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Performance and Economic Analysis of Broiler Chicks Fed Enzyme Supplemented Heat Treated Goat Manure-Based Diets

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ABSTRACT

A 35 day feeding trial was conducted to study the effects of exogenous enzymes supplementation of heat-treated goat manure-based diets on the performance of broiler starter chicks. Two hundred and ten (210) 7-day old broiler chicks were randomly allotted to seven groups in a completely randomized design. Each group was replicated three times. Seven experimental broiler starter diets were formulated such that diet 1 contained 0% heat-treated goat manure (HGM). Diets 2, 4 and 6 contained 5%, 10% and 15% HSM without supplementation, respectively, while diets 3, 5 and 7 contained 5%, 10% and 15% HGM supplemented with 100mg of exogenous enzyme (Roxayme G.), respectively. The results of indicated that body weight gain, feed intake, feed conversion ratio and protein efficiency ratio of starter broilers were negatively affected by feeding HGM without exogenous enzyme dietary inclusion level. Furthermore, the study revealed that enzyme supplementation of HGM in broiler starter diets enhanced the performance, reduced the cost of feed intake and cost of feed per weight gain of the of the young broiler chicks. Consequently, the study maintained that enzyme supplementation at higher level of HGM might be effective for better performance of the birds.

KEYWORDS: broiler starters, enzymes supplementation, heat-treated goat manure, performance.

Introduction

In Nigeria, poultry enterprise is prominent among livestock production and contributes substantial amount of meat and eggs for human consumption. The industry has undergone remarkable growth over the years. For instance, the Nigeria poultry production expanded with the domestic meat production increasing from 172,000 MT in 1999 to 211,000 MT in 2005 (Ahaotu and Ayo – Enwerem, 2008; Alabi and Aruna, 2005). However, the expansion is not keeping pace with domestic consumption requirements cum demographic growth rate, and is being hampered by fluctuations in the supply of good quality feed.

In Nigeria, poultry feed is based primarily on corn and soyabean meals that constitute the most expensive components of the diets. The scarcity and high cost of these feed ingredients are the major drawbacks to the sustainability and development of poultry industry in the country. This has led to increasing cost of poultry production; hence 70 - 80% of production cost is attributable to feed (Yashim *et al.*, 2007). This limitation imposed by scarcity of feed ingredients has forced animal nutritionists to explore for locally renewable non-agricultural and cheaper agricultural and agro-by products that can meet the nutrient requirement of livestock (Onu *et al*., 2006; Onu, 2007).

One of such agricultural by-products is goat manure which has always been discarded as waste and unusable by man and any conventional industry. Recently, goat manure was introduced into monogastric diets by nutritionists as preliminary trials (Abeke *et al*, 2008; Onu and Otuma, 2008). However, results of the preliminary studies showed that the nutritive value of goat manure is negatively affected by its low energy and high fibre contents. Pioneer studies (Abeke *et al*., 2003; Onu, 2007; Abeke *et al*., 2008) showed that high inclusion levels of goat manure in poultry diets results in depressed performance of the animals. However, later study suggests that the sub- optimal performance of the animals fed goat manure based diets could be overcome by inclusion of exogenous enzymes such as Roxazyme in the diets. Exogenous enzymes have been shown to increase the digestibility of fibrous feed ingredients by disrupting the plant cell walls, and enhancing nutrients absorption (Acamovic, 2001).

However, the efficiency of exogenous enzymes in diets can only be assessed by evaluating the performance of birds that are fed with diets containing the enzymes compared to those that are not. It was based on this premise that the present study was conducted to evaluate performance and economic analysis of broiler starter chicks fed enzyme supplemented goat manure based diets.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm (Poultry Unit) of the Department of Animal Production Technology, Imo State Polytechnic, Umuagwo, Nigeria with the approval of the Committee for Animal Experiments of the Institution.

Sources and processing of goat manure

The goat manure used in this experiment was sourced from local goat farmers in Etioha, Ohaji /Egbema local Government Area of Imo State, Nigeria. The manure was oven- dried at 80 ^{0}C for 3 hours and ground in a hammer mill into a meal suitable for incorporation into poultry feed. Proximate analysis of the heat- treated goat manure (HGM) was conducted using standard methods as described by AOAC (1995), Table 1.

Experimental diets

Seven experimental starter diets were formulated such that diet T which served as the control contained O% Heat-treated Goat Manure (HGM) (Maize - based), while diets 2, 4, and 6 contained 5%, 10% and 15% HGM without enzyme supplementation. Diets 3, 5 and 7 contained 5%, 10% and 15% HGM supplemented with 100mg Roxazyme per kilogram weight of feed, respectively. The ingredients were measured out and mixed with a spade on a concrete floor. Turning was vigorously done to ensure good mixing of ingredients and homogeneity.

