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Phytase Changes Performance and Some Blood Biochemical Parameter of Broiler Chicks

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Abstract. The objective of this experiment was to improve the use of phytate phosphorus for broiler chicks and consequently reduce phosphorus environmental contamination. For study this aim, the effects of different levels of phytase were examined on blood biochemical parameter and performance of broiler chicks fed corn-soybean meal diets. Seven diets were fed to Ross chicks (n = 280; 4 replicates of 10 chicks per treatment) from 5 to 21 days of age. A positive control diet (0.422% non-Phytate Phosphorus, nPP) and a negative control diet (0.316% nPP) were used, and five more diets were manufactured by supplementing the negative control diet with 300, 600, 1200, 2400, and 24000 FTU/kg of exogenous phytase. The addition of exogenous phytase above 600 FTU/kg and 1200 FTU/kg improved ($P < 0.05$) feed conversion ratio and body weight gain of the birds fed the negative control diet, respectively. Decreasing nPP content in the diet reduced tibia ash ($P < 0.001$) content and phytase supplementation increased it ($P < 0.001$) as logarithmic liner equation. Phosphorus concentration of serum chicks fed negative control diet was reduced and phytase supplementation above 600 FTU/kg increased it. However, negative control diet increased alkaline phosphatase activity of serum and addition of phytase above 2400 FTU/kg reduced its activity to level of positive control diet ($P < 0.01$). Albumin concentration of serum chicks was increased by addition of phytase above 600 FTU/kg diet. The lowest calcium content and highest total protein concentration of serum chicks were seen at treatment of 600 FTU/kg phytase. These results demonstrated that addition of 600 FTU/kg phytase to low-available phosphorus diets (75% of NRC recommended) improved performance of broiler chicks due to improve utilization of phytate phosphorus of corn-soy bean meal diets.

Keywords: chicks, phytase, performance, serum metabolites.

1. Introduction

Phosphorus (P) is a limiting nutrient for algal growth and excess it causes contaminate water by stimulates algal blooms growth and consequently, depletes dissolved oxygen in surface water (Sharpley *et al.*, 1993). Recently the most effective factor in environment contamination is especially contamination by phosphorus (Musapuor *et al.,* 2006). Poultry feeds typically contain a high proportion of cereals, grain legumes, and oilseed meals, which approximately two-thirds of their P content as phytate form (Cowieson *et al.,* 2006). Phytate is an anionic acid that binds P and other cationic substances, which does not allow them to be completely used by bird. Broilers have insufficient enzyme to effectively hydrolyze the phytate P of corn and soybean meal. To meet dietary P requirement of broiler, diets are supplemented with inorganic P. It and phytate P of broiler diets can be contributed to environmental pollution if the availability of P was low. To help increase the availability of phytate P, exogenous phytase enzymes are being added to commercial diets (Payne et al., 2005). Phytase research that has focused on the effect of varying levels of supplemental phytase has shown increases in broiler performance, bone ash, and phytate P utilization with each additional unit or level of phytase (Shirley and Edwards, 2003). Although many studies have reported improvements in performance parameters associated with the addition of phytases to the diet, few studies have added exogenous phytase at large range of concentrations phytase units (FTU)/kg of diet. On the other hand, few attentions have been done by researcher on effects of phytase supplementation on blood biochemical parameter of chicks. The use of phytase at wide range in broiler diets may be affected health and performance of chicks. Therefore, the aim of this experiment was to evaluate the influence of different levels of dietary supplementation phytase on performance and blood biochemical parameter of broiler chicks.

2. Methods and materials

2.1. Diets

The National Research Council's nutrient values for ingredients (NRC, 1994) were used to formulate the basal diet. The basal corn-soybean meal diet used contained a calculated metabolizable energy of 3000 kcal/g diet and a deficient non-phytate phosphorus level of 0.316% (75% of NRC recommendation) as a negative control diet (C-). To the negative control diet, phytase (Phyzyme XP, Danisco Animal Nutrition, Carol Stream, IL) was added at 300, 600, 1200, 2400, and 24000 FTU/kg. In addition, dicalcium phosphate was added to the basal diet to create a positive control diet (C+) that contained 0.422% non-phytate phosphorus (nPP) and no phytase.

