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Evaluation of Using Phytase Nutrient Equivalency Values for Layer Hens and Broiler Chickens

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ABSTRACT

Two experiments were conducted to determine the effect of phytase supplementation on layer hens and broiler chickens performance and compare the use of phytase nutrient equivalency values in feed formulation with those fed conventional diet. In the first experiment, 640 commercial broiler chicks were used from 11 to 49 days of age. The experimental units were allocated at random to 4 dietary treatments×two sexes with 4 replicates per treatment. The first dietary treatment was formulated with no addition of phytase (C), the second diet contained 500 FTU kg^{-1} phytase over the top (C+P), and the third diet contained 500 FTU kg^{-1} phytase which was calculated as half of the nutrient equivalency values for phyatse (50E). The fourth dietary treatment contained 500 FTU kg^{-1} phyatse which was calculated as the total nutrient equivalency values for phytase (100E). In the second experiment 288 Hy-line W-36 hens were used from 60 to 72 weeks of age. The treatments consisted of a control diet (C) with no addition of phytase, a control diet supplemented with 300 FTU kg^{-1} phytase over the top (C+P), and a third diet containing 300 FTU kg^{-1} phytase which was calculated as the total nutrient equivalency values for phyatse (100E). No significant difference was observed among the four dietary treatments for broiler final body weight, feed conversion ratio (FCR) and carcass characteristics (P> 0.05). The toe ash, and toe ash Ca and P percentage of broiler chickens increased with the addition of phytase (P< 0.05). Hen day egg production for the C, C+P and 100E group were 75.25, 77.25 and 66.0%, respectively; as egg production declined, FCR increased significantly (P< 0.05). There were no significant differences in egg specific gravity, egg shell thickness, shell breaking strength and egg and toe mineralization among the dietary treatments. The results of the present study indicated that using phytase nutrient equivalency in feed formulation has a beneficial effect on broiler performance, but did not have any beneficial effect on the performance of old layer hens. In conclusion, using the same AME and protein equivalency values of phytase for broiler and old layers is not a valid approach.

Keywords: Broiler, Layer hens, Nutrient Equivalency, Performance, Phytase.

INTRODUCTION

Phytic acid, myo-inositil phosphorylated on all of its six hydroxyl groups, can bind minerals and proteins ionically 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. It is well documented that microbial phytase supplementation enhances the phytic acid hydrolysis and increases the release of minerals and proteins which are bound to phytic acid (Namkung and Leeson, 1999; Pourreza and Classen, 2001). It has been reported that phytase supplementation improved N retention in broiler chickens (Farrell *et al*., 1993) and laying hens (Van der klis and Versteegh, 1991). In contrast, Newkirk and Classen (1995) did not find any significant effect on crude protein digestibility by either purified phytase or crude phytase supplementation to broiler

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diets. Little is known about the equivalency values of phytase for calcium, phosphorus and amino acids in poultry diets. On the other hand, the possible economic benefit of phytase as an ingredient in feed formula in different countries is questionable. The present experiments were conducted to evaluate the effectiveness of commercial phytase (Natuphos®) for improving nutrient availability and cost of feed in broilers and layer hens, fed either a corn soybean meal (CSM) diet or a CSM diet supplemented with phytase, either as over the top or using nutrient equivalency of enzyme in feed formulation.

MATERIALS AND METHODS

Experiment 1

Six hundred forty sexed commercial broiler chicks (Ross 308 strain) were used from 11 to 49 days of age to investigate the effect of phytase supplementation on broiler performance and the evaluation of nutrient the equivalency for phytase. The birds received a standard broiler starter diet (2835 kcal kg^{-1} AME_n and 20.8% crude protein) from days 1 to 10. On day 11, chicks were distributed according to statistically equivalent average body weight to 32 floor pens. The experimental units (pens) were allocated randomly to 4 dietary treatments×two sexes with 4 replicates per treatment in a complete randomized design in a factorial arrangement. Four dietary treatments were formulated based on CSM in mash form. The first dietary treatment was a control group, formulated with no addition of phytase (C), the second diet contained 500 FTU kg^{-1} phytase over the top (C+P), and the third diet contained 500 FTU kg^{-1} phytase which was calculated as half of the nutrient equivalency values for phyatse (50E). The fourth dietary treatment contained 500 FTU kg^{-1} phyatse and was calculated as the total nutrient equivalency values for phytase (100E). The composition of experimental diets and calculated analysis are outlined in Table 1. The control diet was formulated to meet the nutrient requirements recommended by the Ross 308 management guide. All the diets were iso-nitrogenous and iso-caloric and the feed ingredients were analyzed for crude protein, fat, crude fiber, calcium and phosphorus (AOAC, 1990). Feed and water were provided *ad libitum* throughout the 49 days of trial. All birds were exposed to 23 hours of incandescent light. The nutrient equivalency matrix values (Table 2) used in diet formulation was based on numerous research trials (Ravindran *et al.,* 1997; Sebastian *et al.,* 1997; Kornegay *et al*., 1996) and recommended by the relevant company. One phytase unit (FTU) is defined as the amount of enzyme activity that librates 1 mmol of inorganic phosphorus per minute from a 0.5 mM Na-phytate solution at pH 5.5 and 37°C.

