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Supplementation of Phytase in Phosphorus Deficient Diets and Its Effect on Egg Production in Commercial Layers

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Abstract

A biological trail of four periods of 28 days each was conducted to evaluate the effect of supplementation of phytase to phosphorus deficient diets on performance of layers. One hundred and twenty commercial laying hens of 26 weeks of age were randomly divided into four dietary treatment groups with five replicates of 6 birds each. The dietary treatments included control diet (0.5% P av); phosphorus deficient diet (0.11% P av); phosphorus deficient diet (0.11% P av) with phytase A of 0.1% and phosphorus deficient diet (0.11% P av) with phytase B of 0.01%. Significant reduction in production was recorded in low phosphorus diets; whereas supplementation of phytase significantly improved the egg production, which was comparable to that of control diet. Supplementation of phytase also significantly improved the eggshell thickness compared to non-supplemented group. Addition of phytase had no effect on feed intake, feed efficiency, egg weight, serum calcium, plasma inorganic phosphorus, leg weakness and mortality. It was concluded that supplementation of phytase to phosphorus deficient layer diet found to be beneficial in improving the egg production and the magnitude of response was more with phytase A than phytase B.
Key words : Commercial layers, Phytase, Feed intake, Egg production, Phosphorus deficient diets.

Feed contributes for major portion of poultry expenditure, which is hard to cope with when compared to several factors in poultry production. Poultry diets largely consist of cereal grains and products derived from seeds. Unfortunately, many grains, oil seed meals and plant derived products contain high concentrations of phytic acid, which in turn contains 60—80% of the total phosphorus present (1). The phosphorus contained in phytate is not available to poultry because they lack the enzymes needed to hydrolyze phytate into inorganic phosphorus and inositol. This limited the ability of monogastric animals to utilize phytate, presents two problems to animal nutritionists. The first is related to the formulation of diets that satisfy the animals physiological needs for phosphorus and second involves the environmental impact of unused dietary phosphorus excreted in feces. To meet the phosphorus requirements of the bird, nutritionists have traditionally supplemented diets with inorganic phosphorus sources. This is not only expensive, but also fails to address such problems as over supplementation leading to potential environmental phosphorus pollution and mineral binding. Recent legislation in many countries has forced the feed industry to look for alternative ways to make phytate phosphorus more available to birds. Thus application of biotechnological methods to increase the utilization of phytate phosphorus present in the plant origin ingredients serves as one of the best alternative sources. One such technique is supplementation of phytase enzyme to hydrolyze phytin in the gut. So enzymes like cellulase, pectinase, xylanase, hemicellulase, beta-glucanase, phytase which are not produced by the poultry can be supplemented exogenously in poultry feed to improve the feeding value of low energy feeds and to eliminate anti-nutritional factors. Hence, a biological experiment was conducted to evaluate the effect of supplementation of phytase enzyme for dicalcium phosphate and variations if any, in egg production and quality of eggs by the incor-

Table 1. Effect of supplementation of phytase enzyme on egg production and performance in commercial layers. [a–c]Means bearing common superscripts in column do not differ significantly with each other ($P \geq 0.05$).

Diets	Enzyme	P av %	Ca %	Egg Production (%)	Feed consumption (%)	Egg weight (g)	Feed efficiency (%)
1	–	0.50	3.50	92.08^{c}	117.70	54.03	1.54
2	–	0.11	3.50	83.45^{a}	116.05	52.54	1.62
3	A	0.11	3.50	92.52^{c}	114.82	54.06	1.53
4	B	0.11	3.50	89.62^{b}	114.56	53.24	1.56

Table 2. Effect of supplementation of phytase enzyme on egg characteristics of commercial layers. [a–c]Means bearing common superscripts in column do not differ significantly with each other ($P \geq 0.05$).

Diets	Enzyme	P av %	Ca %	Egg shell thickness (µg)	Serum calcium (mg/dl)	Plasma inorganic P (mg/dl)
1	–	0.50	3.50	304.60^{a}	11.42	20.06
2	–	0.11	3.50	294.40^{a}	11.49	20.20
3	A	0.11	3.50	325.00^{c}	11.57	21.80
4	B	0.11	3.50	306.20^{b}	11.42	21.69

poration of phytase enzyme.

