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COMPARISON OF THE SUPPLEMENTAL EFFECTS OF ROXAZYME-G ENZYME IN PALM KERNEL MEAL AND BREWERS DRIED GRAIN BASED DIETS FED TO MALE TURKEY POULTS

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ABSTRACT

The influence of exogenous enzymes on the utilization of agro-industrial by-products in poultry ration was assessed. Palm kernel cake (PKC) meal and Brewer's dried grain (BDG) based diets were supplemented with Roxazyme-G enzyme and subsequently fed to male turkey poults for 8 weeks. Diets 1 and 2 contained PKC, which supplied 2.4% fibre while BDG supplied 2.4% fibre in diets 3 and 4. Diets 2 and 4 were supplemented with 15g of Roxazyme-G enzyme, while Diets 1 and 3 were not, thus acting respectively as controls for Diets 2 and 4. Roxazyme-G significantly ($P < 0.05$) influenced the mean daily weight gain and feed-to-gain ratio but not mean daily feed intake. The mean daily weight gain for birds fed diet 2 was numerically higher (40.00g) than those birds fed diet 1 (37.20g), while that of birds fed diet 4 was significantly ($P < 0.05$) depressed (37.63g). The feed-to-gain ratio for birds on diet 2 (1.88) was better than that of birds fed diet 1 (1.97) while those on diet 3 (1.72) were better than those fed diet 4 (1.89). The edible parts expressed as percent live-weight and cut parts were not influenced by treatment except the drumstick. Enzyme supplementation also resulted in a decrease in the Erythrocyte Sedimentation Rate (ESR) and the percent Packed Cell Volume (PCV) of the poults. Congestion of central veins and degeneration of the hepatocytes were also noted in poults fed Diet 2, 3 and 4. There were no significant differences ($P > 0.05$) in the percentage of calcium and phosphorus elements in the bones of the experimental birds. Data from the study also showed that the poults fed diet 1 significantly ($P < 0.05$) developed the shortest bone length (16.08cm). Economic analysis revealed that cost/kg feed (N) was cheapest in diet 1 followed by diet 3 which gave the best mean daily weight gain (44.67g) and feed-to-gain ratio (1.72). Poults fed diet 3 also showed a significantly ($P < 0.05$) higher gross margin than those in the other treatments. Since farmers always aim at maximizing profit at reduced cost of production Diet 3 could be the best option for raising male turkey poults, followed by Diet 2. In order words, supplementing these diets with Roxazyme-G enzyme may not convey any tangible economic benefits to a producer for now. More research work may thus be required.

INTRODUCTION

Dietary ingredients of plant origin contain a proportion of material, usually regarded as fibres, which the simple stomached animal is unable to digest (Van Soest and Robertson, 1977). And, according to Oluyemi and Roberts (1979), digestion is essentially the enzymic breakdown of the feed ingredients into their basic components. Unfortunately poultry do not produce enzymes like cellulase, hemicellulase and betagluconase, which are required for digestion of cell wall of plant material. In Nigeria, about 85 - 90 percent of poultry feed consists of plant materials, which contain large amount of dietary fibre (Ojewola, 1997). Enhancement of the feeding value of agro

and industrial by-products by the supplementation of poultry diets with enzyme becomes a necessity. This is especially helpful in a country like Nigeria, which produces large quantities of high fibre feedstuffs.

The contemporary challenges in broiler and animal production centre on enhancing productivity at the least cost while ensuring environmental sustainability. Also, the optimization of cheap unconventional ingredients as substitute for costly conventional ingredients and reduction of pollution from animal excreta are of concern to nutritionist (Onifade *et al.*, 1999). Apparently, the use of exogenous enzymes seems inevitable to accomplish optimal performance on dietary formulations based on unconventionally high-fibre diets. This is because; it can both complement the chicken's digestive enzymes and also increase the digestibility of fibre components of the diet (Onifade and Babatunde, 1998).