Individual body weight and group feed consumption, were recorded on days 29 and 49. At the end of the experimental period, two birds from each replicate were randomly selected and slaughtered. The left middle toes of the birds within a pen after removal of the soft tissue were pooled, fat content was extracted (in a Soxtec System HT1043) by ether for 4 hours and dried to a constant weight at 100°C. Toe was ashed in a furnace (Heraeus Hanau) at 600°C for 4 hours. The ash from toes was solubilized with nitric and perchloric acid, then the phosphorus and calcium contents were analyzed with a spectrophotometer and atomic absorption spectrophotometer, respectively. At day 49, 2 ml of blood was collected from the brachial vein from two birds in each replicate. Serum was subsequently separated for phosphorus measurement by colorimetric method.

Experiment 2

Three diets were fed to 288 Hy-line W-36 hens from 60 to 72 weeks of age. The treatments consisted of a control diet (C) with no addition of phytase, the control diet supplemented with 300 FTU kg^{-1} phytase over the top (C+P), and the third diet contained 300 FTU kg^{-1} phytase which was calculated as the total nutrient equivalency values for

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Table 1. Ingredient and nutrient content of experimental diets.

Ingredient	Experiment 1 (Broiler) [a]						Experiment 2 (Layer) [b]	
	11-29 d			29-49 d			60-72 wk	
	C	50E	100E	C	50E	100E	C	100E
	g /kg							
Corn	630.3	619.7	608.9	686.4	675.8	665.0	670	692.3
Soybean meal	330.0	322.1	313.8	276.9	269.0	260.7	181.2	173.6
Soybean oil	-	-	-	-	-	-	19.3	8.7
Wheat bran	0.5	20.7	42.0	0.1	20.3	41.5	-	-
Dicalcium phosphate	18.1	15.1	12.0	16.9	13.9	10.9	11.6	5.5
Oyster shell	9.6	10.3	11.1	9.4	10.1	10.1	108.7	110.3
Common salt	3.6	3.6	3.6	3.6	3.6	3.6	3.1	3.1
DL-Methionine	1.6	1.6	1.6	1.1	1.1	1.2	0.9	0.9
L-Lysine-HCl	1.3	1.4	1.5	0.6	0.7	0.8	0.2	0.3
Vitamin premix [c,d]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mineral premix [e,f]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Phytase premix [g]	0	0.5	0.5	0	0.5	0.5	0	0.3
Calculated analysis [h]	%							
AME_n kcal/kg	2860	2860	2860	2924	2924	2924	2817	2817
Crude protein	20.14	20.14	20.14	18.16	18.16	18.16	13.75	13.75
Total phosphorus%	0.71	0.67	0.63	0.67	0.63	0.59	0.51	0.40
Non phytate phosphorus %	0.45	0.45	0.45	0.42	0.42	0.42	0.30	0.30
Calcium	0.9	0.9	0.9	0.85	0.85	0.85	4.05	4.05
Lysine	1.15	1.15	1.15	0.96	0.96	0.96	0.68	0.68
Methionine	0.46	0.46	0.46	0.39	0.39	0.39	0.32	0.32
Met+Cys	0.80	0.80	0.80	0.70	0.70	0.70	0.585	0.585

