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Performance Characteristics of Broiler Chicken (*Gallus gallus*) Fed Rice (*Oriza sativa*) Bran with or Without Roxazyme G2G

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Abstract: A study was conducted on the effect of roxazyme G2G on the nutritional value of rice bran in order to reduce the cost of feeding broiler chicken. Eight week feeding trial was carried out study using day old Anak Strain of broiler. Four groups of fifty birds each were fed two diets that contained 10 and 20% rice bran with or without Roxazyme G2G in a factorial design. Data were collected on performance, nutrient utilization, carcass characteristics and intestinal tract length. At starter and finisher phases Significant ($p<0.05$) depression were observed in Average Daily Gain (ADG) when rice bran was increased from 10 to 20% in the diets (25.60 and 40.20 g versus 22.10 and 36.10 g, respectively). This effect was reversed when enzyme was added. Increasing the rice bran from 10 to 20% reduced ($p<0.05$) feed cost but increased production cost which was reversed when diet was supplemented with enzyme. Birds fed 20% rice bran had lower ($p<0.05$) live weight and nutrient utilization than those fed 10% but which were improved when enzyme was added. Diets had no effect on feed intake and mortality. Gizzard weight and gastro-intestinal tract length of birds fed 20% rice bran were higher ($p<0.05$). It was concluded that 10% rice bran can be included in broiler diets but may be increased to 20% when roxazyme G2G is added.

Key words: Carcass characteristics, enzyme, feed intake, *Gallus gallus*, gizzard weight, intestinal tract length, production cost, weight gain

INTRODUCTION

The soaring demand for global corn, the largest component of animal feed by ethanol producers has led to increase in price of corn and corresponding increase in livestock feed cost. In addition to price, world grain production has also been declined in the past years due to the crops compete for land (Attamangkune, 2007). The use of cereal by-products that have no direct nutritional value to mankind therefore appears to be one of the approaches for solving the food/feed crises that is having negative effect on livestock industry most especially non ruminant animal production.

Rice bran is an agricultural by product of rice milling industry that is available in abundance in Nigeria. It constitutes about 10% of brown rice and about 40-45 million tones is produced annually (Farrell, 1994). Argentina produced 100000 tones of rice bran annually between 1995 and 2000 (Gallinger *et al.,* 2004). Rice bran has no direct nutritional value to man and only limited amount of rice bran is currently used for food (Takano, 1993). Its high nutritive value and vitamins B and E (IRRI, 2009) coupled with the fact that it has high protein content and compares favorably with other cereals in amino acid composition (Warren and Farrell, 1991) makes it a potential feed resource for livestock. Like other agro-industrial by-products however, its high fiber content limits its utilization by poultry (Farrell, 1994).

The use of exogenous microbial enzymes to improve the nutritional value of high fiber diets have been well documented (Angelovicova *et al.*, 2005; Raza *et al.*, 2009). The use of exogenous microbial enzymes have been shown to improve nutrient digestibility, destroy anti-nutritional factors and manipulate gut flora population as well as supplementing endogenous enzymes (Bedford, 1996). Classen and Bedford (1999) reported improved nutrient utilization when poultry birds were fed wheat-based diets supplemented with crude enzyme preparation having high xylanase activity.

Roxazyme G2G is an enzyme complex manufactured by Roche Nigeria Limited. The enzyme contains endo 1,4 beta-glucanase, endo-1,3 beta-glucanase and endo-1,4, beta-xylanase all of which are able to digest complex carbohydrates. This study was therefore conducted to evaluate the effect of Roxazyme G2G supplementation on the utilization of rice bran by broiler chicken.

