ISSN 1682-8356
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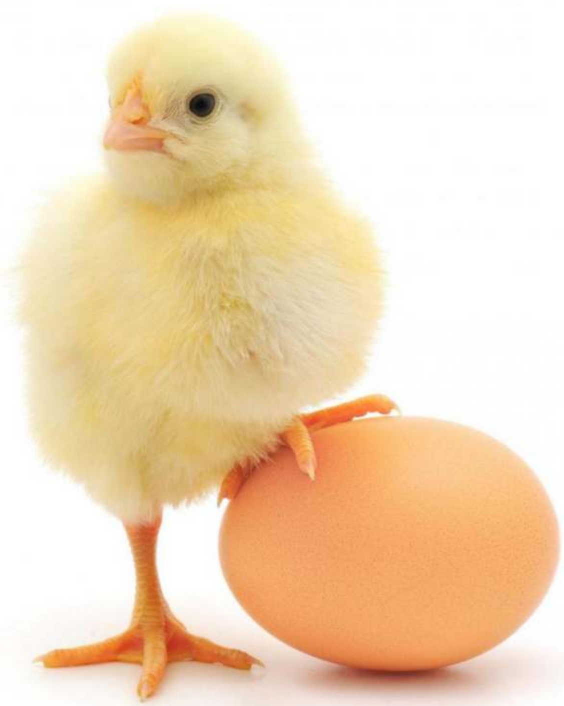

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

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International Journal of Poultry Science 4 (2): 76-80, 2005
ISSN 1682-8356

Effect of Enzyme Supplementation of Palm Kernel Meal and Brewer's Dried Grain on the Performance of Broilers

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Abstract: Seventy-two male broiler chickens were randomly distributed into groups of 6 totaling 12 groups. Three diets (Diet 1-Basal, maize-based with no enzyme; Diet 2-BDG + Enzyme-based and Diet 3-PKM + Enzyme-based) were formulated and randomly offered to any 4 of the groups. The aim was to compare the performance of the birds on the enzyme supplemented high fibre diets with those on the maize-based diet with no enzyme supplementation. Weight gain and feed intake were significantly ($p<0.05$) higher on the enzyme supplemented BDG and PKM diets at the starter phase. At the finisher phase, while feed intake was significantly ($p<0.05$) increased with enzyme supplementation, the weight gain was not significantly affected. The FCR also did not significantly change with enzyme supplementation at the starter phase, but at the finisher phase, feed conversion was significantly ($p<0.05$) poorer. Carcass measures did not significantly change with enzyme supplementation. Weight of the pancreas was significantly ($p<0.05$) increased and that of the kidney significantly ($p<0.05$) reduced in birds on the enzyme supplemented BDG and PKM diets. Apparent digestibility of crude protein, crude fat and crude fibre was significantly ($p<0.05$) higher with enzyme supplementation. The cost of feed per kg weight gain was lower in the enzyme supplemented diets only at the starter phase. But at the finisher phase, enzyme supplementation did not have any benefit in terms of feed cost. Enzyme supplementation resulted in the reduction of the amount of maize needed in the diets of the birds by 31% and 52% at the starter and finisher phases, respectively.

