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Haematological Response, Performance and Economic Analysis of Cockerel Chicks Fed Enzyme Supplemented Brewer's Dried Grains Groundnut Cake-based Diets

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Abstract: The effect of replacing Groundnut Cake (GNC) with enzyme supplemented Brewer's Dried Grains (BDG) at 0, 25, 50, 75 and 100% graded levels in cockerel chicks at 6-11 weeks of age was investigated. Five dietary treatments were formulated to be isonitrogenous and isocaloric to provide 20% crude protein and 2900 kcal/kg metabolizable energy. Two hundred and twenty-five 5 weeks old cockerel chicks (Abor-Acre breed) were randomly allocated to five treatments replicated thrice with 15 cockerels per replicate, fed and watered *ad libitum* in deep litter pens for 6 weeks. Means of body weight, total weight gain, daily weight gain, feed intake, feed: gain ratio, blood parameters and economic assessment of cockerels fed the control diet, 25 and 50% enzyme supplemented brewer's dried grains diets were significantly ($p<0.05$) better than those fed 75 and 100% inclusion levels. The use of enzymes supplemented BDG was more profitable than GNC in cockerel's diets when the replacement do not exceed the 50% level. Mortality ranged from 1.95-3.56%.

Key words: Enzyme, supplemented, cockerel chicks, Brewer's dried grain, groundnut cake

INTRODUCTION

The use of exogenous enzymes in monogastric diets is said to have numerous benefits which include: The removal of anti-nutritional factors, increased digestibility of existing nutrients, increased digestibility of Non-Starch Polysaccharides (NSPs) and supplementing host endogenous enzymes (Classen and Cooper, 1999). The enzymes mostly used in monogastric diets are predominantly glycanases, which cleave Non-Starch Polysaccharides (NSPs) into smaller polymers, thereby removing their ability to form viscous digesta and enhancing nutrient digestibilities (Choct *et al*., 1995). Protein sources for livestock feed are expensive and meeting the protein needs of livestock has continue to be a critical factor in the production of quality animal feeds. The use of feeding stuffs that are cheaper, readily available and not directly required by man have been advocated. Brewer's Dried Grains (BDG) a by-product of the brewery industry has been found to have similar amino acid profile with Groundnut Cake (GNC) even though BDG crude protein is relatively lower than that of GNC (Aduku, 1993). The major limitation to the use of BDG as a plant protein source is it's high fibre content (Onwudike, 1993; Ademosun, 1973). It is therefore, imperative that increase in the use of BDG as a plant protein source will require some form of further processing or use of additives that can break-up the non-starch polysaccharides in BDG into easily digestible smaller polymers to improve its nutritive value and utilization (Isikwenu *et al*., 2008). Research information on the use of enzyme supplemented BDG in poultry diets is relatively limited. This study was conducted to investigate the effect of replacing GNC with enzyme supplemented BDG on performance, haematology and economy analysis in cockerel chicks diets.

MATERIALS AND METHODS

Experimental site: This study was conducted at the Poultry Research Unit of the Department of Animal Science Delta State University, Asaba Campus with a mean annual rainfall, temperature and relative humidity of 1137 mm, 32.7°C and 82% respectively and lies on latitude 5°30' and 5°45' N of the equator and longitude 5°40' and 6°E of the Greenwich Meridian.

Experimental birds and management: Two hundred and twenty five (225) 5 weeks old cockerel chicks (Abor-Acre breed) were used in this study. The cockerel chicks were randomly allotted into five equal treatment groups with each treatment subdivided into three replicates. Each treatment group consists of 45 cockerel chicks and 15 per each replicate. The cockerels were managed on a deep litter house partitioned into fifteen pens measuring 2.04 m x 2.03 m for the six weeks study period. Feed and water were provided *ad libitum* while necessary prophylaxis and vaccinations were administered.

Experimental design: The chicks were randomly allotted into five treatment groups on equal weight basis in a Completely Randomized Design (CRD). Each treatment group consists of 45 cockerel chicks and 15 chicks per replicate.