MATERIALS AND METHODS

Location of the study: The study was conducted at the Poultry Brooder House of Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso,

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Table 1:Gross composition of experimental diets

	diet of rice bran in the diets (%)				Finisher diet			
	10		20		10		20	
Starter level	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Roxazyme G2G enzyme	-	+	-	+	-	+	-	+
Maize	39.00	39.00	29.00	29.00	42.00	42.00	32.00	32.00
Soy bean meal	32.25	32.25	32.25	32.25	31.25	31.25	31.25	31.25
Fish meal	2.50	2.50	2.50	2.50	1.50	1.50	1.50	1.50
Corn bran	9.50	9.50	8.50	8.50	10.00	10.00	10.00	10.00
Palm oil	2.50	2.50	3.00	3.00	1.00	1.00	1.00	1.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
NaCl	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Premix	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Determined analysis								
Crude protein	21.26	21.26	21.41	21.41	20.61	20.61	20.81	20.81
Crude fibre	5.30	5.30	6.23	6.23	5.34	5.34	6.39	6.39
ME (Kcal/kg)	2951	2951	2962	2962	2944	2944	2930	2930

M.E. = Metabolizable energy

Premix composition per Kg feed: Vitamin A, 200,000,00 IU, Vit. D_3, 40,000,00IU, Vitamin E (Mg) 460, Vitamin K_3 (kg) 40, Vitamin B1 (Mg) 60, Vitamin B_2 (Mg) 120, Niacin (Mg) 1,000, Calcium pantothenate (Mg) 200, Vitamin B_6 (Mg) 100, Vitamin B_{12} (Mg) 05, Folic acid (Mg), 20, Biotin (Mg) 1, Chlorinechloride (Mg) 8,000, Manganese (Mg) 2,400, Iron (Mg) 2,000, Zinc (Mg) 1,600 Copper (Mg) 170, Iodine (Mg) 30, Cobalt (Mg) 6, Selenium (Mg) 24, Anti-oxidant (Mg) 2,400.

Oyo State in the derived savanna zone of Nigeria. The study area is located between latitudes 8º07′ and 8º12′N and longitudes 4º04′ and 4º15′E. The mean annual rainfall is 1247mm with relative humidity of between75 and 95%. The location is situated at about 500mm above the sea level with a mean annual temperature of 26.2ºC (Oguntoyinbo, 1978).

Feed preparation: The rice bran that was used for the study was obtained from a local rice miller within the study area and then oven-dried to about 13% moisture content to avoid mould. Four diets were formulated. Diets 1 and 3 contained 10 and 20% rice bran respectively at the expense of maize and corn bran. Diets 2 and 4 were similar to diets 1 and 3 except that they contained roxazyme G2G enzyme at the rate of 150 g/tone of diet. All diets were iso-nitrogenous and iso-energetic and meet the minimum nutrient requirement of broiler birds (NRC 1994). The gross compositions of the diets are presented in Table 1.

Bird management and experimental design: Two hundred day old Anak strain of chicks was randomly divided into four groups of fifty birds each. Each group was randomly assigned to one of the four diets in a Completely Randomized Design (CRD) with factorial arrangement of treatment. Each treatment was replicated five times. Birds were housed in deep litter pen of 1x2 m with wood haven as bedding material. Feed and water were served *ad libitum* while medication and vaccination were carried out according to the standard practice in modern poultry management. Birds were fed starter diet for the first four weeks and finisher diet for the remaining four weeks of eight week duration of the study.

Data collection: Data were collected daily on feed intake and weekly on weight gain. Feed intake was calculated as difference in the weight of feed given and left over after 24 h. Weight gain was determined as the difference in the weight of the birds after 7 days period. Feed: grain ratio was calculated from feed intake and weight gain. Mortality was recorded and expressed as the percentage of the number of birds at the commencement of the experiment. Cost of feed was calculated from the cost of ingredients used in feed preparation. Feed cost per kilogram live weight gain was calculated from feed cost and feed: gain ratio.

Metabolic trial: Metabolic trials was conducted at the end of each feeding phase from which utilization of dry matter, crude protein, crude fat, crude fiber and efficiency of energy utilization were determined. Eight birds were selected from each treatment and housed in metabolic cages. Each group was housed separately with facility for separate feeding and fecal collection. Weighed quantities of feed were supplied and excreta collected over 72 h periods using the total collection method. Excreta collected were oven dried at 70ºC for 72 h. Dried excreta were bulked and the representative samples taken for laboratory analysis.

