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Responses of Broiler Chicks to Non-Phytate Phosphorous Levels and Phytase Supplementation

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Abstract: Supplementation of broiler diets with phytase has proven to be an effective and realistic method for enhancing the digestibility of phytic acid in monogastric animals. This study was conducted to evaluate the effect of microbial phytase (RonozymeP) supplementation in broiler chicks fed different levels of non-phytate phosphorus (nPP) on performance. Five hundred and seventy six day old mixed sex, Ross broiler chicks were distributed randomly into 6 dietary treatments (three replicate /each 32 chicks). Data were analyzed as a 3×2 factorial arrangement with three levels of nPP (0.45, 0.38, and 0.31 % during starter and 0.43, 0.36, and 0.29 % during grower and finisher periods) and two levels of phytase (0 and 500 F.T.U/kg) in each period. The results showed that chicks fed with lower nPP diets had significantly lower body weight at 40 and 50d; lower daily gain during 20-40d and 0-50 d; and higher feed conversion ratio during 20-40d period. Phytase supplementation to the diets had only significantly increased feed intake during 21-40d period. The interactions between nPP levels and phytase supplementation on body weight at 40d and FCR during 0-20d was significant, in which the BW of the chicks fed lowest nPP diets was improved by phytase, whilst those of chicks fed high nPP diets was adversely affected by phytase supplementation.

Key words: Phytase, performance, broiler, Ronozyme

Introduction

Phosphorus, being the third most costly dietary component, as well as one of the major pollutants in poultry excreta, deserves special consideration when formulating to meet precise nutrient requirements. Formulating diets to precisely meet the phosphorus requirements of poultry should be a major economic and environmental concern (Summers, 1997). Unfortunately, most of the phosphorus contained in feed components of plant origin, in particular in seeds, is bound to phytic acid. In legumes and grains phytate phosphorus represents from 50% to 75% of total phosphorus content. In chemical terms phytate is predominantly the calcium-magnesium-salt of myoinositol-hexaphosphate. Phytic acid not only reduces phosphorus availability for poultry, but also reduces the availability of other nutrients in poultry diets (Simons *et al.*, 1990; Waldroup, 1999; Bedford, 2000; Ravindran *et al.*, 2001; Shirley and Edwards, 2003).

During recent years, several alternative methods for reducing the aforementioned negative impacts of phytate P on the environment and poultry performance have been devised. Such strategies include the use of low phytate grains such as corn and barley (Jang *et al.*, 2003; Ceylan *et al.*, 2003), phase feeding and feeding birds closer to their non-phytin P (nPP) requirements (N.R.C., 1994; Summers, 1997; Um and Paik, 1999; Waldroup, 1999; Yan *et al.*, 2001; Dhandu and Angel, 2003) and microbial phytase supplementation of poultry diets (Simons *et al.*, 1990; Qian *et al.*, 1996; Ravindran *et al.*, 1999a ; Sohail and Roland, 1999; Um and Paik, 1999; Ravindran *et al.*, 2001; Yan *et al.*, 2001; Sohail and Roland, 2002; Ceylan *et al.*, 2003; Shirley and Edwards, 2003; Yan *et al.*, 2003).

The interest in the use of phytase in poultry diets has risen due to its ability in releasing phytate-bound phosphorus from plant feedstuffs and alleviation of its detrimental impacts on environment (Simons *et al.*, 1990; Sohail and Roland, 1999; Yan *et al.*, 2003). The addition of microbial phytase to feed is known to help reduce the phytate-mineral-complex and phytase-protein complex thereby improving the overall performance of broilers by improving availability of phosphorus, calcium, zinc, magnesium, copper, AME and number of amino acids (Simons *et al.*, 1990; Ravindran *et al.*, 2001; Yan *et al.*, 2001). Although, supplementation of poultry diets with phytase has proven to be an effective and realistic method for enhancing the digestibility of phytic acid in monogastric animal (Simons *et al.*, 1990; Qian *et al.*, 1996; Ravindran *et al.*, 1999a,b; Ravindran *et al.*, 2001; Lan *et al.*, 2002), but still the effectiveness of phytase on performance in broiler chicks, especially under practical condition and less marginal phosphorus deficient diets should be to established.

The objectives of the present experiment were to investigate the influence of feeding moderated lowering nPP levels with and without of phytase supplementation on performance in broiler chicks.