Experimental animals and procedure

A total of two hundred and twenty (220) day old Anak broiler chicks procured from a commercial hatchery were used for the experiment. Prior to the commencement of the experiment, the birds were fed normal broiler starter chick diets (goat manure and enzyme - free diet) for 7 days (adaptation period). On the 8th day, two hundred and ten (210)

chicks were selected, and randomly placed into seven treatment groups of thirty (30) birds each. Again, each group was randomly assigned to an experimental diet in a completely randomized design. Each group was further sub-divided into three replicates of 10 birds and kept in a compartment measuring 4m x 4m. The chicks were vaccinated against New Castle disease in the first and third weeks and against Gumboro disease in the second and fourth weeks. Prophylactic treatment against coccidiosis with Embazin forte at two weeks of age was also given to the birds. Uniform condition was maintained although the experimental period. Fresh water and corresponding diet were provided *ad libitum* throughout the experimental period. Before the commencement of the experiment, the birds were weighed to obtain their initial body weights. The birds were subjected to standard broiler management procedure as described by FASS (1999). The feeding trial lasted 35 days.

Economics of production

The market costs of the ingredients at the time of the experiment were used to calculate the cost of feed per kilogram in our local currency, that is, naira (₦). One USA dollar is equivalent to one hundred and sixty naira. The cost of feed per 100 kilogram (₦), total cost of feed consumed (₦), cost of feed per kilogram weight gain (₦) and cost savings (%) were calculated.

Statistical analysis

Data obtained were subjected to analysis of variance, and differences in treatment means were separated using Duncan's New Multiple Range Test as outlined by Obi (2002).

Results and Discussion
Chemical composition

Table-1 shows the proximate composition of heat-treated goat manure, and the calculated the composition of the experimental broiler starter diets is shown in Table-2. Heat- treated goat manure (HGM) contained 91.80% dry matter, 21.18% crude protein, 4.95% ether extract, 21.90% crude fiber, 32. 80 ashes and 1817 ME (kcal/kg) (Table-6). The use of a feed ingredient in feeding livestock presupposes that the nutritive value in terms of nutrient content and availability are well known (Alalade *et al*., 2006). Fibre is often used as a negative index for measuring the nutritive value of feed ingredients and in the prediction of its total digestible nutrients and net energy (Van Soest *et al*., 1991). The high crude Fibre content of HGM suggests a low nutritive value of HGM for broilers when included at a high level. However, the dry matter, crude protein, ether extract, ash and ME (kcal/kg) values are slightly higher than the values reported by Abeke *et al*. (2003). The observed variation in the proximate composition is not surprising, as this may have resulted from the chemical composition of the type of pasture consumed by the animals and the processing methods.

The dietary inclusion of HGM at up to 15% in the diet did not alter appreciably the crude protein and ether extract levels of the diets. These levels therefore, met the requirements of the young broiler chicks (NRC, 1994; Aduku, 1993). Increasing HSM inclusion in the diets resulted in a corresponding increase in the crude fibre level of the diets. This is brought about by the high fibre content of the HGM. It was however observed that the increasing fibre content of the diets resulted in a gradual decrease in the metabolizable energy content of the diets. The ash content of the diets increased progressively as the level of HGM increased.

Performance of broiler chicks

Table-3 shows the performance of the young broiler chicks fed the experimental diets. Feed intake, body weight gain, feed conversion ratio, daily protein intake and protein efficiency ratio of the broiler chickens were affected by the treatments. The feed intake of the birds fed 10% and 15% HGM diets without supplementation were significantly ($P < 0.05$) higher than the group on 0% HGM diets. There was no significant variation ($P > 0.05$) among the chicks fed enzyme supplemented diets and the control in their feed consumption.

The increased feed intake of the birds fed 10% and 15% HGM diets without exogenous enzyme may be attributed to the low energy and high crude fibre levels of the diets. Heat-treated goat manure is low in energy and high in crude fibre and as the inclusion level increased, the fibre level of the diets also increased. Since the diets are bulky with low energy levels, the birds apparently increased their intake in an attempt to satisfy their energy requirement due to calorie dilution of diets by the 10% and 15% HGM inclusions. This is so because birds would normally adjust their feed intake to meet their dietary energy requirements. This is in agreement with the reports of Onu (2006), Onu *et al*. (2006), Tufarelli *et al*. (2007) and Teimouri *et al*. (2005), who observed that feed intake of birds' increases as the fibre content of the feed increases.