[a] C= Control diet; 50E= Diet contained 500 FTU kg^{-1} phytase which was calculated half of the nutrient equivalency values for phyatse , 100E= Diet contained 500 FTU/kg phytase which was calculated total nutrient equivalency values for phyatse.
[b] C= Control diet , 100E= Diet contained 300 FTU kg^{-1} phytase which was calculated total nutrient equivalency values for phyatse.
[c] Provided the following per kilogram of broiler diet (experiment 1): Vitamin A, 9,000 IU; Cholecalciferol, 2,000 IU; Vitamin E,18 IU; Vitamin k3, 4mg; Vitamin B12, 0.015 mg; Biotin, 0.015 mg; Folacin, 1 mg; Niacin, 30 mg; Pantothenic acid, 25 mg; Pyridoxine, 2.9 mg; Riboflavine, 6.6 mg; Thiamine, 1.8 mg, Choline, 500 mg.
[d] Provided the following per kilogram of layer diet (experiment 2): Vitamin A, 8,800 IU; Cholecalciferol, 2,500 IU; Vitamin E, 8 IU; Vitamin k3, 2 mg ; Vitamin B12, 0.02 mg; Biotin, 0.015 mg; Folacin, 0.5 mg; Niacin, 30 mg; Pantothenic acid, 13 mg; Pyridoxine, 2.2 mg; Riboflavine, 5.5 mg; Thiamine, 1 mg, Choline, 500 mg.
[e] Provided the following per kilogram of broiler diet (experiment 1): Copper (as cupric sulfate 5H20), 10 mg; Iodine (as calciumiodate), 0.99 mg; Iron (as ferrous sulfate 7H20), 50 mg; Manganese (as manganese oxide), 99 mg; Selenium (as sodium selenite), 0.2 mg and Zinc (as zinc oxide), 84 mg.
[f] Provided the following per kilogram of layer diet (experiment 2): Copper (as cupric sulfate 5H20), 6 mg; Iodine (as calciumiodate), 0.99 mg; Iron (as ferrous sulfate 7H20), 50 mg; Manganese (as manganese oxide), 65 mg; Selenium (as sodium selenite), 0.2 mg and Zinc(as zinc oxide), 55 mg.
[g] Natuphos®, BASF D-67056 Ludwigshafen Germany.
[h] Protein, calcium and total phosphorus contents of diets were calculated on the basis of determined nutrient contents of ingredients.

phyatse (100E). The composition of experimental diets and calculated analysis are outlined in Table 1. The control diet was formulated to meet nutrient requirements recommended by the Hy-line W-36 management guide. All diets were iso-nitrogenous and iso-caloric. Ingredients used in this experiment were from the same batch as in the first experiment. The phytase source was the same as in the first experiment and the nutrient equivalency of enzyme for layer hens is shown in Table 2.

Hens were selected on the basis of statistically equivalent egg production and body weight from a commercial flock of 7,000 birds. Birds were allocated to 144 cages in three treatments with four replicates and 24 hens in each replicate, in a complete randomized design. Two hens were housed in a 30×46 cm cage, 12 adjoining cages consisted of a replicate. Hens were exposed to a

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Table 2. Nutrient equivalency matrix values for Phytase enzyme (one kg commercial enzyme equivalent to).[a]

Nutrient	Broilers	Layers
Metabolizable energy (kcal)	106000	106000
Crude protein (%)	450	450
Available phosphorus (%)	207	344.9
Calcium (%)	200	333
Lysine (%)	24	24
Methionine (%)	2	2
Met+Cys (%)	8	8
Threonine (%)	26	26
Tryptophan (%)	6	6
Isoleucine (%)	24	24

[a] BASF D-67056 Ludwigshafen Germany.

daily lighting schedule of 16L: 8D. All birds were kept under uniform environmental conditions throughout the experimental period. Diets were presented in mash form and provided daily according to expected intake and hens have free access to water.

The individual body weight of the birds was recorded at the beginning and end of the experiment. Egg production was recorded daily and percentage hen day egg production was calculated. All the eggs laid were weighed daily throughout the experimental period. The three eggs were randomly chosen in each replicate from the eggs laid during the three consecutive days at every 28 day period to determine specific gravity (Densitomter, Mettler-Toledo, Iso-14001, Switerland), shell thickness and shell breaking strength (Universal Testing Machine, EZ test, 120891-04, Japan). The shell thickness was measured at three different locations (middle, broad and narrow end) using a micrometer gauge (Mitutoyo code 7027), and the mean value was calculated. Dried shells were ashed at 600^{o}C for 4 hours, and shell ash analyzed for calcium and phosphorus content (AOAC, 1990). During each 28-day period, three eggs were randomly selected from each replicate for two consecutive days to determine the Haugh unit using the method of Haugh (1937). Toe mineralization was measured according to the procedure mentioned in the first experiment.

Data were analyzed using the General Linear Models procedure of SAS software appropriate for a complete randomized design. Significant difference among individual group means was determined with Duncan's multiple range test.

