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The effect of supplementation of enzyme on performance and some blood chemistry parameters in broiler finisher chickens fed ginger by-product meal (*Zingiber officinale*)

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Abstract

An experiment was conducted to determine the performance of broiler chickens fed ginger by- product meal (GBM) supplemented with a multi enzyme preparation (maxigrain©). Birds fed 0% GBM diet performed significantly ($p<0.05$) better than those fed 15 and 30% GBM diets. Birds fed non-enzyme treated diets also performed significantly ($p<0.05$%) better than those fed enzyme treated diets. Enzyme also had no significant effect ($p>0.05$) on the haematological and most serum chemistry profiles of the birds except Alkaline Phosphatase (ALP) which significantly ($p<0.05$) increased with the inclusion of enzyme. Feed cost/kg decreased with increase in GBM in all the dietary treatments, but feed cost/kg gain increased with increase in GBM in the dietary treatments. There was a significant ($p<0.05$) interaction between GBM and enzyme for final weight, weight gain and feed to gain ratio. Birds fed 0% GBM diet performed significantly ($p<0.05$) better than those fed 15 and 30% GBM diets. The use of GBM at 15 and 30% did not improve performance of the birds hence lower levels of GBM and other processing methods could be tested with a view of improving its utilization.

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Introduction

The importance of animal protein in the human diet has necessitated the need to seek for cheaper sources of feed ingredients in developing countries including Nigeria, in order to provide meat at an affordable price. Dafwang *et al.* (2001) reported that non conventional feedstuffs is the best alternative in our environment to produce cheaper feed and ultimately lower the cost of meat and other animal products.

A major challenge in the utilisation of some of these alternative feed ingredients by monogastrics has been their high fibre content which limits their utilization as these animals poorly digest cellulose, hemicellulose and lignin which are the major components of agro-industrial by-products (Madubuike and Obidimma, 2009).

Ginger (*Zingiber officinale*) is a perennial herb whose is used widely as a spice, for pickles, candies, preservatives and many medicinal purposes. The plant belongs to the family *Zingibeaceae*; which are aromatic herbs with fleshy, tuberous or non-tuberous rhizomes and, often have tuber bearing roots (Ke *et al.*, 2000). Nigeria according to FAO (2005) is the third largest exporter of ginger in the world with an annual production of 0.1 million metric tonnes.

The rhizome contains a spectra of biologically active compounds such as curcumin, 6-gingerol i.e., [5-hydroxy-1-4-hydroxy-3-methoxy phenyl), 6-shogoals, zingiberene, bisaboline and several other types of lipids that confers on ginger the characteristic medicinal properties of being pungent and a stimulant (Bliddal *et al.*, 2000). Its low anti-nutrient content makes it suitable for both animal and human herbal medicine (Adanlawo and Fadairo, 2007).

The major components of ginger are zingiberen and zingerol that can stimulate the digestive system by controlling the digestive pH and the activity of digestive enzyme and the microbial activity. Ginger has also been known to have antioxidant activity due to the presence of gingerol-related compounds and diarylheptanoids [Kikuzaki and Nakatani, 1993]. Ginger as a natural feed additive may be of immense benefit and value in poultry nutrition especially for broilers due to their antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immunomodulatory properties (Onu, 2010). Ginger is one of the natural plants which can be used as phytobiotic to improve broiler's performance.

Ginger By-product Meal (GBM) is an agro-industrial by-product with a have high energy content (12.98MJ/kg) comparable to that of maize and solvent extracted GBM up to 10% in broiler diets has been reported to produce comparable results to maize (Onimisi, 2004). Dooley *et al.* (2009) also showed that live weight gain and feed intake of broilers were not affected ($P>0.05$) when fed diets supplemented with 0.25% ginger, garlic or turmeric. However, Ademola *et al.* (2009) reported an impaired growth when broiler chickens were fed 0.25-0.50Kg/100Kg diet of dried ginger. Saeid *et al.* (2010) observed no significant difference in total protein, albumin and cholesterol levels but serum cholesterol was significantly reduced in chickens administered aqueous extract of ginger at concentration of 0.4 and 0.6%.