Various enzymes are now produced commercially. These include such enzymes as, Xylanase (Endo-xylanase), Barlicase (B-glucanase), Natuphos (Phytase), Veronyme (α-amylase) etc. These feed enzymes when added to the feed ingredients form the building blocks for a new dimension in feed additive performance. For instance, Bedford *et al.* (1991) observed that the soluble fibre fractions of barley (mixed-linked-B-glucans) and wheat (Pentosans) have been shown to be responsible for the reduced nutrient digestibility in the small intestine. But when supplemented with enzyme, it resulted in significant improvement in bird performance and the energy value of the diet (Dierick, 1989). Bedford and Classen (1992) also observed that the performance of broiler chickens fed enzyme supplemented feeds correlates to a high degree with reduced digesta in the small intestine. Supplementation of barley-based feeds with B-glucanases has also resulted in improved performance (Thomke *et al.*, 1980), nutrient digestibility (Inborr *et al.*, 1991) and reduction of excretory output (Wiseman, 1992). Furthermore, Simons *et al.*, (1990) demonstrated that a crude microbial phytase preparation improved the coefficient of phosphorous availability in young poultry from 0.498 to 0.645. This was accompanied by a reduction in phosphorus excretion from 2.7 to 1.9g/kg dry matter feed intake.

Nutrients shielded by plant cell wall fibres were also liberated when the insoluble Non-Starch Polysaccharide (NSP) were hydrolysed in the presence of enzymes, thus, improving the efficiency of digestion (Bedford and Classen, 1992). When Malted Sorghum Sprout (MSP) was supplemented with Roxazyme, Bedford *et al.*, (1991) observed that the soluble fibre fractions of barley (mixed-linked-B-glucans) were and wheat (Pentosans) were responsible for the reduced nutrient digestibility in the small intestine, an exogenous enzyme that contains cellulase, glucanase, hemicellulase and protease. The growth rate, feed intake, protein efficiency ratio, net protein retention and apparent protein digestibilities of rats were significantly increased (Oduguwa *et al.*, 2001).

In an attempt to improve production and performance in the poultry industry, a lot of feed additives and feed materials whose toxicological potentials are not fully known have been introduced. Among the major organs affected by these feed materials are the liver, kidney and gonads. Evaluation of changes in blood parameters and liver histology has been used to produce useful results of tissue damage in avian species (Fransson *et al.*, 1985).

It is on this basis that the potentials of Roxazyme-G enzyme as a possible performance enhancer in dietary fibre utilization is being evaluated; such information is necessary to stimulate awareness and adoption of alternative strategy for performance enhancement of cheap unconventional agro-industrial by-products in broiler production.

MATERIALS AND METHODS

Diet Formulation and Enzyme Supplementation

Roxazyme-G, an enzyme complex, was purchased from a company in Lagos, Nigeria. Four experimental diets, designated Diets 1, 2, 3 and 4, each containing between 4.83 and 4.94% crude fibre were formulated. Diets 1 and 2 had palm kernel meal as the main fibre source, supplying 2.4% fibre while Diets 3 and 4 had brewer's dried grain as the main fibre source, also supplying

2.4% fibre. Diets 2 and 4 were supplemented with 15g of Roxazyme-G-enzyme, while Diets 1 and 3 were not, thus acting respectively as controls for Diets 2 and 4. All the diets were both isonitrogenous and isocaloric.

Management of Male Turkey Poults and Data Collection

Metal hovers, kerosene lamps and 200 watts electrical bulbs were used in brooding the 60 day-old poults procured from a commercial hatchery in Owerri, Imo state, Nigeria. They were brooded in a deep litter house. The poults were fed conventional commercial broiler starter mash from day 1 to 7 weeks before the diet was changed. At the end of the 7th week, the poults were randomly allotted to the 4 experimental treatments having 15 birds each. The treatments were further sub-divided into 3 replicates of 5 birds each in a completely randomized design (CRD). The birds were fed and watered ad-libitum for 8 weeks. Routine health management practices were carried out. Initially live weights of the birds were taken after transferring the poults from the brooder house to the experimental pens. Thereafter, the mean live weight and feed intake were taken on weekly basis, while feed conversion ratio was calculated.