RESULTS AND DISCUSSION

Experiment 1

The growth performance, carcass quality, toe ash and toe ash Ca and P of male and female broiler chickens fed various dietary treatments are shown in Table 3. No significant difference was observed among four dietary treatments for final body weight, average feed intake, feed conversion ratio and carcass characteristics (P> 0.05). Regardless of phytase nutrient equivalency values, the crude protein and energy intake of chicks fed the 50E and 100E diets were 0.55, 0.92 and 1.11, 1.85% less than that of control group, respectively. Thus data suggested that phytase could release nutrient equivalent and increased the availability of nutrient in both the 50E and 100E treatments, because the BW gains of broiler with the addition of

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Table 3. Effect of phytase supplementation on means and standard error of performance, toe ash (Ca and P) and blood P (at 49 d) of broiler chicks (Exp 1) .

Attributes	Dietary treatments					Sex		
	C [a]	C+P [b]	50E [c]	100E [d]	SEM [e]	Male	Female	SEM
Final body weight (g)	2391	2345	2315	2363	24.21	2571[a]	2136[b]	17.15
Average feed intake (g d^{-1})	111.6	111.6	112.6	110.3	1.62	114.3[a]	108.5[b]	1.14
Feed : Gain	1.84	1.88	1.88	1.87	0.018	1.76[b]	1.98[a]	0.013
Abdominal fat (%)	1.9	2.9	2.2	1.7	0.005	2.3	2.1	0.003
Breast meat (%)	23.6	25.3	23.9	24.2	0.005	24.2	24.2	0.003
Toe ash (%)	57.59[d]	71.11[a]	66.01[b]	63.01[c]	0.417	65.63[a]	63.33[b]	4.65
Toe ash calcium (%)	28.56[d]	35.01[a]	33.13[b]	31.54[c]	0.261	32.61[a]	31.51[b]	2.48
Toe ash phosphorus (%)	15.90[d]	19.64[a]	17.64[b]	16.92[c]	0.158	17.87[a]	17.18[b]	0.11
Blood phosphorus (mg dl^{-1})	18.39	18.74	19.41	18.62	0.58	19.26	18.33	0.41

[a-d] Means not sharing a common superscript letter within a row differ significantly (P<0.05).
[a] Control diet; [b] Diet contained 500 FTU kg^{-1} phytase over the top; [c] Diet contained 500 FTU kg^{-1} phytase which was calculated half of the nutrient equivalency values for phyatse, [d] Diet contained 500 FTU kg^{-1} phytase which was calculated total nutrient equivalency values for phyatse.
[e] Standard error of the means.

phytase and calculation of nutrient equivalency values for phytase, restored very close to the control diet. These results supported by those of Namkung and Lesson (1999), Pourreza and Classen (2001) and Kornegay (1996) who reported that phytase supplementation improved the AME and digestibilities of some other nutrients, such as amino acids in broilers. 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 the corn soybean diet has a high concentration of phytate.

The toe ash and toe ash Ca and P percentage increased with the addition of phytase in diets (P< 0.05). So, in all cases the highest toe ash, and toe ash Ca and P percentage was for the 50E treatment (Table 3). According to the nonphytate phosphorus (NPP) equivalency value of phytase, the NPP intake of chicks fed a C diet was 114.9 mg less than that of the C+P group, so it seems that the NPP level in the control diet was insufficient for maximum bone mineralization, because supplementation of phytase over the top of the C diet increased bone mineralization significantly (P< 0.05). Improvement of the Ca and P utilization and retention found in this experiment are supported by other findings (Yi *et al.*, 1996; Shirley and Edwards, 2003). Dietary treatments did not have a significant effect on the blood phosphorus concentration, which may be due to homeostasis regulation. No significant interaction between dietary treatments and sexes was seen in any of the cases. As expected, the effect of sex on most traits was significant.

Addition of phytase and the use of phytase nutrient equivalency values in feed formulation, improved feed efficiency, so that in the 100E diet, feed cost per kg body weight gain in comparison to the C diet decreased about 2.7%, but adding phytase over the top (C+P) elevated the feed cost (Figure 1). Overall, using the nutrient equivalency value of phytase, enhanced broiler growth performance, Ca and P retention and reduced the broiler production cost.