Multienzymes could improve feed utilization as well as overcome the antinutritional factors of feedstuffs and improve gut health and immune response (Attia *et al.*, 2008). There is however a paucity of information on possible improvement in the utilization of GBM with enzyme supplementation and its effect on performance of broiler chickens. The study aimed at evaluating the potential of improved utilisation of GBM using enzymes and its effect on haematological and serum chemistry profile of broiler birds.

Materials and method

The feeding trial was conducted at the Poultry Unit of the Department of Animal Science, Ahmadu Bello University, Samaru Zaria located in Northern Guinea Zone on latitude 11° 16' N and longitude 7°64' E at an altitude of 674 m above sea level. A total of 252 broiler chickens aged 34 days were randomly allocated to six treatments in a completely randomized design (3 x 2 factorial) for a period of four weeks. Six experimental diets were formulated, GBM included at three levels (0, 15 and 30%) and the enzyme included at two levels (0 Kg/MT and 0.10 Kg/MT) for each level of GBM. GBM is the by-product of juice extraction from the ginger rhizome.

The broilers were weighed at the beginning of the experiment and weekly thereafter. Feed consumption and weight gain were calculated while mortality was recorded when it occurred. The proximate composition of GBM was carried out according to the methods described by (AOAC 1990).

Blood collection and analysis

Two mls of blood was collected from the wing vein of two fasted birds per replicate at the 8th week after which 0.5 ml was dispensed into clean bottles containing ethylenediamine tetraacetic acid (EDTA) and the remaining 1.5mls dispensed into another set of clean bottles and allowed to clot. The uncoagulated blood was used to determine packed cell volume (PCV), haemoglobin (Hb) concentration and total protein (TP). Haemoglobin concentration and PCV were determined using cyanmethaemoglobin and Wintrobe microhaematocrit methods respectively.

The serum was analyzed for aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), cholesterol and triglyceride using RANDOX analytical kits.

Statistical analysis

All data obtained from the trial were subjected to analysis of variance using the SAS (2002) general linear model. The model used was:

$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + E_{ijk}$

Y_{ijk} = observation K in level i of factor A and level j of factor B

μ - overall means

A_i = effect of level i of factor A (level of GBM)

B_j = effect of level j of factor B (level of enzyme)

$(AB)_{ij}$ - effect of the interaction of level i of factor A with level j of factor B

E_{ijk} – random error with mean 0 and variance δ^2

In order to compensate for variance heterogeneity, measured values for cholesterol, triglyceride, AST and ALP were logarithm transformed and those of ALT, PCV, Hb, Tp and mortality were log (10+x) transformed prior to data analysis; where 'x' is the value of the parameter to be analyzed. The Tukey's studentized range test was used to separate means where there was significance.

Results and discussion

The proximate composition of GBM (Table 1) indicates that the crude protein content was low (3.75%) but higher than the value (1.99%) reported by Onimisi (2004). The high nitrogen free extract (81.45%) is an indication that it can be used as a source of energy and agrees with the value of 80.25% reported by Onimisi (2004). The composition of the experimental diets is presented on Table 2, the diets were all isonitrogenous.

Table 1. Proximate analysis of GBM.

Parameters	Composition (%)
Crude protein	3.75
Crude fibre	9.09
Ether extract	1.86
Ash	3.85
NFE	81.45

NFE – Nitrogen Free Extract

Table 2. Composition of Broiler Finisher Diet.