Key words: Enzyme, palm kernel meal (PKM), brewer's dried grain (BDG), broiler

Introduction

Agro-industrial by-products (AIBs) have in recent years become important feed components in poultry diets in Nigeria mainly due to the increased competition for the conventional ingredients by humans and the food industries. Those of high fibre contents are being used either as fillers or as energy diluents. For example maize offal (Uko *et al*., 1991) and palm kernel meal (Okon and Ogunmodede, 1996; Ezieshi and Olomu, 2004) have been employed in the formulation of poultry feeds. It is expected that as the demand for animal products increases with increasing population and improvements in living standards, conventional feedstuffs are likely to be insufficient to sustain poultry production. Therefore more reliance on the use of AIBs will result. Inclusion of high levels of some of the AIBs or the use of high fibre containing ones in poultry diets is limited due to their effect of reduced performance in birds. It has been reported that enzyme supplementation does improve the productive value of fibre feedstuffs. Chen *et al.,* (1997) reported that growth rate of broilers, ducks and geese were significantly increased by 10%, 12-18% and 10-21%, respectively by adding enzymes to cereal-based diets. Bedford (1997) reported that addition of enzymes to the diets of chicks up to 42 days reduced the viscosity of the digesta with a resultant improvement in the FCR and fat digestibility in the birds. Günal and Yasar (2004) have also reported that supplementation of high-wheat diets with enzyme preparations decreased the viscosity and the dry matter of digesta, but without significant effects on bird performance. Enzyme supplementation of AIBs commonly used in poultry feed formulation in Nigeria will be of benefit in improving the values of these feeds. As yet, there is a dearth of information on enzyme supplementation of palm kernel meal and brewer's dried grain: two AIBs presently being incorporated in poultry feeds in the country. This study reports the supplementation of these two ingredients with an enzyme preparation (Avizyme 1300) on the performance of broilers.

Materials and Methods

Palm kernel meal (PKM) and brewer's dried grain (BDG) used in the study were obtained from a poultry feed shop. Seventy-two (72) day-old male broiler chicks (Anak 2000 strain) were obtained from S & D Farms (S & D, Abeokuta, Nigeria) and housed in a well ventilated and illuminated poultry house. They were divided into 12 groups of 6 birds each and given a commercial diet for 7 days. Three diets were formulated. For the starter phase, a basal diet (Diet 1) containing no PKM or BDG served as the control. Diets 2 and 3 contained 300 g/kg

Table 1: Composition of experimental diets at the starter phase

Ingredients (g/kg)	Basal	BDG + enzyme	PKM+ enzyme
Maize	480	330	330
Cassava flour	50	50	50
Wheat offal	105	-	-
Brewer's dried grain	-	300	-
Palm kernel meal	-	-	300
Groundnut cake	150	150	150
Soya bean meal	140.2	95.1	95.1
Fish meal	40	40	40
Oyster shell	10	10	10
Bone meal	10	10	10
Premix	2.4	2.4	2.4
Salt	2.4	2.4	2.4
Methionine	5	5	5
Lysine	5	5	5
Avizyme (g/1000 kg)	-	0.1	0.1
Total	1000	1000	1000
Analyzed nutrient composition			
ME (KJ/kg)	11,919	10,935	11,178
Crude protein (g/kg)	220	224	224
Crude fibre (g/kg)	40	85	61
Calcium (g/kg)	14.9	15.4	15.6

Table 2: Composition of experimental diets at the finisher phase

Ingredients (g/kg)	Basal	BDG + enzyme	PKM + enzyme
Maize	480	230	230
Cassava flour	110	110	110
Wheat offal	50	-	-
Brewer's dried grain	-	300	-
Palm kernel meal	-	-	300
Groundnut cake	75	75	75
Soya bean meal	207.7	207.6	207.6
Fish meal	30	30	30
Oyster shell	20	20	20
Bone meal	15	15	15
Premix	2.4	2.4	2.4
Salt	2.4	2.4	2.4
Methionine	2.5	2.5	2.5
Lysine	5	5	5
Avizyme (g/1000 kg)	-	0.1	0.1
Total	1000	1000	1000
Analyzed nutrient composition			
ME (KJ/kg)	12,084	10,626	10,864
Crude protein (g/kg)	202	201	201
Crude fibre (g/kg)	36.4	87	63
Calcium (g/kg)	24.5	25	24.9

each of BDG and PKM, respectively and 100 g/tonne of the enzyme both at the starter and finisher phases. The level of maize at the starter phase was reduced from 480 g/kg in the basal to 330 g/kg in diets 2 and 3 (Table 1) and at the finisher phase it was further reduced to 230 g/kg (Table 2). All the diets were made up with other essential ingredients such that they supplied the required nutrients of the birds. On day 8, the birds were weighed and the average weight of each group was equalized. Each diet was randomly allocated to 4 groups and the birds were given the starter diet for 28 days. Thereafter, the diets were switched to the finisher diets for a further 28-day period. Another set of birds were maintained in metabolic cages for a 5-day collection of feaces for the determination of apparent nutrient digestibility. Feed and water were given *ad libitum*. Records of feed intake and weights were taken on pen basis at the end of every week. At the end of day 63, the birds were killed by suffocation, defeathered and their dressed wights recorded. They were quickly split open, the organs removed and weighed. The eviscerated weights of the birds were then recorded.

