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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Performance of pullet chicks fed different levels of dietary fibre and enzyme

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Abstract

The response of pullet chicks to varying levels of dietary fibre and supplementary enzyme was investigated for 8 weeks using 120 three weeks old Harco black pullet chicks. The chicks were randomly divided into 8 groups of 15 birds each and assigned to 8 energetic (11.78-11.96 MJ/Kg ME) and nitrogenous (20% crude protein) diets in a 4 x 2 factorial arrangement involving four fibre levels (5.0, 6.0, 7.0 and 8.0%) and two enzyme levels (0 and 0.25%). Each treatment was replicated 3 times with 5 birds per replicate. Results showed that while body weight gain of chicks that were fed diets without supplementary enzyme decreased significantly ($P<0.01$) as the dietary fibre level increased beyond 6% level, average daily feed intake increased significantly ($P<0.01$) at the 7 and 8% dietary fibre levels. Chicks fed 6% crude fibre diet with enzyme supplementation had significantly ($P<0.01$) higher average daily weight gain, final body weight and protein efficiency ratio and lower ($P<0.01$) cost of feed per kg weight gain than those fed the control diet. It was concluded that 6% crude fibre can be included in pullet chicks' diet without supplementary enzyme and 8% crude fibre with supplementary enzyme for normal growth of chicks.

Keywords: Pullets fibre; enzyme; growth performance; diets

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Introduction

Poultry production has an unquestionable potential to close the existing gap in animal protein consumption in a developing country like Nigeria. This is because of their short gestation and generation intervals, large number, fast growth, greater affordability, ease of raising, absence of taboos to production and consumption and absence of barrier to production in any climatic zone in the country (Obioha, 1992a; Ani and Okeke, 2011). According to Oluyemi and Roberts (2000) poultry enjoys a relative advantage over other livestock in terms of its ease of management, high turn-over, quick return to capital investment and wide acceptance of its product for human consumption. The highest productivity of eggs in the Nigerian poultry industry apparently stemmed from the use of high producing strains of birds as well as the development of balanced feeds, intensive housing and better poultry equipment (Obioha, 1992b; Oluyemi and Roberts, 2000). For some time now, the Nigerian poultry industry has devoted more attention to the exotic breeds of chicken due to their high performance in terms of body weight, egg-production and feed to gain ratio. Egg is one of the most nutritious animal products. It is an excellent source of high quality protein in human food that is common and affordable. Most of the eggs in the Nigerian market are produced by exotic breeds of chicken genetically developed for egg production. Increased egg production in Nigeria is being hampered by high cost of feed, which constitutes about 70-80% of the total cost of egg production (Acromovic, 2001). The rapid development of intensive poultry and egg production has been accompanied by an increased competition between humans and animals for maize which is a major staple food in the main poultry production zones. This competition could be alleviated by replacing maize in poultry feed by locally available agricultural by-products that are less exploited by humans. (Teguia, 1995). The rapid expansion and success of the poultry industry would depend mostly on the availability of good quality and relatively

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inexpensive feed ingredients for the formulation of poultry feeds. Dependence on the alternative source of ingredients, especially, when it encourages a shift to ingredient for which there is less competition, may help if it is sufficiently available. However, industrial by-products such as brewers' spent grain, wheat offal, palm kernel cake, and so on generally contain high levels of fibre hence they are not commonly used in compounding feeds. Ordinarily, poultry cannot utilize high fibre diets and this is because of the absence of the digestive frame work that can elaborately digest large amounts of fibre. This limits the proper utilization of those feeds that contain a high proportion of structural components such as cellulose lignin and pectin by the poultry. It is therefore necessary to achieve a near complete breakdown of these fibres by incorporating enzymes in diets of monogastrics to further break down the high fibre materials not taken care of by the endogenous enzymes (ZoBell et al., 2000). The exogenous enzyme being considered in this study is Roxazyme G®, an enzyme complex derived from Trichoderma viride with glucanase and xylanase activity. Roxazyme G® is capable of hydrolyzing the non starch polysaccharides (NSP) in cereal grains and their by–products into smaller molecules which birds can digest and utilize (Broz and Frigg, 1990). This study was therefore conducted to investigate the response of pullet chicks to diets containing graded levels of fibre and supplementary enzyme.

