorded in this study on feed conversion ratio across the dietary treatments compared favorably with the control. The results on organ weights indicated higher values on crop and gizzard ($P< 0.05$) on rice offal diets as compared to control; this could be related to the effective utilization of enzyme and also nature of feed digested. This is in line with (11) who indicated that xylanase acts in providing higher values of metabolisable energy, resulting in greater weight and improvement in feed to gain ratio. Though in contrast, some related reports indicated that enzyme supplemented birds had lower gut and pancrease weight which may also be attributable to strain effects. The non-significant difference ($P>0.05$) in weight of intestine shows that enzyme supplementation is a safe method of reducing fiber content of rice offal. Since exogenous enzyme action was found to be most effective in the pH medium (7.0) of the small intestine (12).

Table 3: Performance of Broiler Finisher Fed Rice Offal Supplemented with Enzyme (xylanase)

	Dietary levels of rice offals (%)				
Parameters	0	5	10	15	SEM
Final weight (g)	2133.91	2146.73	1920.6	2105.8	-
Av daily wt gain/bird(g)	49.39	50.45	45.40	49.63	4.59^{NS}
Av daily feed intake (g)	145.45	138.14	135.20	149.33	15.24^{NS}
Feed conversion ratio	2.91	2.73	2.98	2.96	0.22^{NS}
Feed cost/kg gain (N)	187.6	172.53	174.04	170.54	18.26^{NS}
Mortality	1	2	1	0	-

NS- Not Significant SEM- Standard Error of Means

The result of morphometric analysis showed a significant difference ($P < 0.05$) only in length of the liver with birds on control diets having similar mean values with 15% rice offal. This result might not be connected to the effects of the diets but may likely be due to other environmental factors and strain variations. Even though the presence of anti-nutritional factors in diets has been associated with enlargement of organs such as liver and pancreas due to their detoxifying activities (13). But when anti-nutritional factors are reduced by some treatments, the liver would not be enlarged (14). Besides the general trend in the results indicated a favorable comparison of control diets and 15% rice offal revealing effective utilization by the gastro-intestinal tract in response to the positive action of the enzyme xylanase. This was buttressed by (15) who reported that synthetic enzymes have been found to aid the effective utilization of nutrients in the diet of a broad range of monogastric animals.

The non-significant difference ($P > 0.05$) in the dimension of the other organs is in line with a scientific reports by (16) who indicated that enzyme supplementation of diets counteracts the negative effects that viscous grains have on the gut. Although rice offal in terms of morphometric results seems to increase the size of the intestine, proventriculus and the spleen but the increase was not significant ($P > 0.05$). However (17) showed that diets high in roughage do increase the size of the gastro-intestinal tracts in some species of animals. There was reduction in cost per kg on enzyme supplemented diets with a linear decrease as the level of rice offal increased. This agreed with (10) who reported that enzyme supplementation of diets reduced feed costs. Mortality records were not attributed to diets. The litter quality of birds on control and rice offal diets was similar. This was due to effect of exogenous enzyme supplementation on diets which improved production

efficiency by reducing the nutrient cost through excreta (18).

Table 5: Morphometric Measurements of Broiler Finisher Fed Rice Offal Supplemented with Enzyme Xylanase

Parameters Dietary treatments	Liver	Proventr	Crop	L1	S1	Lungs	Gizzard	Spleen
Width Measurement (cm):								
0% rice offal	4.73	4.27	3.63	1.00	0.70	2.50	5.23	1.70
5% rice offal	4.90	3.93	4.57	1.07	0.70	2.93	4.77	1.77
10% rice offal	5.20	3.67	3.97	1.10	0.73	2.63	5.70	1.87
15% rice offal	5.80	4.63	3.70	1.10	0.77	2.47	5.33	2.07
SEM	0.35^{NS}	0.48^{NS}	0.57^{NS}	0.09^{NS}	0.05^{NS}	0.16^{NS}	0.31^{NS}	0.14^{NS}
Length Measurement(cm):								
0% rice offal	11.43^{a}	8.80	5.87	180.00	80.00	3.90	6.53	2.13
5% rice offal	11.10^{a}	8.70	5.60	184.67	70.20	4.77	5.60	2.23
10% rice offal	10.13^{b}	8.50	7.83	183.33	75.40	3.70	7.83	2.40
15% rice offal	11.23^{a}	8.80	5.80	190.33	79.67	3.87	5.98	2.67
SEM	0.52^{*}	0.66^{NS}	1.18^{NS}	8.96^{NS}	3.78	0.30^{NS}	1.18^{NS}	0.19^{NS}

^{a,b} Means with different superscripts in the same row are significantly ($P < 0.05$) different SEM - Standard error of means *Significantly different ($P < 0.05$) L1 – Large intestine S1 – Small intestine NS- Not Significant

Conclusion and Application

In conclusion,

1. Birds fed rice offal supplemented with the enzyme xylanase resulted in similar performance on organ characteristics and morphometric, to that obtained with the control diet. Therefore, indicating effective utilization of rice offal.
2. Up to 15% inclusion level of rice offal diet with xylanase supplementation can be practiced as a means of reducing cost of poultry production with no adverse effect on the performance and organ characteristics.

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