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Table 1: Composition of experimental cockerel chicks diets (6-11 weeks)

	Dietary treatment				
Replacement levels (%)	100 GNC 00 ENBDG	75 GNC 25 ENBDG	50 GNC 50 ENBDG	25 GNC 75 ENBDG	00 GNC 100 ENBDG
Ingredients					
Maize (Yellow)	58.70	52.95	47.00	39.50	32.60
Groundnut cake	27.00	20.25	13.50	6.75	-
Brewer's dried grains + enzymes	-	12.00	24.70	37.65	50.50
Fish meal	3.50	3.50	3.50	3.50	3.50
Wheat offal	3.50	3.50	3.50	3.50	3.50
Bone meal	3.20	3.20	3.20	3.20	3.20
Oyster shell	1.10	1.10	1.10	1.10	1.10
Premix*	0.50	0.50	0.50	0.50	0.50
Palm oil	1.90	2.40	2.40	3.40	4.50
Salt	0.40	0.40	0.40	0.40	0.40
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	20.09	20.05	20.02	19.95	19.86
Crude fibre	5.23	6.12	7.10	8.07	9.15
Metabolizable energy (kcal/kg)	2996.84	2971.33	2915.61	2905.15	2900.36
Determined analysis					
Dry matter (%)	89.93	87.72	87.90	88.00	91.90
Crude fibre (%)	7.20	8.50	11.10	13.20	16.30
Crude protein (%)	20.13	20.16	20.18	20.20	20.22
Ether extract (%)	6.75	7.57	8.78	9.70	10.82
Ash (%)	9.12	11.00	11.51	12.38	13.50
NFE	46.73	40.49	36.33	32.52	31.06

*Each 2.5 kg vitamin-mineral premix provided the following: A 8,500,000iu, D_3 1,500,000 iu, E 10,000 mg, K_3 1.500 mg, B_1 1,600 mg, B_2 4,000 mg, B_6 1,500 mg, B_{12} 10,000 mg, Folic acid 500 mg, Biotin H_2 750 mg, Pantothemic acid 5,000 mg, Choline Chloride 175,000 mg, Cobalt 200 mg, Copper 3,000 mg, Iodine 1000 mg, Iron 70,000 mg, Manganese 40,000 mg, Selerium 200 mg, Zinc 30,000 mg, Antioxidant 1,250 mg. Enzyme used is Hemicell® at 500 g/ton of feed. GNC: Groundnut Cake, ENBDG: Enzyme Supplemented Brewer's Dried Grains

Experimental diets: Brewer's Dried Grains (BDG) was used to replace Groundnut Cake (GNC) at 0, 25, 50, 75 and 100% levels in cockerel chicks diets on protein equivalent basis. Five treatment diets were formulated to be isonitrogenous and isocaloric to supply 20% crude protein and 2900 kcal/kg metabolizable energy. The four experimental diets containing 25, 50, 75 and 100% replacement levels were fed with enzyme supplementation (Hemicell®), used at 0.5% (500 g/ton) concentration in the feed. The composition of the cockerel chicks diets are presented in Table 1.

Measurements: Body weight development, body weight gain, feed intake and mortality were recorded on replicate basis weekly while feed conversion ratio was calculated according to Lambert *et al*. (1936). At the end of the feeding trial, one bird was randomly selected from each replicate, fasted overnight, weighed and slaughtered by severing the jugular vein in the neck. Blood samples approximately 10 ml per bird were collected from replicates in each treatment group into specimen bottles with or without Ethylene Diamine Tetra-Acetic Acid (EDTA). Haematological analysis was carried out using routinely available methods. The Packed Cell Volume (PCV) was determined by Wintrobe's microhaematocrit method, Red Blood Cell Count (RBC) and White Blood Cell Count (WBC) were by Neubauer haemocytometer and Haemoglobin concentration (Hb) by cyanomethaemoglobin method. The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were computed as outlined by Seal and Erickson (1979). Economic analysis of cockerel chicks was based on the cost of the diets as produced from the prevailing market price of the ingredients at the time of purchase. This was used to compute the cost of feed consumed per kg weight gain for each diet, the cost differential and relative cost benefit values of the diets in relation to the control.

Chemical analysis: The chemical analysis of the proximate compositions of the test ingredients (Table 2) and experimental diets (Table 1) were determined according to the procedure of AOAC (1990).

Statistical analysis: Data obtained were subjected to analysis of variance and treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955) using SPSS (10.0) package.