Materials and Methods

The study was conducted at the Poultry Unit of the Department of Animal Science Research and Teaching Farm, University of Nigeria, Nsukka. Raw bambara nut waste and other feed ingredients used in the study were purchased at Nsukka and Enugu in Enugu State, Nigeria.

Animals and Experimental Diets

One hundred and twenty 3-week old black Harco black pullet chicks averaging 249.87–250.23g body weight were randomly divided into 8 groups of 15 birds each. The groups were randomly assigned to 8 energetic (11.78-11.96 MJ/Kg ME) and nitrogenous (20% crude protein) diets in a 4x2 factorial arrangement involving four levels (5.0, 6.0, 7.0 and 8.0%) of fibre and two enzyme levels (0 and 0.25%). The percentage composition of the diets is shown in Table 1. Each treatment was replicated 3 times with 5 birds per replicate placed in 2m x 3m deep litter pens of fresh wood shavings. Kerosene stoves placed under metal hovers for 28 days provided heat. Feed and water were supplied *ad libitum* to the birds. The birds were properly vaccinated against New Castle disease in the first, third and sixth weeks. They were also vaccinated against Gumboro disease in the second and fourth weeks and against fowl pox in the fifth week. Prophylactic treatment against coccidiosis with Embazin forte at two weeks of age was also given to the birds. The experiment lasted for a period of 8 weeks during which feed intake, weight gain, feed conversion ratios and protein efficiency ratios were determined.

At the beginning of the experiment, chicks in each replicate were weighed together. Feed intake was determined daily by the weigh-back technique. Live weights were recorded weekly for each replicate. Feed conversion ratio was then calculated from these data as quantity (grams) of feed consumed per unit (grams) weight gained over the same period. All measurements were taken between 8.00am and 12.00 noon.

Proximate and Statistical Analyses

Feed and excreta samples were assayed for proximate composition by the methods of AOAC (2006). Gross energy of feed and faecal samples was determined in a Parr oxygen adiabatic bomb calorimeter. Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (Steel and Torrie, 1980). Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Results and Discussion

Table 2 shows the proximate composition of the experimental diets while the growth performance of pullet chicks fed diets containing varying fibre levels and supplementary enzyme is presented in Table 3. There were significant ($P<0.01$) differences among treatments in average daily weight gain (ADWG) and final body weight of chicks. The average daily weight gain and final body weight (FBW) of chicks on treatment 4 (6% fibre diet with enzyme supplementation) were significantly ($P<0.01$) higher than the ADWG and FBW of chicks on other treatments. The results showed that as the fibre level increased beyond 6% in the diet, there was a decrease in the weight gain of chicks that consumed diets without enzyme supplementation. This could be due to decrease in digestibility and utilization of the diets emanating from the high fibre contents of such diets. Ajaja et al. (2003) had observed that high fibre content of diets decreased nutrient utilization and resulted in metabolic dysfunction with the attendant weight reduction in monogastric animals. The birds fed the high fibre diets could have utilized most of the available nutrients for maintenance purpose and channeled less nutrients for growth, hence the observed depressed growth.

An (1994) earlier reported that when birds are starved or when energy levels drop below body

Table 1: Percentage composition of experimental diets

Crude fiber level (%)	5.00		6.00		7.00		8.00	
Enzyme levels (%)	0	0.25	0	0.25	0	0.25	0	0.25
Ingredients /Diets	1	2	3	4	5	6	7	8
Maize	46.11	46.11	34.26	34.26	38.56	38.56	37.94	9.37
Wheat offal	8.53	8.28	12.72	12.47	19.40	19.40	9.62	9.66
Ground nut cake	15.74	15.74	16.04	16.04	10.26	10.26	13.92	13.92
Soybean meal	11.81	11.81	12.58	12.58	8.26	8.26	9.30	9.30
Palm kernel cake	7.87	7.87	9.70	9.70	4.31	4.06	9.30	9.30
Bambara nut offal	3.94	3.94	8.70	8.70	13.21	13.21	13.92	13.92
Fish meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral-vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Enzyme	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.25
Total	100	100	100	100	100	100	100	100
Calculated composition:								
Crude protein	20	20	20	20	20	20	20	20
Crude fiber	5.02	5.02	6.02	6.02	7.09	7.09	8.02	8.02
Energy (MJ/kgME)	11.96	11.96	11.91	11.91	11.80	11.80	11.78	11.78