Organ Proportions and Carcass Composition

At the end of the feeding trial, one turkey having weight closest to the mean weight was randomly selected from each of the replicates and their carcasses evaluated according to the procedure of Scott *et al.* (1969). The gizzard, proventriculus, kidney, liver and heart weights of each bird were taken and expressed as percentage of the body weight. The percent composition of the feed and carcass were also determined using AOAC (1990) methods, while gross energy was determined with a Gallenkamp oxygen ballistic bomb calorimeter.

Packed Cell Volume (PCV), Erythrocyte Sedimentation Rate (ESR), and Bone Calcium and Phosphorus Determination

The PCV was determined using the microhaematocrit method. Erythrocyte sedimentation was determined with the sedimentation tube held vertically over a period of 60 mins. Bone calcium and phosphorus were determined after ashing and dilution with conc. HCl by using atomic absorption spectrometer and spectrophotometer, respectively. Sections of the liver were fixed with 10% formal saline, stained with H and E and slides prepared for studies under the microscope.

Economic Analysis

The costs of dietary ingredients (N/kg) were recorded. Feed intake per bird for the 8 week period was used to multiply the cost / kilogramme of feed to obtain the cost of feed consumed by a bird. The cost / kilogramme weight gain was calculated according to the procedure of Sonaiya *et al.*, (1986) and Ukachukwu and Anugwa (1995) which involves taking the product cost /kg feed and feed-to-gain ratio of birds consuming such diets.

(i) Cost / kg weight gain X mean total weight gain = cost of production.

(ii) Price ₦ / kg Meat X mean total weight gain = Revenue.

(iii) Gross margin (₦) = (Revenue - Cost of Production).

Statistical Analysis

Results were statistically evaluated by analysis of variance (Steel and Torrie, 1980); the Duncan multiple range test (Gomez and Gomez, 1983), was used to detect differences among means. The criterion for significance was a probability of 0.05.

RESULTS AND DISCUSSION

The performance, carcass characteristics and economic analysis of the local male turkey poults fed control and test diets are presented in Tables 2, 3, and 4. Although, no significant difference ($P > 0.05$) was observed in the voluntary feed intake among the treatments, poults fed diet 2 showed increased feed intake over that fed diet 4. This corroborates the results reported by Ogbuewu *et al.*, (2002) and Ogbuewu *et al.*, (2008) that enzyme supplementation enhanced feed intake by birds fed fibrous feeds. This however, was not in agreement

diets 3 and 4 where the control (Diet 3) showed higher feed consumption ($P > 0.05$). Since, the diets were isocaloric as well as isonitrogenous, palatability of the feed based on fibre source could be implicated.

Diet 2 resulted in increased mean daily body weight gain of poults though there was no significant ($P > 0.05$) difference between the diet, its control and Diet 4. This is in agreement with Agbede *et al.*, (2002) who reported improved average weight gain by chicks as a result of Roxazyme-G-supplementation. Generally, diet 2 showed better feed-to-gain ratio when compared with diet 1; thus, indicating that supplementation with enzyme resulted in efficient utilization of feed. It is possible that more energy was released from the diets due to the breakdown of NSP in the PKC by the enzyme which may be responsible for the observed enhanced feed: gain ratio.

Chesson (1993) noted that enzymes increased effectiveness of nutrient utilization and caused improved efficiency. Eruvbetine *et al.*, (2002) also obtained improved FCR values in hens fed corn-soya enzyme supplemented diets. This however, was not the case with diets 3 and 4; where diet 3 had a lower feed-to-gain ratio when compared with poults fed diet 4. The fibre source could be responsible for this difference in response to enzyme supplementation.