Material and Methods

The present study was an intervention study carried out at the Animal Science Department of Kurdistan

Table 1.Composition (%) and calculated analysis of basal diets

Phytase[1] (FTU /kg diet)	Starter			Grower			Finisher		
	±	±	±	±	±	±	±	±	±
Ingredients					%				
Corn grain	57.83	58.17	58.50	61.70	62.04	62.34	66.97	67.41	67.85
SBM (44 % Cp)	34.91	34.85	34.78	31.25	31.19	31.12	26.58	26.38	26.18
Fish meal (63 % Cp)	2.50	2.50	2.50	2.00	2.00	2.00	1.17	1.23	1.31
Corn oil	1.27	1.16	1.05	1.53	1.42	1.31	1.59	1.44	1.29
$CaCo_3$	1.13	1.35	1.57	1.08	1.30	1.51	1.05	1.27	1.48
D.C.P[2]	1.33	0.96	0.58	1.32	0.95	0.58	1.48	1.10	0.71
Common Salt	0.30	0.30	0.30	0.28	0.28	0.28	0.30	0.30	0.29
Mineral premix[3]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin Premix[4]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL. Methionine	0.17	0.17	0.17	0.17	0.17	0.17	0.20	0.20	0.20
L-Lysine-HCL	0.05	0.06	0.06	0.15	0.15	0.15	0.18	0.18	0.18
Calculated dietary nutrient content									
ME (Kcal\kg)	2900	2900	2900	2962	2962	2962	3010	3010	3010
CP (%)	22	22	22	20.5	20.5	20.5	18.4	18.4	18.4
Ca (%)	0.95	0.95	0.95	0.9	0.9	0.9	0.88	0.88	0.88
T.P (%)	0.7	0.63	0.56	0.67	0.6	0.53	0.67	0.6	0.6
nPP (%)	0.45	0.38	0.31	0.43	0.36	0.29	0.43	0.36	0.36

[1]From Ronozyme P (2500 F.T.U. phytase activity/gr.)
[2]Contain 250 g/kg Ca and 180 g/kg P.
[3]Supplied per Kg: Vit. A, 7200 mg; Vit. D_3, 1600mg; Vit. E, 14400mg; Menadion, 800 mg; Thiamine, 720 mg; Riboflavin, 2640 mg; Niacin, 12000 mg; Pyridoxin, 1200 mg; Vit B_{12}, 6 mg; D-Pantothenic acid ,4000 mg; Folic acid, 400 mg; Biotin ,40 mg; Choline chloride, 100000mg; Antioxidant, 40000 mg.
[4]Supplied per Kg: Manganese, 40000 mg; Zinc, 33880 mg; Iron, 20000 mg; Copper, 4000 mg; Iodine, 400 mg; Choline chloride, 100000 mg.

University, Kurdistan, Iran. Five hundred and seventy six day-old, mixed-sex, Ross broiler chicks, were randomly allocated to six dietary treatments, each replicated three times (32 chicks per pen) in a completely randomized design in a 3×2 factorial arrangements. The chicks were housed in floor pens (1.2×1.5 cm) containing wood shavings throughout the experiment. Light were on continuously for the first day posthatching, after which a 23L: 1D lighting schedule was maintained for the duration of the experiment. Temperature was maintained between 32°C and 34°C at the beginning of the rearing period and were gradually decreased every 2 to 3 d to 22°C at the end of rearing period. Chicks were provided free access to feed and water during the experimental period. Care and management of the chicks were in accordance with commercial guidelines.

Dietary treatments: The corn-soybean meal-based starter, grower and finisher diets were formulated to meet or exceeded the requirements (NRC, 1994) for all nutrients, with the exception of nPP (Table 1). Experimental diets were formulated to contain different nPP levels (0.45, 0.38, and 0.31 % during starter period and 0.43, 0.36, and 0.29 % during grower and finisher periods) with and without 500 F.T.U Ronozyme P[1].

Measurements: The experiment was conducted for 51 days. Birds were weighed as a group on arrival. At 20, 40 and 51 days of age, all birds were weighed by pen. Then feed intake was recorded at the same points in time for determination of feed conversion. Mortality was recorded daily and feed consumption data were corrected for body weight of mortality. Average body weight, daily gain, and feed to gain ratio (FCR) were determined for each period and for the overall experiment.

Statistical analysis: Data were analyzed according to General linear model (GLM) procedure of SAS (SAS institute, 1991) as a CRD experiment. Significant differences among treatments were determined at $P<0.05$ by Duncan's new multiple range tests.

Results

During the experimental period mortality was within acceptable levels (less than 2%) and was not related to dietary treatments. The results of statistical analysis are summarized in Table 2.

