ISSN 1682-8356
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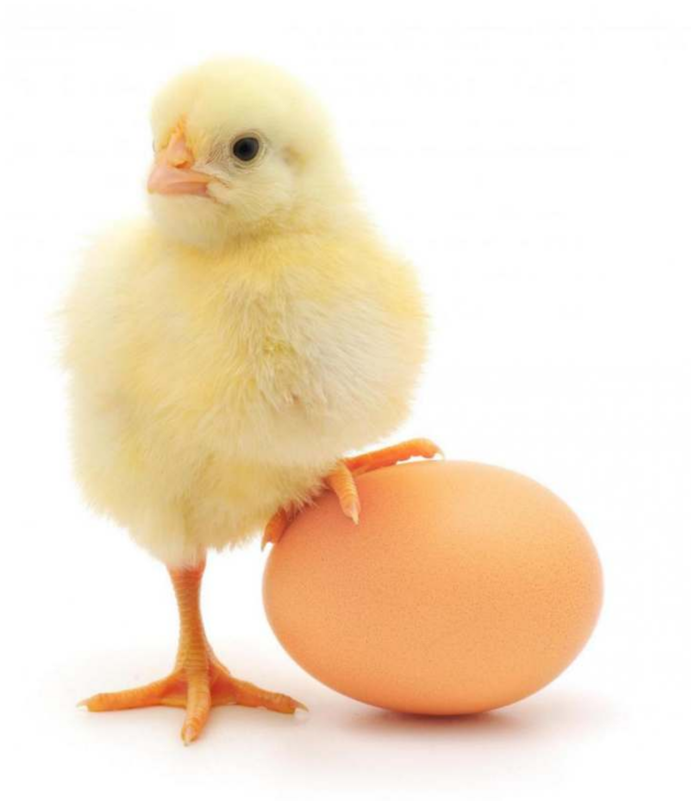

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

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International Journal of Poultry Science 6 (1): 55-58, 2007
ISSN 1682-8356

Effect of Phytase Supplementation on Nutrients Availability and Performance of Broiler Chicks

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Abstract: An experiment was conducted to determine the effect of phytase supplementation on broiler performance and evaluation of nutrients equivalency for Natuphos phytase, using 640 day-old commercial broiler chickens from 1 to 49 days of age. The experimental units were allocated randomly to 4 dietary treatments × two sexes with 4 replicates per treatment. The first dietary treatment formulated without phytase, the second one contained 500 FTU/kg phytase, and the third one contained 500 FTU/kg phytase which was calculated half of the nutrients equivalency values for phyatse. The fourth dietary treatment contained 500 FTU/kg phyatse which was calculated the total nutrients equivalency values for phytase. During the experiment Feed intake, body weight gain, and feed conversion ratio (FCR) were measured in each phase of the rearing. Mortality was recorded throughout the experiment. No significant difference was observed among four dietary treatments for final body weight, feed conversion ratio and carcass characteristics ($p>0.05$). The results indicated that phytase increased the availability of nutrients in third and fourth treatments. Toe ash, and toe ash Ca and P percentage increased with the addition of phytase in both sexes ($p<0.05$), but had no significant effect on blood phosphorus concentration.

Key words: Phytase, nutrients availability, performance, broiler chick

Introduction

The major portion of phosphorus (P) in plant feed ingredients, including corn and soybean is present in the form of phytate, which is largely unavailable in monogastric animals. Phytic acid (myo-inositil phosphorylated) on all of its six hydroxyl groups, can ionically bind minerals and proteins in aqueous medium (Sebastian *et al*., 1997). The interactions among phytic acid, minerals and protein appear to be primarily responsible for the adverse nutritional effects of a high phytate diet. The interest in the use of microbial feed enzymes such as phytase arises from the need to improve the availability of phytate-bound phosphorus and to reduce the phosphorus levels in effluent from intensive livestock operations. In addition to reducing phosphorus availability, phytates are associated with a number of anti-nutritional effluents; largely because of they can chelate divalent cations such as Ca, Mg, Fe, Zn, Cu, Mn and also can reduce protein availability (Ravindran *et al*., 2000; Bedford and Schulze, 1998). Phytase may significantly improve the utilization of the essential amino acid in broilers fed soybean meal basal diets (Biehl *et al*., 1997). Diets deficient in P depressed growth rate and feed efficiency (Fernandes *et al*., 1999; Li *et al*., 2000), but microbial phytase supplementation has been shown to relieve the detrimental effects a phosphorus deficiency on broiler health status.