The edible parts expressed as percent live weight were not significantly ($P > 0.05$) different among treatment means (Table 3). The values recorded tend to agree with those obtained by Ojewola et al., (2002) which followed no particular trend. Higher value (71.44%) was observed in diet 2. This observation is in line with the suggestion of Hayse and Marison (1973) that plump appearance in birds is associated with a higher percentage of edible meat. The situation differs with diet 4 which recorded the lowest value. The extent of benefit obtained with enzyme inclusion as observed by Eruvbetine *et al.*, (2002) would depend on the nutrient composition of the ingredient used, thus complimenting the earlier report of Gidenne and Perez (1993) that the availability of starch for digestion by non-ruminants depends on factors such as botanical origin and technological treatment. It could be possible therefore that the PKC was better digested than BDG. It is only the drumstick that showed significant ($P < 0.05$) difference among the cut-parts and for the organ proportions. The gizzard and the heart were significantly ($P < 0.05$) different among treatment means. Previous report (Aletor *et al.*, 1989) showed that apart from changes in nitrogen balance and bio-chemical parameter, nutrition or dietary manipulation exert several influences on the development of carcass traits, organs and certain muscles in poultry. Perhaps, the inclusion of Roxazyme-G enzyme had a complimentary effect in increasing nutrient utilization thereby resulting in improved proportions of some parts and organs.

The effects of Roxazyme-G enzyme supplemented diets on some bone and blood parameters of Male Turkey poults are summarized in Table 5. The ESR decreased in poults fed diets supplemented with Roxazyme-G-enzyme. The ESR values of 3.00, 2.30, 3.00 and 2.00 mm/hr for T_1, T_2, T_3 and T_4 respectively, were lower than 3.86mm/hr reported for cocks (Sturkie, 1976). The ESR and PCV of the controls (D_1 and D_3) were significantly higher ($P < 0.05$) than those of the treated birds (Diets 2 & 4). The PCV values of treatments 1, 2, 3 and 4, that is 33.00, 30.00, 32.50, and 31% respectively were lower than 38.5% reported for turkey at 20 weeks of age (Sturkie, 1976) but were higher than that reported for broilers (Adejinmi *et al.*, 2002). Studies on the liver of the experimental birds reveal some variations. There tend to be an increase in the severity of liver damage from T_2, T_3 and T_4. This is manifested in the increase in the congestion of central veins and degeneration of the hepatocytes. The control (T_1) showed normal liver sections with open central veins and no congestion was observed. In T_2, there was mild congestion of the central veins, and the hepatocytes were intact. T_3 showed swollen liver samples and spaces in the liver parenchyma between the hepatocytes. The central veins were dilated with mild congestion. There was degeneration and slight necrosis of hepatocytes especially in the periportal areas where the nucleus of most of the hepatocytes were observed to be pyknotic. In the case of the T_4 group, the central veins were heavily congested and filled with red blood cells. There was also massive degeneration of hepatocytes especially in the periportal area. The changes in the blood

parameters as well as the histological changes observed in the liver could be due to the effects of the inclusion of Roxazyme-G enzyme.

The concentrations of calcium in the thighbones of the turkey are 14.56, 14.34, 14.42 and 14.57% respectively for poults fed D_1, D_2, D_3, and D_4. The respective phosphorus percent (%) of the birds are 8.78, 9.53, 9.50 and 10.05 (Table 5). There were no significant differences ($P > 0.05$) in the percentage of the calcium and phosphorus elements in the bones of the experimental birds. The fact that the liver and the blood parameters in the present study showed some negative responses does not mean that Roxazyme-G enzyme is lethal, rather the proper inclusion levels need to be re-examined or ascertained. The results showed that the shortest bone length (16.08cm) was observed with the poults fed diet 1 while poults fed diets 2, 3 and 4 were not significantly ($P > 0.05$) influenced. The high bone length observed in poults fed diet 2 and 4 suggests increase in nutrient utilization brought about by the complementary action of Roxazyme-G enzyme with digestive enzymes of the poultry (Mc Nab *et al.*, 1992) which could have led to protein accretion (Baker *et al.*, 1993). It is also possible that there was a reduction in phosphorous and calcium excretion (Simmons *et al.*, 1990;Wiseman, 1992) while 18.37cm observed in poults fed diet 3 could be due to some inherent factors in some fibres that advance growth. Generally, altering an animal's nutrition means altering their growth pattern (Mc Donald *et al.*, 1995) which includes decrease or increase of body mass, skeletal development and also nitrogen metabolism.