Table 2: Proximate composition of experimental diets

Dietary fibre Levels (%)	5.00		6.00		7.00		8.00	
Enzyme levels	0	0.25	0	0.25	0	0.25	0	0.25
Components/Diets	1	2	3	4	5	6	7	8
Dry matter (%)	91.00	90.40	90.25	90.95	91.10	88.90	90.85	90.80
Crude protein (%)	20.01	20.02	20.04	20.07	20.08	20.02	20.05	20.03
Ether extract (%)	3.45	3.33	3.70	3.60	3.20	3.05	3.75	3.30
Crude fibre (%)	5.03	5.02	6.03	6.02	7.07	7.09	8.02	8.03
Ash (%)	5.2	5.6	4.15	4.2	4.8	7.7	3.75	4.45
Nitrogen-free extract (%)	57.31	56.43	56.33	57.06	55.95	51.04	55.28	54.99

Table 3: Performance of pullet chicks fed varying dietary fibre levels and supplementary enzyme

Dietary fibre Level (%)	5.00		6.00		7.00		8.00		
Enzyme level (%)	0	0.25	0	0.25	0	0.25	0	0.25	SEM
Parameters/Treatments	1	2	3	4	5	6	7	8	
Initial body weight (g)	249.90	250.23	250.08	249.97	250.1	249.87	250.03	249.93	0.23
Final body weight (g)	692.67^{bc}	703.17^{b}	686.49^{c}	746.38^{a}	670.32^{d}	699.77^{bc}	667.23^{d}	693.33^{bc}	4.97
Av. daily weight gain (g)	7.96^{bc}	8.09^{b}	7.79^{c}	8.86^{a}	7.50^{d}	8.03^{bc}	7.45^{d}	7.92^{bc}	0.09
Av. daily feed intake (g)	50.66^{b}	46.57^{c}	50.89^{b}	50.11^{b}	55.09^{a}	50.60^{b}	56.25^{a}	52.05^{b}	0.63
Feed conversion ratio	6.37^{a}	5.82^{b}	6.53^{a}	5.65^{b}	7.35^{a}	6.30^{b}	7.55^{a}	6.58^{b}	0.17
Protein efficiency ratio	0.66^{b}	0.67^{b}	0.65^{b}	0.74^{a}	0.62^{c}	0.66^{b}	0.61^{c}	0.65^{b}	0.01

^{a,b,c,d} Means on the same row with different superscripts are significant (P<0.01) different; SEM= Standard error of mean.

Table 4: Cost implication of feeding varying dietary fibre levels and supplementary enzyme to pullet chicks

Dietary fibre Level (%)	5.00		6.00		7.00		8.00		
Enzyme level (%)	0	0.25	0	0.25	0	0.25	0	0.25	SEM
Parameters/Treatments	1	2	3	4	5	6	7	8	
Cost of 1kg of feed (₦)	53.78	55.28	42.26	43.76	43.87	45.37	45.02	46.52	-
Total feed intake (kg)	2.84^{a}	2.61^{b}	2.85^{a}	2.81^{a}	3.09^{a}	2.88^{b}	3.15^{a}	2.92^{b}	0.24
Total weight gain (g)	445.67^{bc}	453.78^{b}	436.49^{c}	496.38^{a}	420.32^{d}	449.77^{bc}	417.23^{d}	443.33^{bc}	4.96
Cost of daily feed intake(₦)	2.37^{abc}	2.58^{a}	2.20^{cd}	2.15^{d}	2.42^{abc}	2.29^{bcd}	2.53^{ab}	2.42^{abc}	0.04
Cost of total feed intake(₦)	152.56^{a}	144.28^{b}	122.74^{d}	120.58^{e}	135.41^{c}	128.55^{d}	141.81^{b}	135.68^{c}	2.23
Cost of feed per kg wt gain(₦)	342.40^{a}	321.73^{b}	272.16^{e}	247.24^{f}	322.30^{b}	285.83^{d}	340.05^{a}	305.95^{c}	6.68

$^{a,b,c…f}$ Means on the same row with different superscripts are significant (P<0.01) different.

requirement, birds tend to channel the available energy for maintenance. However, supplementation of the diets with enzyme resulted in significant (P<0.01) improvement in weight gain of the birds over the birds fed un-supplemented diets. Similar results have been reported by Iyayi and Tewe (1998) in layers, Iyayi and