The comparable intake of enzyme supplemented diets and the control diets may have emanated from the breakdown of the non- starch polysaccharides in the diets by the enzyme, leading to enhanced metabolizable energy value for the enzyme supplemented diets. Oldalle and Hoffman (1996) in an earlier report observed that diets supplemented with enzymes had their metabolizable energy increased by 10%. This finding is also supported by Samarasinghe *et al*. (2000) and Richter *et al*. (1995). They found that feed intake decreased by addition of exogenous enzymes due to the fact that birds fulfill their requirements by taking less amount of feed.

Body weight gain of birds fed 15% HGM diet without exogenous enzyme were significantly ($P < 0.05$) depressed while birds fed 5% enzymatic diet had the highest ($P < 0.05$) body weight gain. The body weight gain of the birds fed the other treatment diets compared favourably ($P > 0.05$) with the control. At the various levels of HGM dietary inclusion, enzyme supplementation of the diets significantly ($P < 0.05$) improved the body weight gains of the birds.

The marked reduction in weight gain at 15% HGM inclusion level without enzyme supplementation despite the higher feed intake of the birds fed this diet indicated that the feed was not adequately translated into increased body weight gain. This is attributed in part to decreased digestibility and utilization of the diet emanating from the high fibre content. Ajaja *et al*. (2003) had observed that high fibre diets decrease nutrient utilization and precipitate metabolic dysfunctions with the attendant weight reduction in monogastric animals and this may have been responsible for the observed weight loss in this study. This observation could be due to the fact that birds mobilized body nutrients for maintenance of metabolism in the place of high dietary fibre and low energy. An (1994) had earlier reported that when birds are starved or when energy levels drop below body requirements, birds tend to mobilize body energy reserves for maintenance, and this may have applied to the observed results in this study. The enhanced weight gain of the birds on enzymatic diets compared to the birds fed HGM diets without enzyme supplementation suggests that exogenous enzyme supplementation could improve growth in chickens. Response to enzymes could be due to hydrolysis of non-starch polysaccharides and consequent elimination of the negative effects of those polysaccharides on chicks. This may have resulted in greater digestion and absorption of nutrients within the small intestine. Similar observations have been reported by Saki *et al*. (2005), Kongbuntad *et al*. (2006), Onu (2006), Zou *et al*. (2006), Ani and Omage (2007) and Zakaria *et al*. (2008). According to Broz *et al*. (1994) and Zobell *et al*. (2000) exogenous enzymes complements the digestive enzymes of poultry by hydrolyzing the NSPs in cereals, agro - by products and vegetable proteins, thereby decreasing gut viscosity and thus improve nutrient absorption. Feed enzymes also have the ability to alter the bacterial population by digesting the bacteria that colonize the tract and increase the quantity of protein amino acid digested in the pre cercal section of the tract (Bedford, 1997; Gunal and Yasar, 2004) enhancing weight gain of the birds as in this study.

Birds fed 15% diet without enzyme supplementation (T) recorded the poorest ($P < 0.05$) feed conversion and protein efficiency ratios. There was marked improvement in feed conversion ratio of birds on enzyme supplemented diets over those fed HGM without enzyme addition at the various levels. The daily protein intake of the birds on diet containing 15% HGM without enzyme addition was significantly higher than those on the other treatment diets. However, this did not differ significantly ($P > 0.05$) from those fed 10% HGM diet with exogenous enzyme. Enzyme supplementation of the diet at different level of inclusion improved the protein efficiency ratio of the birds.

The reduction in feed conversion and protein efficiency ratios of the birds fed 10% and 15% HGM diets without exogenous enzyme have been reported earlier by Abeke *et al*. (2003). The observed reduction in FCR and PER could be attributed to the deleterious effect of high

fibre, which limits the amount of energy and protein available to the birds, and correspondingly contribute to excessive nutrient excretion. However, this limitation was overcome by enzyme supplementation as evident in the superior FCR and PER of the birds fed enzyme treated diets in this experiment. The improved feed conversion ratio achieved with exogenous enzyme supplementation is in agreement with the findings of Jackson *et al*. (2004) and Zou *et al*. (2006) who reported that exogenous enzymes greatly improved the feed conversion ratio of broiler chicks fed enzyme supplemented diets.