Economic data (Table 4) reveals that cost/kg feed (₦) was cheapest in diet 1 followed by diet 3 which gave the best weight gain (44.67g) and feed-to-gain ratio (1.72). Poults fed diet 3 again showed a significantly ($P<0.05$) higher gross margin than poults fed diets 1,2 and 4. Farmers always aim at maximizing profit at reduced cost of production. Diet3 could be the best option for raising male local turkey poults as revealed by the data in this study.

Table 1: Percentage Composition of the Roxazyme-G supplemental diets fed to Male Local poults (7 - 15 weeks of age).

INGREDIENT	DIET 1	DIET 2	DIET 3	DIET 4
Yellow maize	32.20	32.19	37.20	37.20
Fish meal	6.00	6.00	6.00	6.00
Blood meal	6.00	6.00	7.00	7.00
Full fat soyabean meal	30.20	30.20	30.20	30.20
Palm kernel meal	20.00	20.00	-	-
Brewer's dried grain	-	-	12.00	12.00
Washed sand	-	-	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Oyster shell	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0
Calculated Analysis				
Crude protein (%)	27.90	27.90	27.76	27.76
Crude fibre (%)	4.83	4.83	4.94	4.94
ME (kcal/kg)	2780.55	2780.55	2776.85	2776.85
Determined Analysis (%DM)				
Crude protein (%)	27.28	26.75	26.84	27.12
Ether extract (%)	4.21	3.59	4.28	4.57
Crude fibre (%)	8.25	7.94	8.17	7.82
Ash (%)	19.21	17.06	16.89	15.17

Vitamin Mineral premix[1] provided (per 2.5kg of a tonne of broiler feed): Vit. A, 10,000,000 I.U; Vit. D_3 2,000,000 I.U; Vit. E, 2,000 I.U; Vit. K, 2,250mg, Thiamine B_1, 1,750mg; Riboflavin, B_2, 5000mg; Pyridoxine B_6, 2750mg; Niacin, 27,000mg; Vit. B_{12}, 15mg; Pantothenic acid, 7,500mg; Folic acid,

Table2: Effects of Roxazyme-G-enzyme supplemented diets on the growth performance of male Turkey poults (7 - 15 wks)

Parameter	DIET 1	DIET 2	DIET 3	DIET 4	SEM
Mean daily feed intake (g)	73.26	75.84	76.66	71.93	2.89[ns]
Mean total feed intake (kg)	4.10	4.25	4.29	4.03	1.62[ns]
Mean initial body weight (g)	746.67	780.00	786.67	803.33	26.55[ns]
Mean final body weight (g)	2830.00[c]	3070.00[b]	3353.33[a]	2910.00[bc]	79.01
Mean total weight gain (g)	2083.33[b]	2256.67[b]	2500.00[a]	2106.67[b]	76.55
Mean daily body weight gain (g)	37.20[b]	40.00[b]	44.67[a]	37.62[b]	13.94

A,b,c. values with different superscript on same row are significantly different ($P<0.05$):

Table 3: Effects of Roxazyme-G-enzyme supplemental diets on the carcass and organ proportions of male Turkey poults (7 - 15wks).