Methods

Experimental Design

One hundred and twenty commercial laying hens of 26 weeks of age were randomly divided into four dietary treatment groups with five replicates of six birds each in open sided cage layer house. A total lighting period of 16 hour was followed throughout the experimental period. Birds in all the replications were reared under uniform standard conditions. Feed and water was given *ad libitum*. The dietary treatments included : Control diet (0.5% P av); phosphorus deficient diet (0.11% P av); phosphorus deficient diet (0.11% P av) with phytase A; and phosphorus deficient diet (0.11% P av) with phytase B. Phytase A (437.5 FYT/g) and Phytase B (1150 PTU/g) were incorporated at 1,000 g and 100 g per ton of feed respectively. These diets were formulated using yellow maize, soybean meal, groundnut extract, sunflower extract and deoiled rice bran.

Data Collection

Feed intake, egg production, egg weight and feed efficiency were recorded on daily basis throughout the experimental period. Eggshell thickness was measured using a screw guage and expressed in micrometer. At the end of trial, the blood was collected from one bird in each replicate, both in the heparinized and non-heparinized tubes. The serum and plasma were collected and used for the estimation of calcium and phosphorus using BT-224 photometer respectively. Mortality, if any, was recorded in each treatment group and the carcasses were subjected to post mortem examination.

Statistical Analysis

The results were subjected to analysis of variance by the General Linear Model procedure of SAS (2). The differences between means were compared by Duncan's multiple range test. The level of significance was tested at $P \leq 0.05$.

Results and Discussion

Egg production, feed consumption, feed efficiency and egg weight of the birds fed on experimental diets are presented in Table 1. Significant reduction in egg production (92.08 vs 83.45) was recorded in low phosphorus diet compared to control diet. Addition of phytase significantly improved the egg production, which was comparable to that of control diet. The magnitude of response was highest ($P \geq 0.05$) with phytase A (0.1%) supplementation than phytase B (0.01%) (92.52 vs 89.62). The results are in accordance with the findings of Gordon and Roland (3), who observed increased egg production (2.35 to 3.0%) on supplementation of 0.1 and 0.2% phytase enzyme. This may be due to increased bioavailability of phytase phosphorus and mineral in the phosphorus deficient diets. Amino acids which were unavailable due to phytate complex will be made available and thereby sustain better egg production on supplementation.

Feed intake, feed efficiency and egg weight were not affected with low phosphorus level in the diet and phytase addition had no effect on feed intake, feed efficiency and egg weight. These findings are in accordance with Hamilton and Sibbald (4) and

Chandramoni et al. (5).

Eggshell thickness, serum calcium and plasma inorganic phosphorus of the birds fed on experimental diets are presented in Table 2. Significant difference in eggshell thickness was revealed among various dietary treatments. The highest eggshell thickness was recorded in low phosphorus diet group with enzyme A supplementation and was significantly higher when compared with control. On contrary, the lowest shell thickness was recorded in low phosphorus diet group without enzyme supplementation. These results are similar to the findings of Gordon and Roland (6), that phytase enzyme addition can maintain better calcium; Pav ratio can result in better egg shell quality.

The serum calcium levels were statistically similar among different treatments indicating that none of the phytase enzyme supplementation was able to exert effect on calcium dynamics which suggest that calcium uptake and homeostasis in the blood are independent of levels of phytase enzyme, Pav and calcium. These results are in accordance with the findings of Roberson and Edwards (7), who reported serum calcium levels ranging from 8—12 mg/dl in hens, fed low phosphorus diet fed with phytase enzyme. Similarly, analysis of variance revealed no statistical significance in plasma inorganic phosphorus levels among treatment. Elevated levels of plasma inorganic phosphorus was observed in phytate supplemented diet, which are in accordance with results of Hamiliton and Sibbald (4).

It is concluded that addition of phytase to phosphorus deficient layer diet was found to be beneficial in improving the egg production and eggshell quality. The magnitude of response was more with phytase A addition than phyaase B. Attempts have to be made to study the effect of different levels of economically available phytase in combination of varying levels of the phosphorus available and calcium to understand and extract maximum benefits in layer diets.

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