GBM Level (%)	0		15		30	
Enzyme Level (%)						
Ingredients	0	0.01	0	0.01	0	0.01
Maize	48.70	48.69	32.00	31.49	14.50	14.49
Enzyme	0.00	0.01	0.00	0.01	0.00	0.01
Soya bean (full fat)	39.00	39.00	39.00	39.00	39.00	39.00
Groundnut cake	0.30	0.30	2.00	2.50	4.50	4.50
Maize offal	8.00	8.00	8.00	8.00	8.00	8.00
GBM	0.00	0.00	15.00	15.00	30.00	30.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.40	0.40	0.40	0.40	0.40	0.40
*Premix	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis						
ME (MJ/kg)	13.28	13.28	13.01	13.00	12.71	12.71
Crude Protein (%)	20.10	20.10	19.93	20.11	20.04	20.04
Crude Fibre (%)	3.85	3.85	5.07	5.11	6.36	6.36
Ether Extract (%)	9.26	4.19	3.96	3.98	3.76	3.76
Calcium (%)	1.09	1.09	1.69	1.69	2.30	2.30
Phosphorus (%)	0.83	0.83	1.20	1.20	1.58	1.58
Lysine (%)	1.19	1.19	1.18	1.19	1.18	1.18
Meth (%)	0.74	0.74	0.72	0.73	0.71	0.71
Met+Cys (%)	0.88	1.98	2.14	2.57	2.32	0.85
Cost₦/Kg	70.68	71.04	67.98	68.34	65.28	65.64

GBM – Ginger by-product meal

*Biomix premix supplied per Kg of diet: Vit. A, 10,000iu;Vit D3, 2000iu; Vit E, 23mg; Vit. K, 2mg; Vit, B1, 1.8mg; Vit B2, 5.5mg; pantothenic acid, 7.5mg; Vit. B12, 0.015mg; Folic acid, 0.75mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30mg; Antioxidant, 1.25mg.

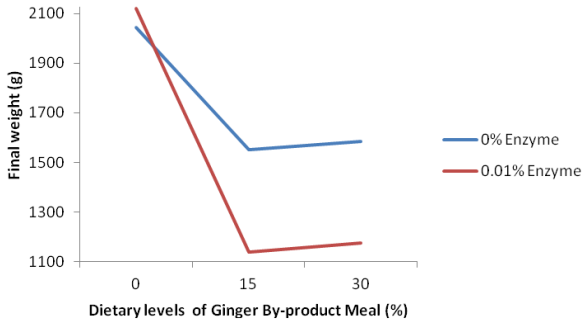

Fig. 1. Effect of interaction of GBM and Enzyme on final weight.

The inclusion of GBM had no significant ($p>0.05$) effect on feed intake but there was a significant decrease ($p<0.05$) in final weight and weight gain (Table 3), birds fed 0% GBM performed significantly ($p<0.05$) better than birds fed 15 and 30% GBM diets. The reduction in final weight, weight gain and efficiency of feed utilization with increase in the level of GBM, agrees with a similar study by Ademola *et al.* (2009) who reported significant decrease in weight gain when 2% ginger was included in broiler diet but disagrees with the finding of Onimisi, (2004) who reported non significant increase in these parameters with increase in inclusion of GBM from 0 to 20% but agrees with his finding for inclusion of GBM at 30% where there was a significant decrease in weight gain and final weight. Onimisi *et al.* (2004) adopted a dual processing method, mechanical and chemical. In this study, only the mechanical procedure was adopted for processing this ginger meal. The method of processing ginger therefore, may be an important factor to consider when including GBM in poultry feeds. Feed to gain ratio also significantly ($p<0.05$) increased as dietary level of GBM increased. Onimisi (2004) also reported significant decrease in efficiency of feed utilization beyond 10% inclusion of GBM. Feed cost per Kg gain was lowest at 0% GBM diet and highest at 15% GBM diet. No significant difference was observed in mortality, an indication that the experimental diets did not have a detrimental effect.

