EFFECT OF PHYTASE SUPPLEMENTATION ON GROWTH PERFORMANCE OF ROSS 308 BROILER CHICKENS FED CABBAGE MEAL-BASED DIETS

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ABSTRACT
*A total of one hundred and fourty four one-day-old ROSS 308 broiler chickens (BC) were fed broiler starter diet till day 21. Experimental diets were fed from day 22-30, after which the BC's feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) were recorded. The experiment had three replicates with eight birds per replicate. Six semi-purified diets with 100, 200, and 300g/kg dried cabbage meal (DCM)-based diets and 0 or 1000 units of phytase (Natuphos) were formulated in a 2x3 factorial arrangement. Data were analysed using the general linear model of SAS. Orthogonal polynomial contrast was used to determine phytase (Phy) and their interaction with DCM. The responses for FI, BWG gain and FCR were not significant (P>0.05) as dietary inclusion levels of DCM increased across the sequential diets. Body weight gain was influenced (P<0.05) by the addition of phytase and the interaction with DCM, DCM×Phy at 100g/kg DCM inclusion. Feed conversion ratio (FCR) of the birds had no significant (P>0.05) response to feeding supplemental phytase. Though the interaction of DCM*Phy clearly resulted in a decrease in FCR of the birds fed 200 and 300g/kg DCM inclusion, the lower the ratio, the better is the index. Comparing the mean BWG, FI and FCR of the birds at specific level of DCM inclusion in the diet showed no variation (P>0.05). Overall, bird performance was essentially affected by phytase addition at 1000 FTU/kg,*

Keywords: Phytase, Growth performance, Dried cabbage meal, ROSS 308, Broiler starter

INTRODUCTION

Most of the ingredients of plant origin used for poultry feed formulation contain phosphorus (P) as a phytate complex, which affects the availability of P (Tahir *et al.,* 2012). Phytate is an anti-nutritional factor found in grains which limits the availability of essential minerals in monogastric nutrition as they lack enzymes to break it down. Cabbage 11.25%, wheat and corn both contain 0.18% phytate phosphorus, but the bioavailability of phosphorus from these sources is different (Ahmed *et al.,* 2003; Mossa *et al.,* 2018). Phytate also binds many minerals like Ca, P, iron, zinc and makes them unavailable to birds, which results in weak bones and stunted growth (Hakami *et al.,* 2022). To fulfil P requirements, inorganic phosphorus (mostly dicalcium phosphate "DCP") is supplemented in poultry feed, but it increases feeding costs (Makiyama *et al.,* 2012). This problem could be resolved by supplementing phytase in poultry rations to increase the bioavailability of P already present as phytate complex in feed ingredients, which ultimately decreases the feeding cost (Gehring *et al.,* 2013). Dietary supplementation of phytase enhances the bioavailability of P in broiler chicks. The phytase enzyme releases phosphorus by breaking the phytic acid and helps in the synthesis of myoinositol, giving better results in growth and development (Baloch *et a*l., 2021). Phytase catalyses the inorganic phosphate that contains chelated minerals and improves their availability to birds (Al-Harthi *et al*., 2020**).** It was hypothesized that phytase supplementation could increase the availability of phosphorus to broilers and dietary phosphorus levels could be reduced without compromising the growth performance in broilers. The beneficial effects of exogenous enzymes on the nutrient utilisation and subsequently growth performance of broiler chickens have been extensively studied (Borda-Molina *et al*., 2019; Roofchaei *et al*., 2019). Phytate is the primary storage form of phosphorus (P) in seeds and it accounts for two-thirds of the P in vegetable feedstuffs. Dietary phytase supplementation has become a common practice because the activity of endogenous phytase in broilers does not allow for the adequate utilization of phytate-bound P. Consequently, the effects of phytase have been widely studied and the beneficial effects on broiler growth performance. Hence, the objective of this study was to determine the effect of exogenous phytase (Natuphos) supplementation on growth performance of ROSS 308 broiler chickens fed cabbage meal-based diets.