Dietary inclusion of heat - treated sheep manure steadily reduced the cost of feed per kilogram as shown on Table-4. There were significant ($P < 0.05$) variations in the cost of feed intake and the cost of feed per kg weight gain of the birds. Enzyme supplementation significantly reduced the cost of feed intake and the cost of feed per kg weight gain over the control. Although 15% HGM inclusion was the least expensive in terms of feed cost per kilogram, feed cost per kilogram weight gain was highest for birds on 15% HSM diets without exogenous enzyme. This is because of the need to eat more by the broilers to gain 1 kg weight. Thus, the high feed intake, poor feed conversion efficiency and utilization and poor growth rate of the chicks that consumed the 15% HGM diet without enzyme supplementation may have contributed greatly to the high cost of production. Nevertheless, enzyme supplementation significantly reduced feed cost per kilogram weight gain and consequently improved cost saving. The observed reduction in feed cost / kg weight gain resulting from enzyme supplementation which enhanced cost saving on the production of the birds may probably be due to reduction in feed intake, improved feed conversion efficiency and utilization that resulted to the weight gains of the broilers. Similar results have been reported by earlier studies by Ajaja *et al*. (2003), Onu *et al*. (2006) and Ani and Omeje (2007).

Conclusions

Results of this study indicated that body weight gain, feed intake, feed conversion ratio and protein efficiency ratio of starter broilers were negatively affected by 15% HGM without exogenous enzyme dietary inclusion level. Enzyme supplementation of HGM broiler starter diets enhanced the performance, reduced the cost of feed intake and cost of feed per weight gain of the of the young broiler chicks. It may be concluded that that enzyme supplementation of higher level of HGM might be effective for better performance of the bird1s.

Table-1: Proximate composition of the heat-treated goat manure

Nutrients	%
Dry matter	91.80
Crude protein	21.18
Ether extract	4.95
Crude fibre	21.90
Total ash	32.80
ME (Kcal/kg)	1817.16
Calcium	1.34
Phosphorus	0.56

Table-2: Ingredient and chemical composition of experimental broiler starter diets (%)

	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Ingredients	0.0%	5.0%	5.0%+E	10.0%	10.0%+E	15.0%	15.0%+E
Maize	50.00	47.00	47.00	44.0	44.00	41.00	41.00
SBM	25.00	23.00	23.00	21.00	21.00	19.00	19.00
HGM	0.00	5.00	5.00	10.00	10.00	15.00	15.00
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
PKC	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix*	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
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Chemical composition							
Crude protein	21.72	21.22	21.22	21.12	21.12	21.04	21.04
Ether extract	4.28	4.34	4.34	4.4	4.4	4.45	4.45
Crude fibre	4.42	5.31	5.31	6.19	6.19	7.08	7.08
Total ash	8.03	9.53	9.53	10.58	10.58	11.68	11.68
ME(Kcal/kg)	2907.9	2839.56	2839.56	2771.22	2771.22	2702.84	2702.84

Table-3: Effect of Roxazyme supplementation of heat-treated goat manure on the performance of the birds.

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	
% **Heat- treated goat manure and roxazyme G inclusion**								
Performance criteria	0%	5%	5%+E	10%	10%+E	15%	15%+E	SEM
Av. Initial body weight (g)	63.16	62.48	63.11	62.94	62.92	62.88	63.09	
A.V Final body weight (g)	680.44^{bc}	665.11^{bc}	761.01^{a}	650.68^{c}	703.42^{b}	591.87^{d}	623.12^{bc}	4.19
Av. Body weight gain (g)	617.28^{bc}	602.63^{bc}	697.90^{a}	587.74^{c}	640.50^{b}	528.98^{d}	623.12^{bc}	4.19
Av. Daily weight gain (g)	17.64^{bc}	17.22^{bc}	19.94^{a}	16.79^{c}	18.30^{b}	15.11^{d}	17.80^{bc}	0.17
Av. total feed intake (g)	1732.03^{d}	1789.32^{ced}	1739.62^{cd}	1869.70^{b}	1789.69^{cd}	1978.90^{a}	1829.22^{bcd}	10.74
Av. Daily feed intake (g)	49.48^{d}	$51.12b^{cd}$	49.70^{cd}	53.4^{2b}	51.13^{cd}	56.54^{a}	52.26^{bc}	0.93

Table-3: Effect of Roxazyme supplementation of heat-treated goat manure on the performance of the birds.

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	
Feed conversion ratio	2.81 ^{b}	2. 97 ^{b}	2. 50 ^{a}	3.18 ^{c}	2.80 ^{b}	3.74 ^{d}	2.94 ^{b}	0.35
Av. Daily protein intake (g)	10.75 ^{ab}	10. 85 ^{ab}	10. 55 ^{a}	11. 29 ^{bc}	10. 80 ^{ab}	11. 90 ^{bc}	11.00 ^{ab}	0.41
Protein efficiency ratio	1.64 ^{b}	1. 59 ^{bc}	1. 84 ^{a}	1. 49 ^{c}	1. 69 ^{b}	1. 27 ^{d}	1. 62 ^{b}	0. 25

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