Proximate composition of the diets was analyzed by the methods of AOAC (1984). Apparent nutrient digestibility (% retention) was calculated using the following equation:

$$\text{Apparent nutrient digestibility (\%)} = \frac{\text{Nutrient intake} - \text{nutrient output} \times 100}{\text{Nutrient intake}}$$

Data were analyzed using the ANOVA procedure described by Steele and Torrie (1980) and significant means separated by the Duncan's Multiple Range test.

Results

Results of feed intake, weight gain, efficiency of feed utilization and feed conversion ratio are shown in Table 3. Feed intake at both the starter and finisher phases was significantly ($p<0.05$) higher in birds receiving the enzyme supplemented BDG and PKM diets than those receiving the basal diet. Weight gain of birds on the BDG and PKM enzyme supplemented diets was only significantly ($p<0.05$) higher than those on the basal diet at the starter phase. But as the birds grew older enzyme supplementation did not produce any significant gain in weight. FCR did not significantly change at the starter phase but at the finisher phase, the feed was significantly ($p<0.05$) less converted.

The results of carcass measures are presented in Table 4. Birds on the BDG and PKM enzyme supplemented diets had significantly ($p<0.05$) higher live weights than those on the basal diets. But of the two supplemented diets, birds on the BDG diets had significantly ($p<0.05$) higher weights than those on the PKM diets. Other carcass measures were not significantly affected by enzyme supplementation. The results of organ weights (relative to body weights) are shown in Table 5. The weight of the pancreas was significantly ($p<0.0$) increased while that of the kidney was significantly ($p<0.05$) reduced. There was no treatment effect on the other organs. The results of apparent nutrient digestibility (% retention) of crude fibre, protein and fat

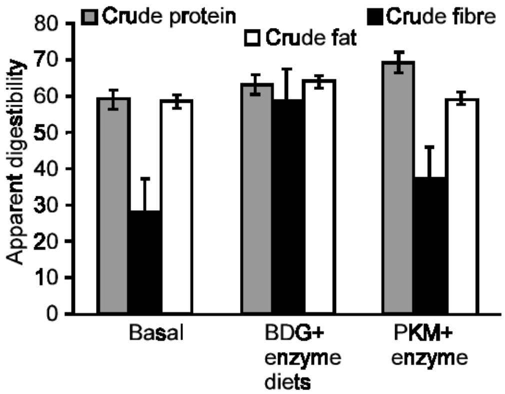

Fig. 1: Apparent digestibility of CP, CF and Fat in broilers

are presented in Fig. 1. Apparent digestibility values of crude protein and fibre were significantly higher in the enzyme supplemented diets than on the basal. Birds on the PKM diets had higher values of fat digestibility and those on the BDG diets had lower values than those on the basal diets. These differences were more pronounced with increase in age of the birds. The cost of feed per kg weight was lower in the enzyme supplemented diets only at the starter phase (Table 6). But at the finisher phase enzyme supplementation was no longer of any feed cost benefit.