MATERIALS AND METHODS

This study was conducted at the Poultry Unit of the Teaching and Research farm of the Faculty of Agriculture and Agricultural Technology, Benson Idahosa University, Benin City, Edo State.

Experimental Birds and Management

One hundred and forty-four one-day-old Ross 308 broiler chicks was raised on floor pens in a well-ventilated and illuminated standard poultry house. On arrival, the birds were fed a commercial broiler starter diet that met (NRC,

1994) nutrient requirements for broiler chicks for 21days. At day 22 post-hatch, 120 birds were transferred to metabolic cages, before then, birds were tagged, individually weighed and randomly allotted to six experimental diets, with three replicates in a randomized complete block in a 2x3 factorial arrangement. Birds had free access to water and experimental diets for eight days, with the first two days allowed for acclimatization to the experimental diets. All necessary routine management practices as well as room temperature regulation were adhered to.

Experimental Diet

Sequential, semi-purified diets containing 100, 200 and300g of DCM/kg (table 1) with or without 1000 units of phytase/kg diet were formulated. The dietary inclusion levels of the test ingredients were obtained by the gradual replacement of cassava starch with the DCM. Soya oil was added to the diets to obtain similar gross energy across the diets. Across all studies, varied dietary levels of limestone was added to the experimental diets to ensure that similar calcium: total phosphorus was maintained in the diets.

Table 1: Percentage Composition of Experimental Diet

	0 FTU/Kg (Phytase)			1000FTU/Kg(Phytase)		
Ingredients	**DCM 100g/kg of diet**	**DCM 200g/kg of diet**	**DCM 300g/kg of diet**	**DCM 100g/kg of diet**	**DCM 200g/kg of diet**	**DCM 300g/kg of diet**
Dried Cabbage Meal (DCM)	100.00	200.00	300.00	100.00	200.00	300.00
Cassava Starch	522.50	420.75	319.00	512.50	410.75	309.00
Casein	220.00	220.00	220.00	220.00	220.00	220.00
Soya oil	10.00	10.00	10.00	10.00	10.00	10.00
Dextrose	102.25	102.25	102.25	102.25	102.25	102.25
Methionine	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	10.25	12.00	13.75	10.25	12.00	13.75
Vitamin-Premix	2.50	2.50	2.50	2.50	2.50	2.50
Salt	2.50	2.50	2.50	2.50	2.50	2.50
Phytase Enzyme	0.00	0.00	0.00	10.00	10.00	10.00
Titanium Dioxide	25.00	25.00	25.00	25.00	25.00	25.00
Total	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1000.00**
Calculated Nutrients						
ME Kcal/Kg	3958.51	3909.13	3859.74	3923.61	3874.23	3824.84
CP (g/kg)	205.64	219.44	233.24	205.64	219.44	233.24
Ca (g/kg)	5.37	6.16	6.96	5.37	6.16	6.96
Total P (g/Kg)	2.85	3.50	4.15	2.85	3.50	4.15
Phytate P (g/Kg)	0.43	0.86	1.29	0.43	0.86	1.29
Non Phytate P (g/kg)	2.42	2.64	2.86	2.42	2.64	2.86
Ca : NPP ratio	2.22	2.33	2.43	2.22	2.33	2.43
Ca : P ratio	1.88	1.76	1.68	1.88	1.76	1.68

[1]Composition of vitamin premix per kg of diet: vitamin A, 12500 I.U; vitamin E, 40mg; vitamin K_3, 2mg; vitamin B_1, 3mg; vitamin B_2, 5.5mg; niacin, 5.5mg; calcium pantothenate, 11.5mg; vitamin B_6, 5mg; vitamin B_{12}, 0.025mg;choline chloride, 500mg, folic acid,1mg; biotin, 0.08mg; manganese, 120mg;iron 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg;selenium, 0.12mg, anti-oxidant, 120mg. [2]Phytase premix prepared by mixing phytase with maize. [3]Titanium dioxide premix prepared by mixing 1g of titanium oxide with 4g of maize

Growth Performance

Feed intake was calculated as the difference between amounts offered and refused on cage basis during the eight day feeding trial. Birds were weighed at days 22 and 30 post hatch respectively on cage basis to calculate body weight gain. Feed conversion ratio (FCR) was calculated by dividing feed intake by weight gain.