The results indicated that during starter period, average body weight , daily gain , feed intake and feed conversion ratio were not significantly influenced by different dietary nPP levels ($P<0.05$). The average body weight (40d), daily gain and feed conversion ratio of broiler chicks through the grower period (21-40d) were significantly affected by nPP levels ($P<0.05$). The results showed that

[1]Roche Corporate Headquarter, F.Hoffmann-LaRoche Ltd, Group headquarter, Grenzachers, trasse 124, CH-4070 Basel, Switzerland

Table 2: The effect of non-phytate phosphorus levels and phytase supplementation on performance in broiler chicks

		NPP level[1]			Phytase (FTU/kg)	
		High	Medium	Low	0	500
Body weight(gr.)	20d	503.80	518.80	512.60	510.50	513.00
	40d	1666.50[a]	1709.70[a]	1586.90[b]	1657.70	1651.10
	50d	2193.70[ab]	2257.80[a]	2106.20[b]	2174.20	2197.60
Daily gain(gr.)	0-20d	23.00	23.80	23.50	23.40	23.50
	21-40d	55.40[ab]	56.70[a]	51.20[b]	54.70	54.20
	41-50d	65.90	68.50	64.90	64.60	68.30
	0-50d	43.80[ab]	45.10[a]	42.00[b]	43.40	43.90
Feed intake(gr.d^{-1})	0-20d	34.40	36.00	36.60	34.80	36.50
	21-40d	109.90	108.30	111.70	107.10[b]	112.80[a]
	41-50d	163.40	171.60	168.90	165.10	170.90
	0-50d	87.60	88.90	90.20	86.90	90.90
FCR(gr.gr^{-1})	0-20d	1.51	1.52	1.57	1.49	1.56
	21-40d	2.00[b]	1.92[b]	2.18[a]	1.97	2.10
	41-50d	2.49	2.51	2.61	2.57	2.51
	0-50d	2.00	1.97	2.15	2.01	2.07

[a-b]Mean values within a row and under each main effects with no common superscripts differ significantly(P<0.05).
[1]High, Medium, low: 0.45, 0.38 and 0.31% in starter, and 0.43, 0.36 and 0.29% in grower and finisher periods.

the chicks fed with diet containing lowest nPP level (0.29%) had lower BW and average daily gain and higher feed conversion ratio values compared with chicks fed higher nPP level diets. The results also indicated that through finisher period (41-50d), dietary nPP levels (P>0.05) did not significantly affect the average daily gain, feed intake and feed conversion ratio of broiler chicks.

The results also showed that the average chicks body weight at 50d was significantly affected by nPP levels, as a result the broiler chicks fed marginally deficient nPP diets (0.29%) had significantly (P<0.05) lower BW than chicks fed diets containing adequate nPP levels (0.36-0.43%). Over the whole experimental period (0-50d), the average chick's daily gain was the only criteria, which significantly influenced by dietary nPP level. The average broiler chick's daily feed intake was not affected by nPP level during this experiment. The fact that reduced nPP levels did not adversely affected daily gain during starter period, suggesting that even 0.31% nPP contained diet was not severely deficient in phosphorus during this period, but the results at the grower and finisher phase indicating that the 0.29 % nPP was not enough to satisfy the increasingly phosphorus demands of chicks for metabolic needs and skeletal developments during this periods. Data from the literature on nPP requirements during different growth periods is equivocal, with some papers suggesting lower levels of nPP are required to constrain growth (Sohail and Roland, 1999; Waldroup, 1999) and others suggesting these levels are already deficient (N.R.C., 1994).

The results showed that phytase supplementation to the diets had only significantly (P<0.05) increased feed intake during 21-40d period, and other performance criteria were not affected by phytase supplementation. Lack of significant effects of phytase during this experiment, could be partially explained by the fact that the nPP levels of the diets in this experiment were marginally deficient, not severely (Simons *et al.,* 1990; Waldroup *et al.,* 1999). Sohail and Roland (1999) in an experiment on 4-6 wk broiler chicks reported that when nPP levels were set at 0.33% little effect of added phytase on performance was observed, however, the chicks response to phytase was significant at lower nPP levels (0.225%).

The interaction between nPP levels and phytase supplementation on body weight at 40d and feed conversion ratio during 0-20d was significant (P<0.05). The results showed that body weight of the chicks fed lowest nPP diets was improved by phytase, whilst those of chicks fed high nPP diets was adversely affected by phytase supplementation(data not showed).

In conclusion, the results of this experiment indicated that the effect of feeding low nPP diets becomes most evident after 21d of age, and phytase addition to the diets failed to return performance back to the control groups. Further studies needed to determine proper nPP levels and effective phytase dosage during different growth periods.

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