Table 2: Chemical Composition of Groundnut Cake (GNC) and Brewer's Dried Grains (BDG)

Chemical components	GNC	BDG
Crude protein	45.00	27.90
Ether extract	9.16	7.40
Crude fibre	3.81	11.70
Ash	5.51	4.80
Calcium	0.20	0.30
Phosphorous	0.60	0.88
TDN	76.00	78.00
ME kcal/kg (Swine)	3185.00	2240.00
ME kcal/kg (Poultry)	2530.00	2513.00
Lysine	1.73	0.90
Methionine	0.44	0.60
Cystein	0.72	0.40
Arginine	5.00	1.30
Tryptophan	0.49	0.40

Source: Aduku (1993)

RESULTS

The effect of enzyme supplemented Brewer's Dried Grains (BDG) inclusion levels on the body weight development of cockerel chicks is presented in Table 3. The final mean body weight, total weight gain, daily weight gain, feed intake and feed: gain ratio of cockerels fed the control diet, 25 and 50% replacement levels of enzyme supplemented BDG diets were significantly ($p<0.05$) better than those fed 75 and 100% enzyme supplement BDG diets. Mortality was moderate and evenly spread, ranging from 1.95-3.56% in all treatment groups. The results of the haematological indices are presented in Table 4. There were no significant ($p>0.05$) differences among cockerels fed the experimental diets in Red Blood Cell Count (RBC) and White Blood Cell Count (WBC) values. Significant ($p<0.05$) differences were observed in Packed Cell Volume (PCV), Haemoglobin (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) values among treatments. The Packed Cell Volume (PCV) of all treatments were similar ($p>0.05$) except for 100% enzyme supplemented BDG diet which was significantly ($p<0.05$) lower than the other treatments. The haemoglobin content, MCH and MCHC values of the control and 25% enzyme supplemented BDG diets were similar ($p>0.05$) but significantly ($p<0.05$) higher than the others. The values of Hb content and MCH progressively decreased with increased levels of enzyme supplemented BDG in the diets. The MCV values of the control and 25% enzyme supplemented BDG diets were similar ($p>0.05$) but significantly ($p<0.05$) lower than diets with 50 and 75% enzyme supplemented BDG diets, the 100% enzyme supplemented BDG diet had the least value. The results of the cost-benefit analysis of the production of cockerels fed the experimental diets are presented in Table 5. There was significant ($p<0.05$) reduction in the amount of total feed consumed per bird, cost of total feed consumed per bird, cost per kg feed and cost per kg weight produced as the levels of enzyme supplemented BDG increased in the diets of cockerels. The values of these parameters for the control treatment were significantly ($p<0.05$) higher than all the enzyme supplemented BDG diets and the values progressively decreased as the levels of enzyme supplemented BDG increased in the diets. The cost differential and relative cost benefit per kilogram gain significantly ($p<0.05$) increased with increasing levels of enzyme supplemented BDG in the diets.

Table 3: Performance characteristics of cockerels fed experimental diets (6-11 weeks)

Replacement levels (%)	100 GNC 00 ENBDG	75 GNC 25 ENBDG	50 GNC 50 ENBDG	25 GNC 75 ENBDG	00 GNC 100 ENBDG	SEM
Initial weight (g/bd)	413.42	413.24	412.50	412.85	412.89	
Final body weight (g/bd)	1182.45^a	1179.50^a	1174.53^a	881.29^b	891.30^b	38.32
Total weight gain (g/bd)	766.58^a	765.76^a	761.50^a	467.15^b	477.11^b	38.31
Daily weight gain (g/bd)	18.25^a	18.23^a	18.13^a	11.12^b	11.36^b	0.91
Feed intake (g/bd/d)	69.40^a	69.32^a	68.95^a	56.95^b	57.85^b	1.55
Feed: Gain ratio	3.80^a	3.80^a	3.80^a	5.12^b	5.09^b	0.17
Mortality (%)	1.95	3.56	2.56	2.63	2.44	

^{a,b}Mean values with different superscripts in the same row are significantly different ($p<0.05$). ENBDG: Enzyme Supplemented Brewer's Dried Grains, GNC: Groundnut Cake, g/bd: Grammes per Bird, g/bd/d: Grammes per Bird per Day. SEM: Standard Error of the Mean

Table 4: Haematological indices of cockerels fed experimental diets (6-11 weeks)

