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IMPACT OF HEAT TREATED SHEEP MANURE-BASED DIETS WITH OR WITHOUT EXOGENOUS ENZYME ON NUTRIENT DIGESTIBILITY AND ECONOMICS OF PRODUCTION OF FINISHER BROILERS

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ABSTRACT
The aim of this study was to determine the impact of heat-treated sheep manure (HSM) diets with or without enzyme on nutrient digestibility and economics of production of finisher broilers. Two hundred and ten 5-week old broiler birds were randomly allotted to 7 dietary treatments in 3 replicates of 10 birds each in a completely randomized design. The dietary treatments were made up of diets 1, 2, 3 and 4 which contained 0%, 5%, 10% and 15% HSM dietary levels respectively without enzymes supplementation. Diets 5, 6, and 7 contained 5%, 10%, and 15% HSM dietary levels supplemented with 100mg Roxazyme enzyme per kg feed respectively. Diets were fed for 35 days. A nutrient digestibility trial was conducted during the fourth week of the study. Results showed no significant (P>0.05) effect of either HSM or enzyme on apparent nutrients digestibility. There were significant differences in the cost daily feed intake and the cost of feed per kg weight gain of the birds. The results of this experiment suggested that broiler finisher could tolerate up to 15% unsupplemented HSM diets without any adverse effect on nutrient digestibility of the birds. The results also showed that costs can be saved by enzyme supplementation of the broiler finisher diets and contributes to the preservation of limited feed resources..

KEY WORDS: broiler finisher, economics, enzyme supplementation, heat-treated sheep manure, nutrients digestibility

INTRODUCTION

In developing countries like Nigeria, the increasing demand for maize and soyabean as human food staples and livestock feed ingredients has pushed their prices to an alarming level. The high cost of these ingredients has adversely affected the production of farm animals in these countries. This situation has resulted to increased interest in the utilization of unconventional feeding stuffs as alternatives for the expensive conventional ones. One example of such unconventional feed ingredients that is relatively high in protein and energy levels and can form a satisfactory feed ingredient when incorporated in poultry diet is sheep manure (Onu, 2007; Abeke *et al*., 2008; Onu and Otuma, 2008). However, the usefulness of sheep manure as feedstuff in non ruminant diets is constrained by its relative high fibre content which causes increased viscosity of the gut content and adversely affect nutrient digestibility (Galassi *et al*., 2004; Len, 2008). According to Kanengori *et al*. (2002) and Partanen *et al*. (2007), as the level of fibre in monogastric diets increases, digestibility of nitrogen and energy decreases. Trait and Wright (1990) reported that fibre decreases availability of nutrients by reducing the period of exposure of the food to digestive enzymes and absorptive surfaces due to the increased rate of passage of the feed induced by its fibre content. Hajati (2010) reported that endogenous enzymes of broilers cannot adequately digest nonstarch polysaccharides and subsequently the ingestion of high levels of soluble NSP leads to increased digesta viscosity and reduced nutrient digestibility and absorption.

The above facts suggests that any technology that will breakdown fibre to small molecules that birds can digest and absorb will certainly improve the utilization of sheep manure by broilers. Research work has suggested that these negative effects of NSPs can be overcome by supplementation of diets with suitable exogenous enzyme preparations (Zanella *et al.*, 1999; Gracia *et al.*, 2003). Feed enzymes have been used commercially for years and recent developments in research have emphasized the value of exogenous enzymes in order to control the variability in the nutritional value of feedstuffs and maximize feed cost reduction. Enzymes are added to feed to facilitate the breakdown of larger molecular structures of the cheaper fibrous feed ingredients into smaller ones by their specific action and making these nutrients more readily available to the digestive system for better absorption. The disruption of the cell matrix of fibrous feedstuffs by exogenous enzymes can lead to easy access of the endogenous proteolytic and cellulolytic enzymes to digest the entrapped protein and carbohydrates (Choct and Kocher, 2000; Sorensen, 1996). This will consequently reduce the cost of broiler production. However, the effects of exogenous enzymes can be variable and it depends on a large number of factors such as the age of the bird and the quality and type of diet (Bedford, 2000; Acamovic, 2001).