2.2. Birds and data collection

Two hundred eighty one-day-old Ross broiler chicks were used for this experiment. Each 10 birds were housed randomly in cages with 1m x 1.2m floor space. Each experimental diet was tested with four replicate cages of ten chicks. Birds from 1 to 5d of age were fed by C+ diet and from 5 to 21 d of age were fed by seven experimental diets. Feed consumption and body weight gain of chicks were recorded and feed conversion ratio (FCR) calculated from 5 to 21d of age. At the end of experiment (21d of age), two chicks were selected randomly from each cage and blood samples were collected from wing vein, sera were separated and then stored at -20ºC until assayed. The right tibia was removed, and ash content of dried, fat free bone was determined as described by AOAC (1990). Concentration of albumin, total protein, calcium, phosphorus and alkaline phosphatase activity of serum were measured by commercial kit based on ZiestChem Diagnostics kits (Tehran, Iran; by Technicon RA1000).

2.3. Statistical analysis

All Data were analyzed using the GLM procedure of SAS software (SAS, 1993) for analysis of variance as completely randomized design. Significant differences among treatments were identified at 5% level by Duncan's multiple range tests (Duncan, 1955).

3. Results and Discussion

The addition of exogenous phytase above 1200 FTU/kg and 600 FTU/kg improved ($P < 0.05$) body weight gain (fig.1) and feed conversion ratio (fig. 2) of the birds fed the negative control diet (C-), respectively. This result is in agreement with Watson, *et al.* (2006). The improve of body weight gain and feed conversion ratio of chicks as a result of phytase application might be due to the increased availability of energy (Shirley and Edwards, 2003) and amino acid digestibility (Selle et al.,2006) due to a raise in phytate degradation. The ability of phytase to improve P availability by hydrolyzing phytate-bound P in poultry diets can therefore reduce supplementation of diets with inorganic P sources.

Decreasing nPP content in the diet (negative control, C-) reduced tibia ash ($P < 0.001$) content and phytase supplementation increased it ($P < 0.001$) as logarithmic liner equation [$Y=2.308 \log (X+1) +44.77$; Y: percent of tibia ash, X: phytase activity of diet (FTU/kg) , $R2=0.74$, $P < 0.0001$] (fig.3). These results are in close agreement with Shirley and Edwards, 2003; Vali and Jalali, 2011. Changes in the amount of P available to the animal may affect its bone mineral status. This is the reason for the use of percentage bone ash as an indicator of mineral adequacy in animals (Onyango *et al.*, 2005).

Phosphorus concentration of serum chicks fed negative control diet was reduced and phytase supplementation above 600 FTU/kg increased it. However, negative control diet increased alkaline phosphatase activity of serum and addition of phytase above 2400 FTU/kg reduced its activity to level of positive control diet ($P < 0.01$). Albumin concentration of serum chicks was increased by addition of phytase above 600 FTU/kg diet (Table). Decreased plasma P and alkaline phosphatase activity has also been observed in chickens as dietary nPP level decreased (Viveros *et al.*, 2002). The decrease alkaline phosphatase activity and increased P in serum associated with the diets supplemented with phytase might be reflected the increased availability of phosphorus (Viveros *et al.*, 2002).

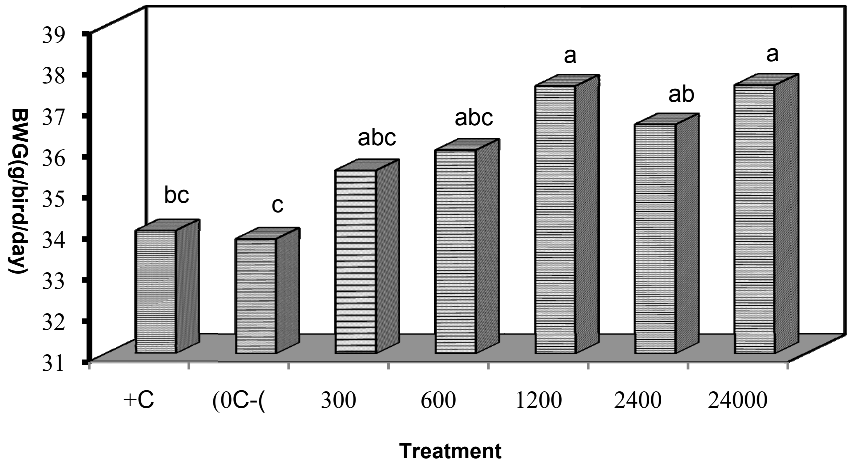

Fig.1. Effects of different level of phytase on body weight gain (BWG) of broiler chicks.
(C+: Positive control diet, C- : Negative control diet.
a-d column values with same superscript are not significantly different (P<0.05).