Studies have demonstrated that exogenous dietary phytase improves phytate phosphorus utilization and enhanced overall performance in broilers (Huff *et al*., 1998; Atia *et al*., 2000; Waldroup *et al*., 2000). Little is known about the equivalency values of phytase for calcium, phosphorus and amino acids in poultry diets. On the other hand, possible economic benefit of phytase as an ingredient in feed formulation in different country is questionable. The aim of the present experiment was to evaluation the effectiveness of Natuphos® phytase for improving nutrients availability and cost of feed in broilers production.

Materials and Methods

Six hundred forty day-old sexed commercial broiler chickens (Ross 308 strain) were used from 1 to 49 days of age to investigate the effect of Phytase Supplementation on broiler performance and evaluation of nutrient equivalency for Natuphos phytase. The birds received a standard broiler starter diet (2835 kcal/kg AME_n and 20.8% crude protein) from days 1 to 10. On day 11, chicks were distributed according to very nearly the same average body weight to 32 floor pens. The experimental units (pens) were allocated at random to 4 dietary treatments and two sexes with 4 replicates per treatment. Four dietary treatments formulated based on corn and soybean meal in mash form. The first dietary treatment formulated without phytase, the second one contained 500 FTU/kg Natuphos phytase, and the third one contained 500 FTU/kg Natuphos phytase which calculated half of the nutrient equivalency values for

Table 1: Composition of diets used in grower period (10-29 days) (%)

Ingredients	Control	Control+ Enzyme	Semi corrected	Completely corrected
Corn	63.03	62.98	61.97	60.89
Soybean meal	33.00	33.00	32.21	31.38
Wheat bran	0.05	0.05	2.07	4.20
Limestone	0.96	0.96	1.03	1.11
Dicalcium phosphate	1.81	1.81	1.51	1.20
Vitamin premix[1]	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25
Salt	0.36	0.36	0.36	0..36
Methionie	0.16	0.16	0.16	0.16
Lysine	0.13	0.13	0.14	0.15
Enzyme	0.00	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00
Composition (%)				
ME_n (kcal/kg)	2860.00	2860.00	2860.00	2860.00
CP	20.14	20.14	20.14	20.14
Ca	0.90	0.90	0.90	0.90
Available Phosphorus	0.45	0.45	0.45	0.45
Methionie+Cystine	0.80	0.80	0.80	0.80
Methionine	0.47	0.47	0.47	0.47
Lysine	1.15	1.15	1.15	1.15

[1]Supplied per kilogram of diet: 6050 µg vitamin A (retinyl acetate+retinyl palmitate), 55 µg vitamin, D_3, 22.05 µg vitamin E (dl-α-topheryl acetate), 2.0 mg K_3, 5 mg B_1, 6.0 mg vitamin B_2, 60 mg vitamin B_3, 4 mg vitamin B_6, 0.02 mg vitamin B_{12}, 10.0 mg pantothenic acid, 6.0 mg folic acid, 0.15 mg biotin, 0.625 mg ethoxyquin, [2]Suppled per kilogram of diet: 500 mg $CaCO_3$, 80 mg Fe, 80 mg Zn, 80 mg Mn, 10 mg Cu, 0.8 mg I, 0.3 mg Se

Table 2: Composition of diets used in finisher period (29-49 days) (%)

Ingredients	Control	Control+ Enzyme	Semi corrected	Completely corrected
Corn	68.64	68.59	61.97	60.89
Soybean meal	27.69	27.69	32.21	31.38
Wheat bran	0.01	0.01	2.07	4.20
Limestone	0.94	0.94	1.01	1.01
Dicalcium phosphate	1.69	1.69	1.39	1.09
Vitamin premix[1]	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25
Salt	0.36	0.36	0.36	0..36
Methionie	0.11	0.11	0.11	0.12
Lysine	0.06	0.06	0.07	0.08
Enzyme	0.0	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00
Composition (%)				
ME_n (kcal/kg)	2924.00	2924.00	2924.00	2924.00
CP	18.16	18.16	18.16	18.16
Ca	0.85	0.85	0.85	0.85
Available Phosphorus	0.42	0.42	0.42	0.42
Methionie+Cystine	0.70	0.70	0.70	0.70
Methionine	0.39	0.39	0.39	0.39
Lysine	0.97	0.97	0.97	0.97

