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Performance and Egg Quality of Laying Hens Affected by Different Sources of Phytase

A. Ahmadi, M.M. Tabatabaei, H. Aliarabi, A.A. Saki and S.A. Hosseini Siyar
Department of Animal Science, Faculty of Agriculture, Bu-Ali Sina University, Hamedan, 65147, Iran

Abstract: Ninety hens were divided into six groups as a 2×3 factorial design and fed diets containing Wheat Bran (WB) at two levels of 0 and 5% and the enzyme phytase at three levels of 0, 150 and 300 FTU kg^{-1}. Egg weight, egg production, feed intake and Feed Conversion Ratio (FCR) were determined. Eggs were collected on two consecutive days at fortnightly intervals to measure egg size and egg component weights. Shell thickness was measured. Egg production, egg weight, FCR and feed intake were not affected by WB. Egg production, egg weight and feed intake were significantly higher in phytase-supplemented groups than unsupplemented groups. FCR differed significantly between dietary treatments as phytase supplementation significantly decreased FCR. Inclusion of WB to the diets had no effect on egg size and albumen weight. Phytase supplementation did not affect yolk weight, although albumen and shell weight were significantly affected.

Key words: Endogenous and exogenous phytase, egg quality, layer performance

INTRODUCTION

The major ingredients used in poultry diets are of plant origin. About two thirds of the phosphorus (P) in these feedstuffs is as phytate-bound P which is not available for utilization by poultry (Schwarz, 1994). Therefore, inorganic P supplementation is necessary to support optimal performance which significantly increases the cost of formulation. Improving the availability of phytate-bound P would reduce the necessity to include feed phosphates in the diets. This would result in a lower P excretion and reduce P-linked environmental pollution.

Exogenous dietary phytase improves performance and phytate-bound P utilization in hen (Boling *et al*., 2000). Phytase is also found naturally in plant seeds (Cavalcanti and Behnke, 2004). As compared to other cereals, a higher concentration of endogenous phytase is found in the bran of both rye and wheat (Greiner and Egli, 2003). High-endogenous-phytase cereals and their by products can enhance phosphorus utilization by hens (Cavalcanti and Behnke, 2004). This study was conducted to determine the effect of endogenous and exogenous (microbial) supplementation on egg quality and production in layer hens.

MATERIALS AND METHODS

Ninety 46 week-old white Leghorn laying hens were housed in 30 cages at the research center of Bu-Ali Sina University, Iran. Hens were weighed individually and divided into six groups of five replicates (cages). Groups were arranged in a factorial of 2×3 with Wheat Bran (WB) in two levels of 0 and 5% and phytase (NataphosV®) in 3 levels of 0, 150 and 300 phytase units (FTU kg^{-1}) and fed as part of isocaloric and isoprotein diets containing 12.13 MJ ME, 165 g CP, 35 g Ca and 1.2 g Av P kg^{-1} (Table 1).

Hen-day egg production and food intake were measured over an 8-week experimental period and Feed Conversion Ratio (FCR) was calculated per cage. Eggs from each replicate were collected on two consecutive days every fortnight. Each egg was weighed then broken out onto a flat surface. The yolk was separated from the albumen and weighed. Shell thickness was measured. Egg shells were washed, dried and weighed. Albumen weight was calculated. Data were analyzed by ANOVA using the general linear models procedure of SAS software. Comparison between means was done using Duncan Multiple Range Test method. Significance was assumed at $p<0.05$.

RESULTS AND DISCUSSION

Egg production, egg weight, feed intake and Feed Conversion Ratio (FCR) w ere not affected by WB (Table 2). Egg production and feed intake were significantly higher in phytase supplemented groups than the unsupplemented group. FCR differed significantly between dietary treatments as phytase supplementation significantly decreased FCR. There were no significant interactions between WB and phytase supplementation for all the parameters.

Corresponding Author: Ahmad Ahmadi, Department of Animal Science, Faculty of Agriculture, Bu-Ali Sina University, Hamedan, 65147, Iran Tel: +98 811 4238195 Fax: +98 811 4227012

Table 1: Composition and nutrient level of experimental diets

	WB* 0			WB 5		
Parameters	PE** 0	PE 150	PE 300	PE 0	PE 150	PE 300
Ingredients (g kg^{-1})						
Corn grain	669.00	669.00	669.00	606.00	606.00	606.00
Soybean meal	218.40	218.40	218.40	213.60	213.60	213.60
Oyster shell	90.20	90.20	90.20	90.10	90.10	90.10
Soybean oil	14.20	14.20	14.20	32.10	32.10	32.10
Wheat bran	0.00	0.00	0.00	50.00	50.00	50.00
Common salt	2.90	2.90	2.90	2.80	2.80	2.80
Mineral premix†	2.50	2.50	2.50	2.50	2.50	2.50
Vitamin premix‡	2.50	2.50	2.50	2.50	2.50	2.50
DL-Methionine	0.30	0.30	0.30	0.40	0.40	0.40
Phytase (FTU kg^{-1})	0.00	150.00	300.000	0.00	150.00	300.00
Nutrients (g kg^{-1})						
Protein	165.00	165.00	165.00	165.00	165.00	165.00
Calcium	35.00	35.00	35.00	35.00	35.00	35.00
Avail. Phos.	1.19	1.19	1.19	1.19	1.19	1.19
Metab. Energy (MJ kg^{-1})	12.134	12.134	12.134	12.134	12.134	12.134