Carcass analysis: Carcass analysis was carried out using eight birds per treatment. Live weight and dressed weight were taken using electronic weighing balance and expressed as percentage of live weight of the birds. Weights of abdominal fat and gizzard were also taken and expressed as percentage of the live weight. Length of the different parts of the gastro intestinal tract was taken using measuring tapes and the lengths expressed in cm/100g body weight of the birds.

Chemical analysis: Proximate composition of rice bran, feeds and excreta were determined using AOAC (1990) methods of analysis while the gross energy of the feeds and excreta were carried out using parr-adiabatic bomb calorimeter (parr instrument co, Moline, IL) that had originally been calibrated.

Statistical analysis: Data were analyzed using two way analysis of variance SAS (SAS, 1990) and where significance were indicated means were separated using New Duncan multiple range test.

RESULTS AND DISCUSSION

The proximate composition of the rice bran used in this study is presented in Table 2. The crude protein, ether extract and crude fibre contents were 14.82, 16.38 and 11.51%, respectively. The ether extract value obtained in this study fall within the range reported by Attamangkune (2007) and IRRI (2009) but lower than that reported by Farrell, (1994). The difference could be due to the difference in rice cultivar from which the brans were obtained. Despite the difference in fat content however, the protein content were comparable with the value reported by the same author.

The performance characteristics and economic implication of broilers fed rice bran with or without roxazyme G2G at the starter phase is presented in Table 3. Average daily feed intake (ADFI) and mortality were not affected by the dietary treatment ($p>0.005$). This indicates that broiler chicken can tolerate up to 20% rice bran in their diets without any adverse effect on palatability and survivability. Dietary level of rice bran however had significant ($p<0.05$) effect on the ADG, feed: gain ratio, feed cost and cost of feed per kilogram live weight gain. Weight gain and cost of feed decreased ($p<0.05$) when rice bran was increased from 10% to 20% level the diet, while feed: gain ratio increased ($p<0.05$). This can be attributed to high fiber in rice bran (Farrell, 1994) which probably reached a critical level at this inclusion level. Similar decline in performance had been reported by (Madrigal *et al*., 1995).

Significant interactions were observed between dietary level of rice bran and addition of roxazyme G2G enzyme on ADG, feed: gain ratio and feed cost/kg live weight (Table 4). Enzyme had no significant ($p<0.05$) effect on ADG and feed: gain ratio of the birds at 10% rice bran inclusion level. At 20% rice bran inclusion however, addition of roxazyme G2G improved the weight gain and feed utilization ($p<0.05$). Brenes *et al*. (1993) also reported improvement in weight gain of chicks fed barley containing diets as a result of enzyme addition. Roxazyme G2G had no significant ($p<0.05$) effect on the feed cost/kg live weight gain at 10% inclusion of rice bran. It however resulted in reduced cost at 20% rice bran inclusion levels. This can be attributed to the improvement effect of enzyme on feed utilization.

Table 2: Proximate composition of rice bran (%)

Component (%)	Composition
Dry matter	88.10
Crude protein	14.82
Ether extract	16.38
Crude fiber	11.51
Ash	8.10
Nitrogen free extract	50.81