In Nigeria to date, no known nutritional study has verified this phenomenon using heat treated sheep manure. To fill this gap in knowledge, this study evaluated the effects of enzyme supplementation of heat-treated sheep manure-based diets on nutrient digestibility and economics of finisher broiler production.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm (Poultry Unit) of the Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria with the approval of the Committee for Animal Experiments of the Institution. The sheep manure used in this experiment was oven- dried at 80^{o}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 sheep manure (HSM) was conducted using standard methods of A.O.A.C. (1995) to determine the percentage crude protein, crude fibre, either extract and total Ash

Experimental Diets.

Seven experimental broiler finisher diets were formulated with heat-treated sheep manure (HSM). Diets 2, 4 and 6 contained 5%, 10% and 15% HSM without enzyme supplementation respectively. Diets 3, 5 and 7 contained 5%, 10% and 15% HSM supplemented with 100mg Roxazyme per kilogram weight of feed respectively. Diet 1 which served as the control contained 0% HSM.

Experimental Animals and Management

Two hundred and ten (210) 5 – week old Anak broiler chicks of both sexes were used for the experiment. The birds were brooded on sheep manure and enzyme free diets for five weeks. The birds were randomly divided into seven treatment groups of 30 birds each. Each treatment was replicated thrice with 10 birds per replicate and placed in a 1.5m x 1.5m deep litter pen of fresh wood shavings. The birds were maintained on the treatment diets for five weeks. Water was supplied *ad libitum* to the birds from 36 to 70 days of age.

Nutrient Digestibility

During week 4 of the experiment, a seven-day excreta collection from three birds per replicate was carried out to determine the apparent nutrient utilization of the birds. During this period the birds were housed individually in metabolism cages and weighed quantity of feed was offered to each bird daily. The birds were allowed to adjust to the cages for three (3) days. The digestibility trial lasted for four (4) days. Polythene sheet spread underneath the cage was used for the faecal collection. Feathers and other particles were hand picked and discarded from the faeces, which were weighed wet. The collection for each day was dried in a Gallenkamp forced drought air oven at 80^{o}c for 48 hours and the weights recorded. The sample for each replicate was allowed to cool in desiccators to prevent further absorption of moisture from the atmosphere. The four day samples were pooled, ground and analyzed for dry matter, crude protein; crude fibre, ether extract and total ash according to the method of AOAC (1995).

Economics of Production

Economic evaluation was also conducted to assess the economic feasibility of using enzymes in high fibre heat treated sheep manure-based broiler finisher feed. The market cost of the ingredients at the time of the experiment were used to calculate the cost of feed per kilogram (₦), cost of feed per 100 kilogram (₦), total cost of feed consumed(₦), cost of feed per kilogram weight gain (₦) and cost savings (%) .

Statistical Analysis

Data obtained were subjected to a one-way analysis of variance according to the methods of Snedecor and Cochran (1978). Values were considered significant at $P \leq 0.05$. In case of significant differences Duncan's New Multiple Range Test as outlined by Obi (2002) was employed to compare differences among treatment means.

RESULTS AND DISCUSSION

Heat-treated sheep manure (HSM) contained 91.80% dry matter, 21.18% crude protein, 4.95% ether extract, 21.90% crude fibre, 32. 80% ash and 1817 ME (kcal/kg) (Table 1). The crude protein and ether extract content of the HSM diets compared favourably with the control (Table 2). The crude fibre levels ranged from 4.35% in diet T_1 (0% HSM) to 7.01 in diets T_6 and T_7 (15% HSM). The crude fibre appreciated with increasing levels of HSM in the diets. Similarly, the ash (7.48-10.72%) also increased with increasing levels of HSM in the diets. The energy levels of the diets ranged between 2696.00 kcal/kg in 15% HSM (T_6 and T_7) diets to 2901.06 kcal/kg in 0% HSM (T_1) diet. The energy levels depreciated with increasing level of HSM in the diets.