Discussion

Our results have shown that enzyme supplementation of BDG and PKM caused an enhanced performance in the birds. Similar results have been reported by Iyayi and Tewe (1998) in layers, Iyayi and Adegboyega (2004) and Shakouri and Kermanshahi (2004) in broilers. Enzyme supplementation of fibre feeds results in improved performance in a variety of ways. Various workers (Günal and Yasar, 2004; Marquardt, 1997; Bedford, 1997; Taibipour and Kermanshahi, 2004) have reported the beneficial effect of reduced digesta viscosity with enzyme supplementation. Günal and Yasar (2004) stated that digesta viscosity was decreased by supplementing wheat-based diets in broiler chickens with a resultant effect on digesta and feacal DM. Marquardt (1997) also reported that antinutirents like viscous nonstarch polysaccharides reduce the digestion and absorption of nutrients. These according to the author are usually reduced or eliminated with enzyme supplementation. Feed enzymes also has the ability to indirectly alter the bacterial population of the different regions of the tract (Günal and Yasar, 2004; Bedford, 1997) by digesting the long chain carbohydrate molecules utilized by some bacteria to colonize the tract. This significantly reduces the microbial population and by implication increases the quantity of amino acid digested in the precaecal section of the tract since the micro floral population in viscous grain-based diets do affect digestibility of amino acid in the ileum. Supplementing the BDG and PKM with the enzyme could therefore have reduced the viscosity of the digesta in the birds on these diets with a resultant increase in feed intake and weight gain. The observed increased protein, crude fibre and fat digestibility in this study is supported by the reports of Taibipour and Kermanshahi (2004) that apparent metabolizable energy, apparent lipid digestibility and apparent protein digestibility were all significantly improved when arabinoxylanase and beta-glucanase enzymes were added to wheat-soyabean meal based diets. It therefore means that the supplementation of the BDG and PKM diets resulted in enhanced apparent digestibility of protein and fats due to a reduction in the viscosity of the digesta. Reduced viscosity could have resulted in exposure of the hitherto encapsulated nutrients for uptake and absorption. The increased apparent digestibility of crude fibre observed is an indication of the break down of the nonstarch polysaccharides by the enzyme in the BDG and PKM. In similar studies but employing polysaccharidase producing *Trichoderma viride*, Iyayi and Aderolu (2004), reported that crude fibre in BDG and PKM was reduced by 40% and 36.5% and soluble sugars increased by 37% and 9%, respectively when the AIBs were inoculated with the fungus for 14 days. The ability of enzymes to degrade fibre has also been reported by other workers (Iyayi and Losel, 2001; Ofuya and Nwajiuba, 1990). It is interesting to note at the finisher phase, enzyme supplementation did not induce any significant increase in the weights of the birds even though the feed intake increased. In fact the FCR value which is the most sensitive factor in assessing performance significantly increased at the finisher phase; an indication of poor utilization of the enzyme supplemented diets by the birds because probably due to the higher crude fibre levels of the diets compared to the basal diet (Table 2). Even though viscosity tends to decrease with aging (Peterson *et al.*, 1993), it may well be that at higher levels of fibre occurrence in the diet, more enzyme is required to bring about the desirable viscosity that will enhance optimum nutrient absorption. The increased gizzard weight observed in birds on the BDG and PKM diets though not significant was as a result of the greater grinding action required for these diets. The result of reduced kidney weights is similar to that of Han (1997) who observed reduced weights of digestive organs in broilers when fed barley-based diet supplemented with crude enzyme preparation. The effects of enzyme on the weight of the gastrointestinal tract were similar to the ones earlier reported by Wang *et al.* (1995) when the authors used a rice-bran diet supplemented with enzymes. Results of the present study showed that at the starter phase, inclusion of BDG and PKM with enzyme supplementation proved to be beneficial in terms of cost. There was a reduction in the cost of producing 1 kg weight of the birds by about

Table 3: Performance of broilers on enzyme supplemented BDG and PKM diets

	Starter phase					Starter phase				
	Diet					Diet				
Variable	Basal	BDG+E	PKM+E	SEM	P	Basal	BDG+E	PKM+E	SEM	P
Average feed intake (g/wk)	1020^{b}	1520^{a}	1580^{a}	38.33	<0.05	8020^{b}	1080^{b}	1223^{a}	130	<0.05
Average weight gain (g/wk)	300^{b}	440^{a}	450^{a}	25.67	<0.05	1270	1360	1300	56.67	NS
Feed conversion ratio	3.42	3.56	3.56	0.24	NS	6.49^{a}	8.03^{b}	9.50^{c}	0.37	<0.05
Efficiency of feed utilization	0.30	0.29	0.28	0.02	NS	0.15	0.13	0.11	0.005	NS