The performance of broiler fed rice bran and roxazyme G2G at the finishing phase is presented in Table 5. Addition of 20% rice bran to broiler diet reduced ($p<0.05$) ADG and increased feed: gain ratio which was reversed when enzyme was added to the diets. This indicates that broiler chicken can tolerate up to 20% rice bran in their diet at finishing phase when the diet is supplemented with roxazyme G2G. Feed cost decreased significantly ($p<0.05$) while production cost increased ($p<0.05$) at 20% inclusion level. This makes the feeding of 20% rice bran an attractive option at this phase provided the diet is supplemented with roxazyme G2G. The nutrient utilization by the birds fed graded level of rice bran with or without enzyme at starter and finisher phases is presented in Table 6. At the starter and finisher phases, significant ($p<0.05$) reductions were observed in the utilization of dry matter, crude protein, crude fat, crude fiber and energy when rice bran was increased from 10% inclusion level to 20%. This can also be attributed to high fiber in the diets. Addition of Roxazyme G2G however improved the utilization of all the nutrients considered. This can be attributed to the enhancing effects of roxazyme G2G enzyme. This is in line with the report of Khan *et al*. (2006). The improvement could be due to disruption of plant cell wall fraction in rice bran by xylanase or possibly β-glucanase in roxazyme G2G. xylanaze are known to breakdown the cell wall contents thereby release the encapsulated nutrients for animal use where as β-glucanase increase utilization of carbohydrate. There was no significant interaction effect between rice bran and roxazyme G2G on all the nutrients considered.

The carcass characteristics, gizzard weight and intestinal length of birds fed different levels of rice bran with or without enzyme supplementation are presented in

Table 3: Performance of broiler fed rice bran and roxazyme G2G at starter phase

Dietary treatments	Feed intake ADF (g/bird/day)	Weight gain ADG(g/bird/day)	Feed gain ratio	Mortality	Cost/kg feed (₦)	Feed cost/kg live weight (₦)
Level of rice bran (%)						
10	45.00	25.00^{a}	1.76^{b}	1.0	43.9^{a}	99.50^{b}
20	44.50	22.10^{b}	2.01^{a}	0.8	40.70^{b}	105.30^{a}
Roxazyme G2G						
−	43.20	21.55^{b}	1.73^{a}	0.8	42.60^{a}	104.20^{a}
+	44.10	24.96^{a}	2.15^{b}	0.9	42.80^{a}	98.10^{b}
Interaction (RBxRoxazy G2G	NS	*	*	NS	NS	*
SEM	2.50	1.20	0.20	0.30	2.00	1.50

^{abc}: Means followed by different superscripts within column are significantly different (p<0.5)

Table 4: Effect of interaction of rice bran and Roxazyme G2G on broiler performance at starter phase

On weight gain (g/bird/day)			On feed: gain ratio			On feed cost/kg live weight	
	Roxazyme G2G level			Roxazyme G2G		Roxazymr G2G	
Level of rice bran (%)	−	+	Level of RB(%)	−	+	−	+
10	24.98^{a}	25.60^{a}	10	1.73^{b}	1.71^{b}	97.50^{b}	98.96^{b}
20	21.78^{b}	24.74^{a}	20	2.23^{a}	1.82^{b}	104.20^{a}	98.52^{b}
SEM	1.50	1.58		0.22	0.20	2.0	2.0

^{ab}: Means followed by different superscripts within column are significantly different (p<0.5)

Table 5: performance of broiler fed rice bran and roxazyme G2G at finisher phase

Dietary treatment	Feed intake ADFI (g/bird/day)	Weight gain ADG(g/ bird /day)	Feed: gain ratio	Mortality (%)	Cost/kg feed (₦)	Feed cost/kg live weight (₦)
Level of rice bran (%)						
10	81.50	40.20^{a}	2.03^{b}	0.50	41.00^{a}	115.60^{b}
20	82.40	36..10^{b}	2.18^{a}	0.40	38.10^{b}	119.40^{a}
Roxazyme G2G						
−	81.80	36.81^{b}	2.21^{a}	0.35	39.80^{a}	118.90^{a}
+	82.10	41.02^{a}	2.00^{b}	0.51	39.70^{a}	114.70^{b}
Interaction (RBxRoxazy G2G	NS	NS	NS	NS	NS	NS
SEM	2.00	2.20	0.08	0.2	1`.30	2.0

^{ab}: Means followed by different superscripts within column are significantly different (p<0.05)

Table 6: Effect of dietary level of rice bran and roxazyme G2G on nutrient utilization (%)