*WB: Wheat Bran, **PE: Phytase Enzyme, †Supplied per kilogram of diet: Cu: 12 mg, Fe: 80 mg, Mn: 100 mg, Zn: 75, Se: 0.3 mg and I: 1 mg, ‡Supplied per kilogram of diet: vitamin A: 9600 IU, vitamin D_3:3120 IU, vitamin E: 36 IU, vitamin K_3: 1.0 mg, riboflavin: 7.2 mg, niacin: 60 mg, pantothenic acid: 14.4 mg, folic acid: 0.72, mg, thiamin: 4 mg, pyridoxine: 6 mg, vitamin B_{12}: 0.08 mg, biotin: 0.15 mg

Table 2: Effect of endogenous and exogenous phytase on laying hen performance

	Wheat bran (WB)		Phytase (Ph)			p-value			
Parameters	0	5	0	150	300	WB	Ph	WB×Ph	MSE
Egg production (%)	69.13^a	73.90^a	60.27^b	75.83^a	78.45^a	0.0816	0.0001	0.1043	51.690
Egg weight (g)	57.05^a	57.27^a	56.11^a	57.44^a	57.91^a	0.7525	0.1116	0.7731	3.630
Feed intake (g/hen/day)	88.64^a	92.14^a	82.60^b	92.76^a	93.21^a	0.0916	0.0036	0.0564	28.570
FCR	2.33^a	2.22^a	2.62^a	2.14^b	2.06^b	0.3009	0.0005	0.0983	0.083

$^{a-c}$Means within a main effect in raw with different superscripts are different using Duncan's multiple range test

Table 3: Means of egg size and egg components weights affected by endogenous and exogenous phytase

	Wheat bran (WB)		Phytase (Ph)			p-value			
Parameters	0	5	0	150	300	WB	Ph	WB×Ph	MSE
Egg size (g)	57.750^a	57.450^a	56.730^a	57.410^a	58.300^a	0.1655	0.0039	0.9429	17.325
Albumen weight (g)	36.580^a	36.440^a	35.690^b	36.360^{ab}	37.140^a	0.0613	0.0007	0.7004	11.190
Yolk weight (g)	16.200^a	15.970^b	16.110^a	15.980^a	16.170^a	0.5691	0.2108	0.0229	1.327
Shell weight (g)	5.030^a	5.020^a	4.860^b	5.090^a	5.040^a	0.6718	0.0016	0.9035	0.272
Shell thickness (mm)	0.380^a	0.377^a	0.370^b	0.383^a	0.378^a	0.0989	0.0249	0.2646	0.0011

$^{a-c}$Means within a main effect in raw with different superscripts are different using Duncan's multiple range test

Inclusion of WB in the diets had no effect on egg size, albumen weight shell weight and shell thickness (Table 3). Yolk weight was significantly affected ($p<0.02$). There was a significant main effect of phytase supplementation on egg characteristics (Table 2). Egg size was not significantly affected by phytase supplementation. Albumen weight was significantly higher for 300 FTU kg^{-1} phytase. Phytase supplementation generally improved shell weight and shell thickness. There was no significant interaction between WB level and phytase supplementation.

Although WB is one of the best sources of endogenous phytase it did not affect egg production and other measurements of hen performance (Table 2). The amount of active phytase present in cereals will vary depending on the cultivar, age and storage conditions (Cavalcanti and Behnke, 2004). Supplementation of diets with exogenous phytase caused significant differences in egg production, feed intake and FCR between dietary treatments. The significant increase in egg production observed in the present study is in the agreement with the investigation on the effect of microbial phytase on egg production (Keshavarz, 2000). In the absence of phytase, feed intake was significantly decreased. Similar results were reported by Punna and Ronald (1999). The higher feed intake in enzyme supplemented groups may be the result of higher egg production. FCR was significantly lower in phytase supplemented groups. Liebert *et al.* (2005) found that microbial phytase significantly improved feed conversation ratio whereas Boling *et al.* (2000) reported that FCR was not affected by phytase supplementation. Present results for egg production are in agreement with those of Boling *et al.* (2000), who reported that addition of 100 FTU kg^{-1} phytase was adequate in a P-unsupplemented corn- soy bean meal-based diet.

Inclusion of WB to the diets had no main effect on egg and egg components weights. Although Cavalcanti and Behnke (2004) reported that endogenous phytase resulting from inclusion of WB to a low available phosphorous (Av P) diet was able to improve P utilization, we did not see any effect of WB on layer hen performance. This might be due to the fact that, in the present study, Av P was similar for all the diets. Phytase supplementation significantly affected shell and albumen weight. Keshavarz (2000) also reported that phytase supplementation significantly increased egg size in laying hens.

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