Adegboyiga (2004) and Shakouri and Kermanshahi (2004) in broilers. The enhanced weight gain could be attributed to improved digestion and utilization of non-starch polysaccharides in dietary fibre due to enzyme inclusion. MCNab and Smithland (1992) reported that roxazyme complements the digestive enzymes of poultry to enhance the digestion and utilization of non-starch polysaccharides in cereals and their by-products. Annison (1996) and Francesch and Perez-Vendrell (1999) reported that exogenous enzymes work in combination with endogenous enzymes to break up large molecules to sizes that can be utilized by birds. Enzyme supplementation of fibrous feeds resulted in improved performance in a variety of ways such as reduction in the viscosity of digesta (Marquardt, 1997;Bedford, 1997; Taibipont and Kermanshahi, 2004; Gunal and Yasar, 2004) reduction or elimination of anti-nutrients like viscous non-starch polysaccharide which is known to reduce the digestion and absorption of nutrients (Marquardt, 1997) and indirect alteration of the bacterial population of the different regions of the tract 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 pre-caecal section of the tract since the micro flora population in viscous grain based diets do affect the digestibility of amino acid in the ileum (Bedford, 1997; Gunal and Yasar, 2004). There were significant interactions ($P<0.01$) between fibre and enzyme levels on ADWG and FBW. Enzyme supplementation had an increasing ($P<0.01$) effect on the weight gain and final body of the pullet chicks at the 6, 7 and 8% fibre inclusion levels. There were significant ($P<0.01$) differences among treatments in average daily feed intake (ADFI). Chicks on treatments 5 and 7 (7 and 8% fibre diets without enzyme supplementation) had similar ($P>0.01$) ADFI values and these were significantly ($P<0.01$) higher than the ADFI values of chicks on other treatments. Chicks on 1,3,4, 6 and had comparable ($P>0.01$) ADFI values and these were significantly ($P<0.01$) higher than the ADFI value of chicks on treatment 2(5% fibre diet with enzyme supplementation). Chicks on treatment 2 had the least ADFI value. There was a significant ($P<0.01$) interaction between fibre and enzyme levels on ADFI. Enzyme supplementation reduced feed intake significantly ($P<0.01$) at the 5, 7 and 8% fibre inclusion levels. The observed increase in feed intake by birds that consumed the diets without enzyme supplementation and the decrease in feed intake by birds that consumed enzyme supplemented diets agree with the findings of Ani and Omeje (2007), Samarasinghe et al. (2000), Richter et al. (1995), Ranade and Rajamane (1992) and Kadam et al. (1991) that feed intake decreased by addition of enzyme as the birds fulfilled their nutrient requirement and thereby took less amount of feed. On the other hand, this result did not agree with the findings of Patterson and Aman (1992), Lessen et al. (1996), Augelovicora and Michalik (1997) and Daveby et al. (1998) who suggested that the increase in digestibility of nutrients and higher degradation of the cell wall of feed emanating from enzyme inclusion culminated to improved feed intake in the birds under test. Similarly, Pond et al. (1974) observed an inclination towards increase in feed consumption and increase in feed required per kg of gain as the level of crude fibre increased in the diet and adduced that to the bulky nature and low total digestible nutrient content of such fibrous feed. That birds fed the 7 and 8% CF diets (without enzyme supplementation) had the highest feed intake values was not surprising since feed intake in chickens is inversely related to dietary energy concentration. Increase in dietary fibre level is known to result in decrease in dietary energy level of the diets (Kung and Grueling, 2000; Macdonald et al., 2002). Since birds eat to satisfy their energy requirement (Jurgens, 2007), those birds fed the 7 and 8% CF diets had to consume more feed than other birds in to meet their energy requirements. Beside decrease in energy level, dietary fibre has a laxative effect and might have therefore increased the rate of gastric evacuation in the birds. A high rate of gastric evacuation is usually compensated by increased feed intake (Payne and Wilson, 1999; Williamson and Payne, 2000). The reduction in feed intake could be that the supplementary enzyme worked in combination with the endogenous enzymes to break up large molecules to sizes that can be utilized by birds thereby making more nutrients available to the birds (Officer, 2000). The supplemental enzyme might have helped to reduce or eliminate such anti-nutrients like viscous