Results on apparent nutrient digestibility (Table 2) showed that there was no significant ($P > 0.05$) effect of either HSM or enzyme on apparent digestibility of nutrients. However, it is clear that enzyme supplementation numerically increased nutrient digestibility; but the effects were not strong enough to make scientific significant difference in the birds' ability to digest food nutrients. The result in the present study confirms that digestibility of nutrients increases with age and/or body weight of poultry. The result confirms the findings from previous studies that the ability of birds to digest and utilize diets increases with age, particularly in the case of high fibre diets (Whittemore *et al*., 2003; Esonu, *et al*., 2004). This indicates that the digestive system of the birds at this age are fully matured with functional digestion and absorption capacities and high secretion of pancreatic enzymes, The result agrees with the findings of Tavernmari *et al*. (2008) who reported that enzyme supplementation of sunflower meal had no significant effect on nutrient digestibility of broilers. However, the results are at variance with the findings of Khan *et al*. (2006), who reported that supplementation of broiler diet with exogenous enzyme improved nutrient digestibility of broilers. The discrepancies in the results could be due to the differences in the age of the birds since Khan *et al*. (2006) evaluated effects of enzyme supplementation on young starter (1-42 day old) broilers. According to Maiorka *et al*. (2002) enzyme complex usually exert a significant effect on broilers only during the starter phase possibly due to the immature digestive system of broilers at this age. It is known that after hatching, the broiler digestive system is anatomically complete, but its functional digestion and absorption capacities are still immature, with low secretion of pancreatic enzymes, which will only increase as feed intake and bird age increase the numerical improvement in nutrient digestibility achieved with enzyme

supplementation could be due to change in microbial flora and better gut health. According to Viveros *et al.* (1993) the improvement in digestibility by using an enzyme might get a little better nutrients absorption, but the bigger thing was the change in microbial flora and better gut health. The authors reported that enzyme can break down some NSP in feedstuffs and help promote growth of 'useful' bacteria. Without the enzyme, indigestible fibre promotes the growth of 'harmful' bacteria but with the enzyme, the fibre is broken down and promotes the growth of 'useful' bacteria. With the addition of the enzyme the indigestible starch works like a prebiotic (starch can be fermented by microbes in the gut of the bird, as pre-biotic may selectively enhance beneficial bacteria population in the gut like *bifido* bacteria and *lacto bacilli*). According to Bedford (2001), much of the performance response is thought to relate to the changes in the intestinal microflora, rather than to a direct effect of the enzyme per se on diet digestibility.

There were significant differences ($P < 0.05$) in the cost of daily feed intake and cost of feed per kilogram weight gain among the birds fed the experimental diets. There was no significant difference in the cost of total feed intake. The economic analysis of this study favours the inclusion of HSM and enzyme supplementation in broiler finisher diets. HSM does not attract any cost unlike maize and soyabean. Therefore, replacing the relatively expensive feedstuffs (maize and soyabean) with HSM resulted not only in reduction of cost of feed per kilogram but also the cost of feed per kilogram weight gain. However, cost saving in percentage was higher for the enzyme supplemented diets, indicating that it more feasible and economical to obtain maximum profitability from broiler production by using exogenous enzymes. This agrees with the reports of Partridge and Wyatt (1995) and Onu (2006) that feed cost reduces with the inclusion of non-conventional feedstuff especially when supplemented with exogenous enzymes in monogastric animal diets. It is obvious from the results of the above study that neither supplemented nor unsupplemented HSM diets exerted significant effect on nutrient digestibility of finisher broilers. The economic analyses reveal a downward reduction in cost of feed per kg weight gain with increasing level of HSM inclusion. The results also showed that costs can be saved by exogenous enzyme supplementation of the broiler finisher diets and contributes to the preservation of limited feed resources.