Replacement level (%)	100 GNC 00 ENBDG	75 GNC 25 ENBDG	50 GNC 50 ENBDG	25 GNC 75 ENBDG	00 GNC 100 ENBDG	SEM
PCV (%)	25.00^a	24.00^a	25.67^a	26.67^a	20.67^b	2.04
Hb (g/dl)	6.67^a	6.53^a	5.86^b	5.71^b	4.85^c	0.17
RBC (10^6/mm^3)	2.84^a	2.88^a	2.87^a	2.83^a	2.45^a	0.19
WBC (10^6/mm^3)	2.74^a	2.44^a	2.65^a	2.15^a	2.44^a	0.11
MCH (pg)	23.41^a	22.67^a	20.42^b	20.17^b	19.80^c	0.40
MCV (fl)	88.03^c	88.33^c	89.44^b	94.24^a	84.37^d	0.85
MCHC	26.68^a	27.21^a	22.83^c	21.40^d	23.46^b	0.67

^{a,b,c,d}Means with different superscripts in the same row are significantly ($p<0.05$) different. ENBDG: Enzyme Supplemented Brewer's Dried Grains, GNC: Groundnut Cake, SEM: Standard Error of the Mean

Table 5: Economic analysis of cockerels fed experimental diets (6-11 weeks)

Parameters	100 GNC 00 ENBDG	75 GNC 25 ENBDG	50 GNC 50 ENBDG	25 GNC 75 ENBDG	00 GNC 100 ENBDG	SEM
Total feed consumed g/bird	2914.80[a]	2911.40[b]	2895.90[c]	2391.90[e]	2429.70[d]	65.12
Cost/kg feed	82.12[a]	77.59[b]	73.47[c]	69.16[d]	63.86[e]	1.70
Cost of Total feed consumed/bird	239.38[a]	225.86[b]	212.77[c]	165.43[d]	155.18[e]	8.93
Cost/kg weight	202.86[a]	191.41[b]	181.85[d]	187.71[c]	174.11[e]	2.57
Cost differential/kg gain (Naira)	-	11.45[d]	21.01[b]	15.14[c]	28.75[a]	1.97
Relative cost benefit/kg gain (%)	100.00[e]	105.98[d]	111.55[b]	108.07[c]	116.51[a]	1.47

[a,b,c,d,e]Means with different superscripts in the same row are significantly ($p<0.05$) different. ENBDG: Enzyme Supplemented Brewer's Dried Grains, GNC: Groundnut Cake, SEM: Standard Error of the Mean