non-starch polysaccharide which might have been present in diets and which is known to reduce the digestion and absorption of nutrients (Marquardt, 1997; Francesch and Perez-Vendrell, 1999). There were significant ($P<0.01$) differences among treatments in feed conversion ratio (FCR) and in protein efficiency ratio (PER). Chicks on treatments 1, 3, 5 and 7 (5, 6, 7 and 8% fibre diets without enzyme supplementation) had similar ($P>0.01$) FCR values and these were significantly ($P<0.01$) higher than the FCR values of chicks on other treatments. Chicks on 2, 4, 6 and 8 (5, 6, 7 and 8% fibre diets with enzyme supplementation) also had comparable ($P>0.01$) FCR values and these were significantly ($P<0.01$) lower than the FCR values of chicks on treatments 1, 3, 5 and 7. There was a significant interaction ($P<0.01$) between fibre and enzyme levels on FCR. Enzyme supplementation reduced ($P<0.01$) FCR values significantly ($P<0.01$) at all the fibre inclusion levels, thereby enhance the efficiency of feed conversion and utilization by the birds (Broz and Frigg, 1990; Tuleun et al., 2001). Chicks on treatment 4 (6% fibre diet with enzyme supplementation) had significantly (P<0.01) higher PER value than the PER values of chicks on other treatments. Chicks on 1, 2, 3, 6 and 8 (5, 6, 7 and 8% fibre diets with and without enzyme supplementation) had comparable (P>0.01) PER values and these were significantly (P<0.01) higher than the PER values of chicks on treatments 5 and 7 which were similar and the least. There was a significant interaction (P<0.01) between fibre and enzyme levels on PER. Enzyme supplementation increased (P<0.01) PER values significantly (P<0.01) at the 6, 7 and 8% fibre inclusion levels, thereby enhance the efficiency of protein *vis-à-vis* the amino acid utilization by the birds (Bedford, 1997; Gunal and Yasar, 2004). Table 4 shows the cost of implication of feeding varying dietary fibre levels and supplementary enzyme to pullet chicks. There were significant (P<0.01) differences among treatments in total feed intake, total weight gain, cost of total feed intake, cost of daily feed intake and feed cost per kg weight gain. Chicks on treatments 1, 3, 4, 5 and 7 had comparable (P>0.01) total feed intake values and these were significantly (P<0.01) higher than the similar total feed intake values of chicks on other treatments. The total weight gain value of chicks on treatment 4 was significantly (P<0.01) higher than the total weight gain values of chicks on other treatments. Chicks on treatments 5 and 7 had the least total weight gain values. Chicks on treatments 1had the highest cost of total feed intake while chicks on treatment 4 had the least cost of total feed intake. The feed cost per kg weight gain values of chicks on treatments 1 and 7 were comparable (P>0.01) and these were significantly (P<0.01) higher than those of chicks on other treatments. Chicks on treatment 4 had the least feed cost per kg weight gain value. There were significant(P<0.01) interactions between fibre and enzyme levels on total feed intake , total weight gain, cost of total feed intake, cost of daily feed intake and feed cost per kg weight gain. Enzyme supplementation reduced (P<0.01) total feed intake at the 5, 7 and 8% fibre inclusion levels; increased (P<0.01) total weight gain at the 6, 7 and 8% fibre inclusion levels and reduced (P<0.01) the cost of total feed intake and feed cost per kg weight gain at all the fibre inclusion levels. The observed reduction in cost might be attributed to improved feed utilization and faster growth rate of the treated birds. This is in agreement with the findings of Mikulshi et al. (1990), Morkunas et al. (1993), Augelovicova and Michalik (1997) that inclusion of enzyme in the diet of poultry resulted in reduced feed cost/kg gain. This tends to suggest that it is very economical/ profitable to supplement fibre based diets with enzyme. This implies that inclusion of exogenous enzyme in some of chicks' diets improved the performance of birds. Remarkably, the pullet chicks that consumed 6% crude fibre diet exhibited superior performance over the birds on other dietary treatments in most of the parameters measured. The decrease in feed intake due to inclusion of enzyme in some of the diets led to reduced feed cost per kg weight gain with subsequent decrease in cost of production.

Conclusion

It is evident from the results obtained in the present study that 6% crude fibre can be included in pullet chicks' diet without supplementary enzyme and 8% crude fibre with supplementary enzyme for normal growth of chicks.

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