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Table 1: Ingredient and chemical composition of experimental broiler finisher diets (%)

	T_1	T_2	T_3	T_4	T_5	T_6	T_7
	% Heat- treated Sheep manure and Roxazyme inclusion						
Ingredients	0%	5%	5%+E	10%	10%+E	15%	15%+E
Maize	52.00	49.00	49.00	46.00	46.00	43.00	43.00
Soyabean meal	21.00	19.00	19.00	17.00	17.00	15.00	15.00
Wheat Offal	12.00	12.00	12.00	12.00	12.00	12.00	12.00
HSM	00.00	5.00	5.00	10.00	10.00	15.00	15.00
Fish Meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Palm kernel cake	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	19.87	19.87	19.87	19.69	19.69	19.60	19.60
Crude fibre	4.35	5.24	5.24	6.12	6.12	7.01	7.01
Ether extract	4.34	4.40	4.40	4.46	4.46	4.51	4.51
Total ash	7.48	8.57	8.57	9.63	9.63	10.72	10.72
ME (Kcal/kg)	2901.06	2832.72	2832.72	2764.38	2764.38	2696. 00	2696. 00

*To provide the following per kg of feed: Vitamins A (10, 000,000iu; B_1 (075g), E(35000iu); K(1900mg) D(2,000,000); Biotin, (0.05g); Folic acid (1g); Chlorine chloride (250g); Copper (8g); Manganese (64g); Iron (32g) Zn (40g); Iodine 0.6g, Flavomycin 100g, Spiramycin 5g, 3-nitre 50g, DL-methionine (50g) Selenium (0.6g); Lysine (120g); BHT (5,000mg) and spiramycin(5,000mg). HSM = Heat-treated Sheep Manure and E = Enzyme.

Table 2: Apparent nutrient digestibility of finisher broilers fed the experimental diets

Ingredients	T_1 0%	T_2 5%	T_3 5%+E	T_4 10%	T_5 10%+E	T_6 15%	T_7 15%+E	SEM
Dry matter	78.51	79.18	79.87	79.11	79.85	77.40	43.00	0.70
Crude protein	76.35	76.72	78.01	75.93	77.42	74.57	15.00	1.06
Ether extract	82.71	82.72	83.91	81.36	83.03	79.93	12.00	0.81
Crude fibre	60.12	60.33	62.64	59.48	61.21	59.14	15.00	0.91
Total ash	70.57	71.53	72.47	69.25	68.62	68.25	5.00	0.86

Means on same row did not differ significantly (P >0.05)

Table 3: Economics of production of finisher broilers fed the Experimental diets

Parameters	T_1 0%	T_2 5.0%	T_3 5.0%+E	T_4 10.0%	T_5 10.0%+E	T_6 15.0%	T_7 15.0%+E	SEM
Cost feed / kg (₦)	49.87	45.97	45.84	43.71	43.76	41.63	41.68	
Cost of total feed intake (₦)	185.34	174.69	164.80	168.74	163.34	164.66	161.93	1.91
Cost of daily feed intake (₦)	5.30^{a}	4.99^{ab}	4.71^{b}	4.92^{b}	4.67^{b}	4.70^{b}	4.62^{b}	0.32
Cost of feed intake/kg gain (₦)	127.72^{a}	120.99^{ab}	106.30^{d}	119.19^{b}	108.60^{cd}	117.72^{bc}	109.53^{cd}	1.67
Cost savings (%)	0.00	5.27	16.77	6.68	14.97	7.83	14.24	

^{Abcd}- means bearing identical superscripts with rows are similar (P> 0.05) while means bearing unidentical superscripts differ significantly (P<0.05).