Data Analysis

Data was analysed using the GLM procedure in SAS (2012). Orthogonal polynomial contrasts were used to determine effects of graded levels of DCM on all response criteria, and α level of 0.05 was considered significant.

RESULT AND DISCUSSION

Results of growth performance indices are presented in Table 2. Average body weight gains per bird for birds fed DCM diets without supplemental phytase were; 311.67, 364.58 and 410.00g as against 359.17, 267.08 and 272.92g observed for birds that received DCM with supplemental phytase. The responses for FI, average BWG and FCR were not significant (P>0.05) as dietary inclusion levels of DCM increased across the sequential diets. Body weight gain per bird was influenced (P<0.05) by the addition of phytase; 100g/kgDCM (359.17g) as against 100g/kgDCM (311.67g) without phytase supplementation. Feed conversion ratio values for birds fed DCM without phytase were 3.35, 4.94 and 5.15 while corresponding values with supplemental phytase were 4.85, 3.50, and 4.60. The FCR of the birds had no significant (P>0.05) response to feeding supplemental phytase. Though the interaction of DCM*Phy clearly resulted in a decrease in FCR of the birds fed 200 and 300g/kg DCM inclusion, the lower the ratio, the better is the index. Comparing BWG, FI and FCR of the birds at specific level of DCM inclusion in the diet for with or without phytase showed no variation (P>0.05). Results showed that broilers could grow better at low dietary available P with supplementation of phytase.

Table 2. Selected growth performance indices of 28-day-old broilers fed dried cabbage meal-based diets supplemented without and with phytase

Parameter	Phytase (0 FTU/kg)			Phytase (1000 FTU/kg)			Pooled SEM	P-value		
	DCM 100g/kg of diet	DCM 200g/kg of diet	DCM 300g/kg of diet	DCM 100g/kg of diet	DCM 200g/kg of diet	DCM 300g/kg of diet		Phy	DCM	Phy*DCM
Body weight gain (g)	311.67	364.58	410.00	359.17	267.08	272.92	34.54	0.05	0.75	0.05
Feed Intake(g)	108.33	74.00	79.67	74.00	76.00	60.33	17.15	0.24	0.46	0.58
Feed conversion ratio	3.35	4.94	5.15	4.85	3.50	4.60	0.46	0.68	0.24	0.02

DCM: Dried Cabbage Meal

These results are supported by Hofmann *et al*. (2022), who reported that addition of phytase at 1,500 FTU/kg in reduced protein, amino acid and P diet improved weight gain and FCR. The report of Babatunde *et al*. (2022) also observed that birds on a low P diet had lower weight gain and feed efficiency, but these parameters were improved with addition of phytase. Zarghi *et al*. (2022) revealed that phytase addition in wheat-based diets improved weight gain. This present study negates the work of Lima (2002), who reported that birds fed diets supplemented with two levels of phytase to broilers chickens verified that there were no significant differences in the performance of the birds; Assuena (2007) also did not observe benefit from supplementation with phytase in diets for broilers. Improvements in feed conversion may be attributed to improved energy availability in DCM caused by the enzyme supplementation. The birds on phytase supplementation had better feed conversion ratios compared to the diets without phytase indicating its importance in broiler production.

CONCLUSION

It could be concluded that dried cabbage meal-based diets could be included in poultry diets up to 100g/kg with supplementation of phytase at the level of 1000 FTU/ kg for improved growth performance.