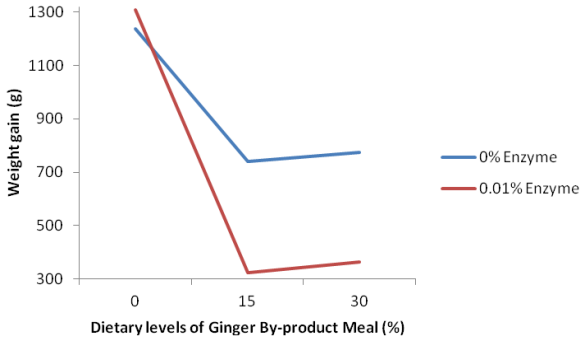

Fig. 2. Effect of interaction of GBM and Enzyme on weight gain.

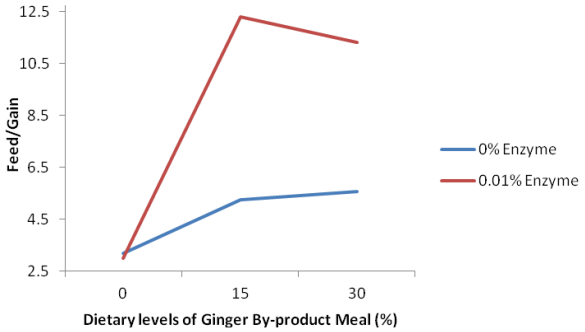

Fig. 3. Effect of interaction of GBM and Enzyme on feed/gain.

With the inclusion of enzyme, there was a non significant ($p>0.05$) difference in feed intake, while final weight, weight gain and efficiency of feed utilization decreased significantly ($p<0.05$) (Table 4). The performance of the birds fed the non enzyme treated diets was significantly ($p<0.05$) greater than the birds fed the enzyme treated diets. There was a significant ($p<0.05$) difference in feed cost per Kg gain, non enzyme treated diets had a lower value, an indication that less feed was eaten to gain a kilogram of weight.

Interaction between GBM and enzyme at 15 and 30% for final weight, weight gain, feed to gain ratio and feed cost per Kg gain is shown in figures 1, 2 and 3. Final weight and weight gain decreased significantly ($p<0.05$) with enzyme inclusion at 15 and 30% GBM levels. The efficiency of feed utilization also decreased with enzyme inclusion at both levels of GBM inclusion. Feed to gain ratio was similar at 0% GBM with and without enzyme inclusion. Feed Cost/Kg gain increased with increase in GBM in the non enzyme and enzyme treated diets, hence it is not economical to include GBM at 15 and 30%.

Table 3. Effect of GBM on production parameters of broilers.

	Level of GBM (%)			
	0	15	30	SEM
Initial weight (g)	810	812	810	0.01
Feed Intake (g)	3884	3858	4208	0.11
Final weight (g)	2083[a]	1344[b]	1380[b]	0.04
Weight gain (g)	1272[a]	532[b]	571[b]	0.04
Feed /Gain	3.05[a]	8.78[b]	8.44[b]	0.44
Feed cost/Kg gain	213.80[a]	537.03[b]	512.86[b]	0.02
Mortality (%)	16.22	14.13	17.38	0.03

[abc] Means within rows with different superscript are significantly different ($P<0.05$); GBM – Ginger by-product meal.

Table 4. Effect of Enzyme on Production Parameters of Broilers.

	Level of Enzyme (%)		
	0	0.01	SEM
Initial weight (g)	810	812	9.00
Feed Intake (g)	3984	3983	87.00
Final weight (g)	1727[a]	1478[b]	33.00
Weight gain (g)	917[a]	667[b]	29.00
Feed /Gain	4.35[a]	5.97[b]	0.36
Feed cost/Kg gain	302.00[a]	512.86[b]	0.02
Mortality (%)	15.49	16.22	0.03

[ab] Means within rows with different superscript are significantly different ($P<0.05$)

The PCA was aimed at identifying clusters of performance parameters that would explain significant proportion of total variation. There were two PCs with significant loadings that collectively explained 82.71% of the total variance (Table 6). The PC 1 values increased with final weight, weight gain and gain per day explaining 58.62%, final weight and weight gain had the highest loading and seem to be the principal controlling factors in the trial. Initial weight and feed intake clustered in PC 2 which accounted for 24.09 % of the total variance.