[1]Supplied per kilogram of diet: 6050 µg vitamin A (retinyl acetate+retinyl palmitate), 55 µg vitamin, D_3, 22.05 µg vitamin E (dl-α-topheryl acetate), 2.0 mg K_3, 5 mg B_1, 6.0 mg vitamin B_2, 60 mg vitamin B_3, 4 mg vitamin B_6, 0.02 mg vitamin B_{12}, 10.0 mg pantothenic acid, 6.0 mg folic acid, 0.15 mg biotin, 0.625 mg ethoxyquin, [2]Suppled per kilogram of diet: 500 mg $CaCO_3$, 80 mg Fe, 80 mg Zn, 80 mg Mn, 10 mg Cu, 0.8 mg I, 0.3 mg Se

Natuphos phyatse. The forth dietary treatment contained 500 FTU/kg Natuphos phyatse which calculated the total nutrient equivalency values for phytase. The nutrient equivalency matrix values used in diets formulation was based on numerous research trials (Ravindran and Bryden, 1997; Sebastian *et al.*, 1997; Kornegay *et al.*, 1996). All diets were isocaloric and isonitogenous (2860 kcal/kg AME_n, 21% crude protein in grower period (10 to 29 days of age) and 2924 kcal/kg AME_n, 18.1% crude protein in finisher period (30 to 49 days of age). The ingredients percentage and chemical composition of in grower and finisher periods are shown in Table 1 and 2. Individual body weights, group feed consumption, were recorded on days 29 and 49. Toe ash, and toe ash Ca and P and blood phosphorus concentration were measured at day 49. Data was analyzed using the General Linear Models procedure of SAS software (SAS Institute, 2001). When differences among means were found, means were separated using Duncan's multiple ranges test at p<0.05 (Steel and Torrie, 1980).

Table 3: Effect of Phytase supplementation on performance in whole period of the experiment (10-49 days of age)

Sex	Body weight gain (g)	Feed intake (g)	FCR (g:g)
Male	2571.37[a]	4460.24[a]	1.76[a]
Female	2136.24[b]	4232.89[b]	1.98[b]
SEM	17.115	44.7	0.013
Dietary treatment			
1	2391.14	4355.19	1.84
2	2345.00	4353.71	1.88
3	2315.11	4391.79	1.88
4	2363.96	4305.44	1.87
SEM	24.21	63.22	0.018
Interaction			
Male×treatment 1	2634.06	4425.13	1.71
Male×treatment 2	2559.72	4482.19	1.78
Male×treatment 3	2553.52	4523.80	1.79
Male×treatment 4	2538.15	4409.86	1.75
Female×treatment 1	2148.21	4285.26	1.97
Female×treatment 2	2130.27	4225.23	1.98
Female×treatment 3	2076.70	4215.77	2.00
Female×treatment 4	2189.77	4201.02	1.98
SEM	34.23	89.40	0.026

Mean within column with different superscripts are significantly different (P<0.05)

Results and Discussion

Effect of phytase supplementation on performance of broiler chicks is shown in Table 3. Adding phytase to diets hadn't significant effect on feed intake in whole period of the experiment. There were significant difference between two sexes for this trait (p<0.05). Male chicks consumed 5.9% feed higher than female. Results of this experiment are in agreement with the findings the previous studies (Ravindran and Bryden, 1997; Zhang *et al.*, 1999). These results suggested that, phytase increased the availability of nutrients in third and forth treatment and it improved feed intake. Aksakal and Bilal (2002) showed that adding phytase to broiler chicks increased feed intake. There wasn't significant difference for body weight gain among treatments in whole periods of the experiment. The highest and lowest body weight gain belonged to treatments 1 (control), and 3 (semi corrected) respectively. The average body weight

Table 4: Effect of Phytase supplementation on carcass characteristics of broiler chicks

Sex	Carcass (%)	Breast meat (%)	Tights (%)	Abdominal fat (%)
Male	73.7	24.2	21.2	2.3
Female	72.7	24.2	21.3	2.1
SEM	0.005	0.003	0.003	0.003
Dietary treatment				
1	72.1	23.6	21.7	1.9
2	74.1	25.3	21.7	2.9
3	72.7	23.9	20.7	2.2
4	73.7	24.2	21.1	1.7
SEM	0.007	0.005	0.005	0.005
Interaction				
Male×treatment 1	72.7	23.4	21.3	1.9
Male×treatment 2	74.8	25.7	20.9	2.6
Male×treatment 3	73.4	23.9	20.9	2.1
Male×treatment 4	74.4	23.8	21.7	1.7
Female×treatment 1	71.5	23.8	22.0	2.0
Female×treatment 2	73.4	24.9	22.4	2.3
Female×treatment 3	72.6	23.9	20.4	2.3
Female×treatment 4	73.0	24.6	20.6	1.8
SEM	0.01	0.006	0.006	0.006