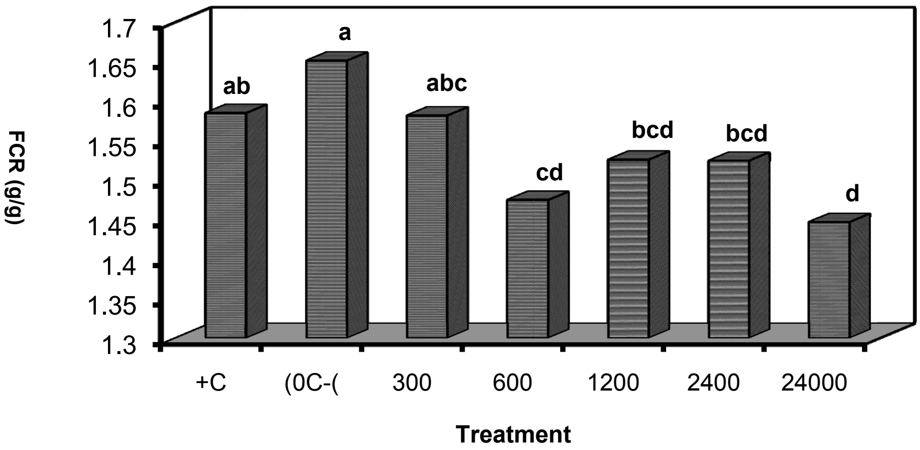

Fig.2. Effects of different level of phytase on feed conversion ratio (FCR) of broiler chicks.
(C+: Positive control diet, C- : Negative control diet.
a-d column values with same superscript are not significantly different (P<0.05).

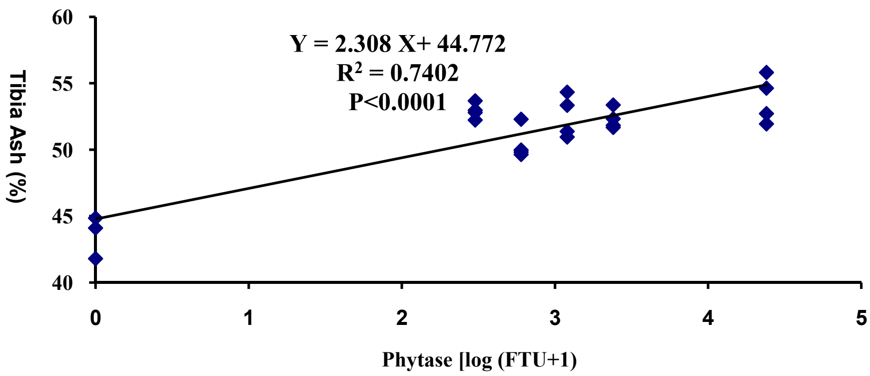

Fig.3. Effects of different level of phytase on Tibia ash content of broiler chicks.

Table 1: Effects of supplemental dietary phytase on blood biochemical parameter of broiler chicks.

Phytase level (FTU/kg diet)	Phosphorus mg/ dl	Calcium mg/ dl	Alkaline phosphatase U/L	Albumin g/ dl	Total protein g/ dl
C+	6.93 ^{a}	8.96^{a}	407.3 ^{b}	2.36^{bc}	3.63^{cd}
C- (0)	4.00 ^{c}	9.93^{a}	482.3^{a}	1.96^{c}	3.40^{d}
300	3.96 ^{c}	8.96^{a}	475.0^{a}	1.76^{c}	3.33^{d}
600	6.76^{ab}	6.06^{b}	488.0 ^{a}	3.03^{ab}	5.10^{ab}
1200	5.16^{bc}	7.73^{ab}	488.6^{a}	3.46 ^{a}	5.37^{ab}
2400	5.60^{abc}	9.13 ^{a}	420.3^{b}	3.30^{ab}	4.16 ^{bcd}
24000	6.30^{ab}	8.03 ^{ab}	390.6 ^{b}	3.26^{ab}	4.46 ^{abc}
SEM	0.515	0.709	10.18	0.298	0.294
Probability	0.003	0.035	0.0001	0.0044	0.0009

C+: Positive control diet, C- : Negative control diet.

a-d column values with same superscript or no superscript are not significantly different (P<0.05).

SEM: standard error of mean.

4. Conclusion

The main objective for supplementing phytase to poultry diets is to improve phytate P use in the birds and reduce the amount of P flowing into the environment in animal waste. These results demonstrated that addition of 600 FTU/kg phytase to low-available phosphorus diets (75% of NRC recommended, 1994) improved performance of broiler chicks due to improve utilization of phytate phosphorus of corn-soy bean meal diets. The addition of phytase to broiler diets at levels of greater than 600 FTU/kg diet (until 24000 FTU/kg diet), doesn't have any adverse effects on performance and health of chicks and improved them.

5. Acknowledgements

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