DISCUSSION

The mean body weight, total weight gain, daily weight gain, feed intake and feed: gain ratio of cockerels fed the control, 25 and 50% replacement levels of enzyme supplemented BDG diets were similar, indicating that cockerels at 6-11 weeks of age can utilize inclusions of enzyme supplemented BDG of up to 50% (24.70% of the diet) level. Cockerels fed enzyme supplemented BDG diets at 0, 25 and 50% replacement levels had higher feed intake than those fed 75 and 100% inclusion levels. This means that at 0, 25 and 50% replacement levels, the diets were all well received by the cockerels as they ate similar quantity. The decrease in feed intake at the 75 and 100% replacement levels may be due to the bulkiness of the feed associated with high BDG levels compared to groundnut cake. The observed mean body weights, total weight gain and daily weight gains are in agreement with the feed intake pattern of the cockerels which shows that the inclusion levels of 25 and 50% of enzyme supplemented BDG diets were capable of supplying adequate nutrients for a growth rate comparable to the control diet that do not contain any BDG. This may have resulted from the activities of celluloses and glycanases contained in the enzyme which might have caused a cleavage of the Non-Starch Polysaccharides (NSPs) in BDG into smaller polymers, thereby preventing the formation of viscous digesta and enhancing nutrient digestibilities (Choct *et al*., 1995). The 50% replacement level which represents 24.70% of the diet as enzyme supplemented BDG is an improvement on the 10% level of dietary BDG inclusion in broiler chicks by Ademosun (1973) and Lopez and Carmona (1981). The improvement in body weight performance are consistent with those obtained by Abubakar *et al*. (2007) when rice bran and wheat offal diets of pullet and broiler starter chicks where supplemented with enzymes. Enzyme treatment is capable of solubilizing high amounts of cell wall thereby producing a good quality high level soluble carbohydrates from non-starch polysaccharides (IFRU, 2003). The high amount of inclusion level obtained in this study could be due to the enzyme supplementation effect on BDG, which initiated fibre breakdown, reduction in fibre content and anti-nutritional activities, causing a release of locked-up nutrients that encouraged good performance of cockerels. Bedford and Morgan (1996) also reported that enzyme supplementation of poultry diets improve overall nutrient digestion and reduce endogenous amino acid losses. The lower weight gain of cockerels fed 75 and 100% replacement levels of enzyme supplemented BDG diets might have been caused by nutrient intake restriction precipitated by lower feed intake or nutrient dilution effect of crude fibre and bulkiness of feeds. Previous reports by Fattori *et al*. (1991), Ubosi (1998) and Mench (2002) on the implication of restricted feed intake on growth rate and body weight performance are in agreement with the results of this study. Poor performance of the cockerels fed the 75 and 100% replacement levels could also be due to the inability of the enzyme concentration to degrade sufficient amount of the non-starch polysaccharides present in the feed. The feed: gain ratio values followed the same pattern with the feed intake and weight development indicating that replacing up to 50% of GNC with enzyme supplemented BDG had no adverse effects on performance. The improvement in the feed: gain ratio obtained in this study due to enzyme effect in high crude fiber diets are consistent with the range of values reported by Ani *et al*. (2010) for pullet chicks, Makanjuola and Iyayi (2010) and Abdulrashid *et al*. (2010) for broiler starter and finisher birds respectively. The similarity of the PCV values obtained (except for the 100% enzyme supplemented BDG diet) indicate that the treatment had no adverse effect on the blood levels and birds were not anaemic. The RBC and WBC values were similar for all treatments and shows that the blood levels and immunity status of cockerels were not negatively affected by the experimental diets. The RBC and WBC values obtained in this study are comparable with those reported by Akpodiete and Ologhobo (1998) and Isikwenu *et al*. (2008) and are within the normal range of values. The Hb, MCH and MCHC values, which are similar to those reported by Isikwenu *et al*. (2008) showed a gradual decrease as the enzyme supplemented BDG increased in the diets, which indicate nutritional inadequacies as the levels of replacement increased. This is in agreement with decreased feed intake of cockerels as the enzyme supplemented BDG increases in the diets. The nutrient intake restriction effect of decreased voluntary feed intake may have resulted in the deficiency of blood nutrient composition. Poor nutrients intake could also be due to the inability of the enzyme concentration to degrade sufficient amount of the non-starch polysaccharides present in the feed (Fattori *et al*., 1991; Ubosi, 1998; Mench, 2002). MCV values were significantly different with 50 and 75% replacement levels better than the control. There was gain in financial margin in the production cost with the inclusion of enzyme supplemented BDG as part replacement for GNC in cockerel diets. The reduction in the cost of a kg feed with incremental levels of enzyme supplemented BDG also resulted in the reduction of cost of feed consumed per bird and cost per kg weight produced. The decrease in feed cost between the control diet of Naira 82.12 per kg feed and that of the 50% enzyme supplemented BDG diet (which had similar performance with the control) of Naira 37.47 per kg feed represent a 10.53% reduction in the cost of producing a kg of feed. A saving of this magnitude on feed production will be of great benefit to the farmer, since feed alone account for about 80% of the recurrent expenditure in poultry production. Therefore, the cost of producing a kg weight decreased from Naira 202.86 for the control to Naira 181.85 for 50% enzyme supplemented BDG diet, representing a 10.36% reduction in the cost of producing a kg weight. This is an indication of a favourable cost analysis which could be interpreted to mean a positive response of cockerels to enzyme supplemented BDG diets at the 50% replacement level. The cost differential and relative cost-benefit also showed a progressive gain per kg weight produced as the enzyme supplemented BDG replace GNC in the cockerel's diets. The use of enzyme supplemented BDG is a possible alternative to GNC in the diets of cockerels when the replacement does not exceed 50% level (that is 24.70% of the diet).

Conclusion: Based on the results of the weight performance, haematological indices and economic analysis, enzyme supplemented BDG can replace up to 50% GNC (24.70% of the diet) as a plant protein source in cockerel diets at 6-11 weeks of age. Enzyme supplementation improved the utilization of BDG diets and therefore, can be used as an alternative to GNC in cockerel diets at 50% replacement level. Based on the production cost per kg weight produced, the use of enzyme supplemented BDG is more profitable than GNC in cockerels diets when the replacement does not exceed the 50% level.

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