REFERENCES

Ahmed I, Javed K, Sattar A. (2003). Effect of phytate contents of cereals on bioavailability of total phosphorus in poultry. *Pakistan Veterinary Journal, 14:23-6*

Al-Harthi, M. A., Attia, Y. A. and El-Shafey, A. S. (2020). Impact of phytase on improving the utilisation of pelleted broiler diets containing olive by-products. *Italian Journal of Animal Science;19:(3)10–18.*

Assuena, V., Junqueira, O. M. and Casartelli, E. M. (2007). Efeito da adição de diferentes niveis da enzima filase sobre o desempenho de frangos de corte. In: reunião annual da sociedade brasileirade zootecnia, 44., Jaboticabal: *Sociedade Brasileira de Zootecnia 2: 586*

Babatunde, O.O., Bello, A. and Dersjant-Li, Y. (2022). Evaluation of the responses of broiler chickens to varying concentrations of phytate phosphorus and phytase. II. Grower phase (day 12−23 post hatching). *Poultry Science, 101:101616.*

Baloch, F. H., Baloch, H. N.and Khan, A. U. (2021). Effect of phytase enzyme on organs growth performance and blood profile of broiler. *Advances in Enzyme Research, 9:37-49.*

Borda-Molina, D., Zuber, T., Siegert, W., Camarinha-Silva, A., Feuerstein, D. and Rodehutscord, M. (2019). Effects of protease and phytase supplements on small intestinal microbiota and amino acid digestibility in broiler chickens. *Poultry Science 98(7): 2906–2918.*

Gehring, C., Bedford, M. and Dozier, W. (2013). Extra-phosphoric effects of phytase with and without xylanase in corn-soybean meal-based diets fed to broilers. *Poultry Science, 92: 979-91.*

Hakami, Z., Al Sulaiman, A.R. and Alharthi, A. S. (2022). Growth performance, carcass and meat quality, bone strength, and immune response of broilers fed low-calcium diets supplemented with marine mineral complex and phytase*. Poultry Science.;101(6):101849*.

Hofmann, P., Krieg, J., Francesch, M. (2022). Effects of added phytase on growth performance, carcass traits, and tibia ash of broiler chickens fed diets with reduced amino acid, crude protein, and phosphorus concentration*. Journal of Applied Poultry Research, 31:100258*

Lima, A. C. F., Harnich, F. A. R. and Macari, M. (2002). Avaliação do desempenho de frangos de corte alimentados com suplementacao enzimatica ou probiotica. *ARS Veterinaria, 18(2): 153-157*

Makiyama, L., Alvarenga, R. R., Rodrigues, P. B. (2012). Energetic and nutrient metabolizability values of corn obtained with nutritional corrections for broilers. *Brazilian Journal of Animal Science, 41:1308-1312.*

Mossa, A. F, Chrystalb, P. V, Dersjant-Lic, Y. (2018). Responses in digestibilities of macro-minerals, trace minerals and amino acids generated by exogenous phytase and xylanase in canola meal diets offered to broiler chickens. *Animal Feed Science and Technology 2018:22-30*

NRC. National Research Council (1994). Nutrient requirements of poultry 9th revised edition National Academy Press, Washington, D.C.

Roofchaei, A., Rezaeipour, V., Vatandour S. and Zaefarian, F. (2019). Influence of dietary carbohydrases, individually or in combination with phytase or an acidifier, on performance, gut morphology and microbial population in broiler chickens fed a wheat-based diet. *Animal Nutrition 5(1):63–67.*

SAS. (2012). Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

Tahir, M., Shim, M.Y., Ward, N. E. (2012). Phytate and other nutrient components of feed ingredients for poultry. *Poultry Science, 91(4):928-35.*

Zarghi, H., Golian, A., and Hassanabadi A. (2022). Effect of zinc and phytase supplementation on performance, immune response, digestibility and intestinal features in broilers fed a wheat-soybean meal diet. *Italian Journal of Animal Science, 21: 430–44.*