Dietary treatment	Dry matter	Crude protein	Crude fat	Crude fiber	Energy efficiency
Level of rice bran (%)	Starter	Phase			
10	65.13^{a}	61.43^{a}	60.50^{a}	44.05^{a}	61.90^{a}
20	64.20^{b}	58.20^{b}	58.36^{b}	42.50^{b}	60.00^{b}
Roxazyme G2G					
−	63.95^{b}	58.40^{b}	58.22^{b}	41.45^{b}	60.50^{b}
+	66.21^{a}	62.82^{a}	61.30^{a}	43.07^{a}	63.02^{a}
Interaction (RBxRoxazy G2G	NS	NS	NS	NS	NS
SEM	1.40	1.41	2.60	1.60	1.8
	Finisher	phase			
Level of rice bran (%)					
10	68.52^{a}	65.72^{a}	63.90^{a}	44.30^{a}	62.80^{a}
20	65.70^{b}	62.98^{b}	62.10^{b}	42.70^{b}	60.20^{b}
Roxazyme G2G					
−	65.82^{b}	62.80^{b}	62.40^{b}	42.50^{b}	61.80^{a}
+	68.98^{a}	65.20^{a}	64.00^{a}	44.10^{a}	63.40^{b}
Interaction (RBxRoxazy G2G	NS	NS	NS	NS	NS
SEM	1.5	1.30	1.30	1.8	1.2

^{ab}: Means followed by different superscripts within column are significantly different (p<0.05)

Table 7. Dietary treatments had no significant (p>0.05) effect on the dressed weight. Live weight of birds fed 20% rice bran was lower (p<0.05) than those fed other diets. This was an indication of poor feed utilization (Uchegbu *et al*., 2004) occasioned by high fiber in this diet. This effect was reversed by addition of roxazyme G2G possibly as a result of enhancement of fiber digestion by this enzyme. Abdominal fat also decreased at 20% rice bran inclusion in the diets. This can be attributed to high fiber in the diet. Hill and Dansky (1954) also noted that body fat content of chicken reduced when 40% oat hull was included in their diet. Gizzard weight and the length of small intestine, large intestine, duodenum and ileum were however increased

Table 7: Carcass characteristics gizzard weight and intestinal length of broilers fed rice bran and roxazyme G2G

Dietary treatments	Live weight (kg)	Dressed weight (%)	Abdominal fat (%)	Gizzard weight (%)	Small intestine (cm)	Large intestine (cm)	Duodenum (cm)	Ileum (cm)
Level of rice bran (%)								
10	1.84[a]	74.10	1.53[a]	2.00[b]	8.68[b]	1.25[b]	1.35[b]	3.35[b]
20	1.60[b]	74.20	1.18[b]	2.33[a]	8.90[a]	1.45[a]	1.52[a]	3.61[a]
Roxazyme G2G								
−	1.62[b]	74.13	1.30[a]	2.03[a]	8.58[a]	1.40[a]	1.56[a]	1.63[a]
+	1.76[a]	74.15	1.50[a]	1.88[b]	8.20[b]	1.26[b]	1.34[b]	1.34[b]
Interaction (RB Enzyme	NS	NS	NS	NS	NS	NS	NS	NS
SEM	0.2	1.7	0.2	0.03	0.40	0.20	0.20	0.33

[ab]: Means followed by different superscripts within column are significantly different ($p<0.05$)

significantly ($p<0.05$) at 20% rice bran inclusion level. This can be attributed to high fiber in this diet (Kenneth, 1981). Similar increase was observed in the gizzard weight and intestinal length of birds fed high fiber diet based on cassava leaf meal (Borin *et al.*, 2006). This was however reversed when enzyme was added to the diet. There was no interaction effect of rice bran and roxazyme G2G supplementation on all these parameters.

CONCLUSION

Rice bran has some nutritional benefits in the diet of broiler chicken. It can be included at 10% level in starter and finisher diets and may be increased to 20% when supplemented with roxazyme G2G enzyme.

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