Table 5. Effect of GBM and Enzyme Supplementation on production parameters of broilers.

	GBM Levels (%)						
	0		15		30		
	Enzyme Supplementation (%)						
	0	0.01	0	0.01	0	0.01	SEM
Initial weight (g)	810.00	812.00	811.00	813.00	811.00	810.00	20.00
Feed Intake (g)	3861.00	3907.00	3790.00	3926.00	4300.00	4116.00	150.00
Final weight (g)	2045.00^{a}	2121.00^{a}	1550.00^{b}	1138.00^{c}	1586.00^{b}	1175.00^{c}	60.00
Weight gain (g)	1236.00^{a}	1309.00^{a}	739.00^{b}	325.00^{c}	775.00^{b}	365.00^{c}	50.00
Feed/Gain	3.18^{a}	2.99^{a}	5.24^{b}	12.31^{c}	5.57^{b}	11.31^{c}	0.63
Feed cost/Kg gain	218.78^{a}	213.80^{a}	354.81^{b}	831.76^{c}	363.08^{b}	741.31^{c}	0.03
Mortality (%)	16.22	16.22	14.13	14.13	16.22	18.62	0.05

^{ab} Means within rows with different superscript are significantly different (P<0.05); GBM – Ginger by-product meal

The haematological profile of the broilers (Table 7) did not vary statistically (p>0.05), suggesting that the feed had no negative effect on levels of PCV, Hb and Tp. The packed cell volume and haemoglobin values were within the range (22-35%) and (7-13g/dl) reported by (Patra *et al.* 2010).

Table 6. Eigenvalues and Principal Component Loading for Broiler Starter.

	Principal Components	
Parameters	PC 1	PC 2
Eigenvalue	3.51	1.06
Variance (%)	70.19	21.27
Cumulative Variance (%)	70.19	91.46
Initial Weight	-0.113	*0.972*
Feed Intake	*0.841*	0.307
Final Weight	*0.998*	-0.001
Weight Gain	*0.998*	-0.010
Feed/Gain	-0.893	0.155

Table 7. Effect of GBM/Enzyme on some haematological parameters.

	Level of GBM (%)				Level of Enzyme (%)		
	0	15	30	SEM	0	0.01	SEM
Packed Cell Volume (%)	32.75	32.33	30.92	1.77	31.06	32.94	1.44
Haemoglobin (g/dl)	10.89	10.74	10.27	4.34	10.31	10.96	3.54
Total protein (g/dl)	4.98	4.87	4.33	0.46	4.62	4.83	0.38

GBM – Ginger by-product meal

Table 8. Effect of GBM/Enzyme on some serum chemistry characteristics.

	GBM Levels (%)				Enzyme Supplementation (%)		
	0	15	30	SEM	0	0.01	SEM
Cholesterol (mmol/L)	2.29	2.68	2.39	0.07	2.34	2.51	0.06
Triglyceride (mmol/L)	0.85	0.80	0.71	0.04	0.81	0.74	0.03
AST (U/L)	190.55	213.80	223.87	0.04	218.78	199.53	0.03
ALT (U/L)	34.67	25.48	19.51	0.09	21.62	30.74	0.08
ALP (U/L)	75.86	63.10	66.07	0.20	51.29^{b}	91.20^{a}	0.08

^{ab} Means within rows with different superscript are significantly different (P<0.05); GBM – Ginger by-product meal.

The serum chemistry profile of the broiler chickens (Table 8) did not vary statistically (p>0.05) for most of the parameters except ALP level that significantly (p<0.05) increased with the inclusion of enzyme in the diet. Salli *et al.* (1991) reported that liver damage causes the death of hepatocytes and a rise in ALP concentration in the bile duct.

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