Note: Values with different superscripts on same row at each phase are significantly (p<0.05) different

Table 4: Carcass measures of birds on experimental diets

Variable	Basal	BDG+enzyme	PKM+enzyme	SEM	P (ANOVA)
Live weight (g)	1940^{a}	2220^{b}	2060^{c}	56.67	0.0373
Dressed weight (g)	960^{a}	954^{b}	941^{b}	43.33	0.0485
Eviscerated weight (g)	716	735	727	13.03	0.6013
Bone: meat ratio	3.55	2.98	3.2	0.41	0.6729
Head (g)	4.60	4.05	4.39	0.63	0.8298
Shanks (g)	6.10	5.47	5.86	0.30	0.3769
Wings (g)	9.13	8.10	10.04	0.61	0.2105
Thighs (g)	22.09	19.76	20.64	0.83	0.2243
Breast (g)	14.88	16.84	15.96	1.04	0.4439
Back (g)	13.29	14.20	14.67	0.84	0.5581

Note: values with different superscripts on same row are significantly (p<0.05) different

Table 5: Organ weights in birds on experimental diets

Variable	Basal	BDG+enzyme	PKM+enzyme	SEM	P (ANOVA)
Heart (g)	0.44	0.40	0.42	0.01	0.6504
Gizzards (g)	2.40	2.60	2.74	0.13	0.2619
Liver (g)	2.23	2.19	2.08	0.11	0.6776
Lungs (g)	0.43	0.44	0.47	0.04	0.7190
Spleen (g)	0.14	0.16	0.12	0.01	0.3058
Large intestine (g)	0.21	0.21	0.17	0.02	0.4318
Small intestines (g)	3.42	3.55	3.45	0.20	0.8989
Kidney (g)	0.56^{a}	0.46$_{b}$	0.52^{c}	0.03	0.0490
Pancreas (g)	0.15^{a}	0.23^{b}	0.25^{b}	0.05	0.0397

Note: values with different superscripts on same row are significantly (p<0.05) different

Table 6: Cost of production of 1 kg weight gain in starter and finisher broilers on experimental diets

	Diet		
	(Basal)	(BDG+E)	(PKM+E)
Starter			
Average total weight gain (kg)	1.7	2.6	2.5
Average feed intake (kg)	6.10	9.00	8.80
Cost of feed (N/kg)	5.52	5.60	5.53
Cost of feed/kg weight gain (N)	19.80	19.40	19.50
Finisher			
Average total weight gain (kg)	14.80	17.80	15.50
Average feed intake (kg)	96.60	136.60	142.10
Cost of feed (N/kg)	11.1	11.2	11.1
Cost of feed/kg weight gain (N)	72.50	86.00	101.80

Note: N = Naira. 1.00 Naira is equivalent to 100 kobo

40-50 kobo in the enzyme supplemented diets. But at the finisher phase, the cost was significantly increased to between N13.50 (BDG diet) and N29.30 (PKM diet). Enzyme supplementation of fibre feeds seems to be economically more beneficial at the starter phase when actually the enzyme complement for breaking down the nonstarch polysaccharides is not yet developed in the birds. But as the birds age and the fibre level in the diet increases, more enzyme is needed in the diet for optimal break down of the fibre components because in accordance with the observation of Bedford (1997), it may well be that a given level of enzyme adequate at the starter phase is too low for optimum performance at the finisher phase. The use of enzyme supplemented BDG and PKM with reduced levels of maize at both the starter and finisher phases is of economic importance. At the starter phase 31% and at the finisher phase 52% of the maize was spared in the diets. It means that using enzyme supplemented AIBs can actually help save the use of the conventional and expensive cereal grains. The fact that birds on the enzyme supplemented BDG and PKM diets performed better than those on the control indicates the ability of the enzyme to have help provide the energy shortfall from the breakdown of the NSP of the BDG and PKM.

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