Parameters	DIET 1	DIET 2	DIET 3	DIET 4	SEM
Live weight (g)	2866.70	3000.00	3366.70	2983.30	229.0[ns]
Defeathered weight (g)	2550.00	2600.00	2933.3	2566.70	242.16[ns]
	(88.94%)	(86.649%)	(87.15%)	(85.55%)	4.60[ns]
Dressed yield (g)	1916.70	2116.70	2166.70	1850.00	151.07[ns]
Dressed yield (expressed as % live weight)	66.85	71.44	71.44	61.53	3.57[ns]
Cut- parts					
Back (g)	533.30	475.00	573.33	516.67	60.62[ns]
	(27.81%)[a]	(22.40%)[b]	(26.50%)[ab]	(28.13%)[a]	(1.73)
Chest Cavity (g)	533.30	525.00	596.67	468.33	74.01[ns]
	(27.81%)	(24.71%)	(27.56%)	(24.79%)	(2.5)[ns]
Wings (g)	266.67	283.33	363.33	300.00	35.22[ns]
	(13.95%)[ab]	(13.34%)[b]	(16.76%)[a]	(15.97%)[ab]	(1.10)
Thighs (g)	233.33	250.00	290.00	250.00	41.18[ns]
	(12.15%)	(11.79%)	(13.39%)	(13.15%)	(1.2)[ns]
Drumstick (g)	266.67[b]	283.33[b]	350.00[a]	233.33[b]	18.41
	(14.00%)	(13.06%)	(16.06%)	(13.06%)	(0.80)
Organ Proportions					
Gizzard(g)	90.13	93.40	90.80	74.93	9.61[ns]
	(13.90%)[ab]	(13.34%)[ab]	(16.21%)[a]	(12.89%)[b]	(1.05)
Liver(g)	48.23	69.20	53.83	47.73	9.75[ns]
	(4.78%)	(4.41%)	(4.20%)	(4.43%)	(0.83)[ns]
Intestine(g)	112.23	126.03	140.60	133.30	18.67[ns]
	(5.86%)	(5.93%)	(6.52%)	(7.16%)	(0.61)[ns]
Heart(g)	11.47[b]	12.53[b]	13.17[b]	16.47[a]	0.90
	(0.60%)[ab]	(0.43%)[b]	(0.61%)[ab]	(0.859%)[a]	(0.11)[ns]
Spleen(g)	2.83	8.07	4.00	2.73	1.97[ns]
	(0.15)	(0.38)	(0.18)	(0.14)	(0.11)[ns]

. values with different superscript on same row are significantly different ($P<0.05$):

Table 4: Effects of Roxazyme-G enzyme supplemental diets on the economy of production of Male Turkey Poults (7 - 15 wks)

Parameter	DIET 1	DIET 2	DIET 3	DIET 4	SEM
Cost/kg feed (N)	45.43[d]	47.08[b]	46.33[c]	47.98[a]	0.0
Cost of total feed consumed (N)					
Cost/kg weight gain (N)	186.40	199.97	197.90	193.28	7.06[ns]
Cost of production (N)	89.50[ab]	88.51[ab]	79.69[b]	90.68[a]	3.52[*]
Price/kg meat (N)	186.06	205.95	198.86	190.81	10.04[ns]
Revenue (N)	450.00	450.00	450.00	450.00	0.0[ns]

A,b,c. values with different superscript on same row are significantly different (P<0.05); $ = N130

Table 5: Effects of Roxazyme-G enzyme supplemental diets on some bone and blood parameters of Male Turkey poults (7 - 15 wks)

Parameter	DIET 1	DIET2	DIET 3	DIET 4	SEM.
Bone length (cm)	16.08[c]	17.80[b]	18.37[a]	17.37[b]	0.00[*]
Bone phosphorous concentration (ppm)	8.78	9.53	9.50	10.05	0.00[*]
Bone calcium concentration (ppm)	14.56	14.34	14.42	15.57	0.00
ESR (mm/hr)	3.00[a]	2.30[ab]	3.00[a]	2.00[b]	0.00

A,b,c. values with different superscript on same row are significantly different (P<0.05);

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