Mean within column with different superscripts are significantly different (P<0.05)

Table 5: Effect of Phytase supplementation on toe ash, Ca and P concentration in toe ash and serum P concentration of broiler chicks

Sex	Toe ash (%)	Toe ash Ca (%)	Toe ash P (%)	Serum P (mg/dl)
Male	65.63^{a}	32.61^{a}	17.87^{a}	19.26
Female	63.33^{b}	21.51^{b}	17.18^{b}	18.33
SEM	0.295	0.185	0.11	0.41
Dietary treatment				
1	57.79^{d}	28.56^{d}	15.90^{d}	18.39
2	71.11^{a}	35.01^{a}	19.64^{a}	18.74
3	66.01^{b}	33.13^{b}	17.64^{b}	19.41
4	63.01^{c}	31.54^{c}	16.92^{c}	18.62
SEM	0.42	0.26	0.16	0.58
Interaction				
Male×treatment 1	58.61	29.11	15.98^{f}	18.32
Male×treatment 2	73.26	35.82	20.54^{fa}	18.89
Male×treatment 3	66.80	33.52	17.86^{c}	20.87
Male×treatment 4	63.84	32.00	17.11^{de}	18.94
Female×treatment 1	56.98	28.01	15.82^{f}	18.46
Female×treatment 2	68.96	34.20	18.74^{b}	18.60
Female×treatment 3	65.22	32.75	17.42^{cd}	17.95
Female×treatment 4	62.18	31.09	16.74^{e}	18.31
SEM	0.59	0.37	0.08	0.82

Mean within column with different superscripts are significantly different (P<0.05)

gain in male was 16.9% higher than female (p<0.05). Interaction of sex and treatment for this trait was not significant. Namkung and Leeson (1999) reported that body weight in chicks fed with diets containing low levels of Ca and P supplements with phytase was similar to chicks fed with control diet. This matter showed that phytase could compensate the possibility of reduction of the level of Ca and P without any adverse effect. Zhang *et al.* (1999) found that growth of chicken fed with diet supplemented with phytase and containing low level of amino acid was similar to chicks fed with diets containing recommended amino acid without adding phytase. Adding phytase could increase the bioavailability of amino acid in diet. There was not significant difference among treatments for FCR. The best value for this trait was seen in treatment 1 and the worst belong to treatment 2, and 3. There was significant difference between two sexes in FCR (p<0.05). FCR for male was 11% lower than female. Aksakal and Bilal (2002) and Naher (2002) reported that feed utilization in broiler fed with diets containing phytase was increased. Viverous *et al.* (2002) reported that due to increasing feed intake simultaneously with body weight, effect of phytase supplementation on FCR of broiler chicks was not significant. Ravindran *et al.*, 1999 and Yi *et al.*, 1996 reported that the addition of phytase to corn soybean meal diet released more phytate due to the fact that corn soybean diet has a high concentration of phytate. Effect of different treatments on carcass characteristics is presented in Table 4. There was not significant difference for carcass percentage, breast meat, tights and abdominal fat among treatments. The highest value for carcass percentage belonged to treatment 2, which was 3% higher than treatment 1 (control). Mean carcass percentage in male was 1.4% than female. The highest breast meat percentage was seen in treatment 2. Ahmad *et al.* (2004) reported that carcass, breast meat, tights and liver weight of chicks were increased in chicks fed with diets supplemented with phytase (1.5 g/kg). Naher (2002), and Moshad (2001) reported that carcass weight was increased with addition of phytase in broiler diets which in contrast with the results of the present study. It seems that in this experiment amounts of nutrients in chicks with diets containing phytase and corrected for its composition was similar to control diet (without phytase). Effect of different treatments on toe ash, Ca and P concentration in toe ash and serum P concentration is presented in Table 5. Toe ash and toe ash Ca and P percentage increased with the addition of phytase in both sexes (p<0.05), but had no significant effect on blood phosphorus concentration. So, in all cases highest toe ash, and toe ash Ca and P percentage was seen in second dietary treatment. Improvements of the utilization and retention of Ca and P were found in this experiment are supported by other findings (Yi *et al.*, 1996; Leeson *et al.*, 2000; Zyla *et al.*, 2000). Calculation of feed cost showed that, with adding phytase and using phytase equivalency values in feed formulation, improved production efficiency, so that in forth dietary treatment, cost per Kg BW in comparison to control diet decreased. In summary, microbial phytase enhanced growth performance, Ca and P retention and reduced the production cost.

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