Experiment 2

The data on mean production performance of layer hens during 60 to 72 weeks of age are presented in Table 4. Supplementation of phytase to diet and calculation of the nutrient equivalency values of phytase, decreased the hen day egg production percentage and egg mass output (g hen^{-1} day^{-1}) in hens fed the 100E diet (P< 0.05). As egg production declined, FCR increased significantly (P< 0.05). The addition of phytase over the top of the C diet slightly increased egg pro-

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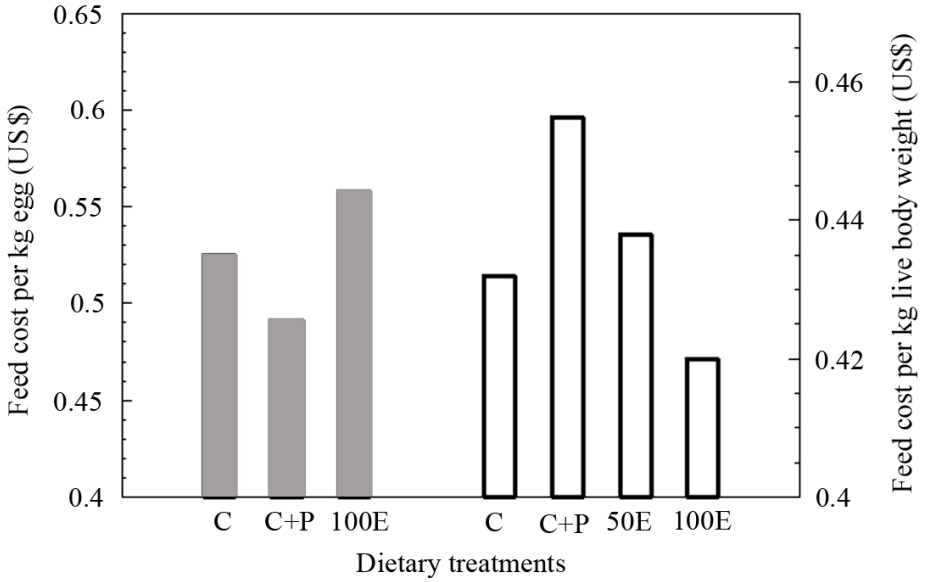

Figure 1. Feed cost per kg live body weight of broiler in experiment 1 (hatched bars) and kg egg production of layer hen in experiment 2 (soild bars), (C= Control diet, C+P= Diet contained phytase over the top, 50E= Diet contained phytase which was calculated half of the nutrient equivalency values for phyatse, 100E= Diet contained phytase which was calculated total nutrient equivalency values for phyatse.

duction, but this effect was not significant. Reduction of production performance in hens fed the 100E diet is very likely due to overestimating the energy, protein and amino acid equivalency derived from enzyme. These findings are do not agree with the results obtained by other investigators. Keshavarz and Austic (2004) reported that, when hens from 36 to 48 weeks of age received the 13% protein diet containing 0.2% NPP and supplemented with phytase, all the traits were comparable to those fed the positive control diet. Jalal *et al*. (1999) in one of two studies with layer hens, observed a significant effect of phytase (250 to 300 U kg^{-1}) on digestibility of only four amino acids and no effect on crude protein digestibility in a CSM diet. Panda *et al*. (2005) and Dorota *et al*. (2006) reported that addition of phytase can allow the reduction of NPP content to 0.12% in the layer diet, without affecting the production performance of layer hens. One likely reason for the inconsistency in the phytase effect between our study and others is the long time monitoring performance in the latter part of production (60 to 72 weeks). Few studies are in agreement with our study. Snow *et al*. (2003) concluded that phytase addition numerically decreased the amino acid digestibilities for CSM layer diet; these authors suggested that phytase did not have a significant effect on digestible energy. Bhanja *et al*. (2005) reported that phytase supplementation to a diet containing 0.18% NPP had no advantage for broiler breeder performance. Another observed that the addition of enzyme in latter part of production cycle had no effect on broiler breeder egg production (Sheikhahmadi *et al*., 2007). Hence, further research is needed to elicit the nutrient equivalency values of phytase for eldery birds.

Without calculation of phytase P equivalency, the NPP concentration in 100E diet was equal to 0.19%, so, despite a dietary NPP concentration decrease from 0.3 in C

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Table 4. Effect of phytase supplementation on performance, egg quality and egg shell ash (Ca and P) of layer hen from 60 to 72 wk of age (Exp 2).

Attributes	Dietary treatments			
	C [a]	C+P [b]	100E[c]	SEM[d]
Average daily feed intake (g hen^{-1} d^{-1})	104.99	104.55	104.31	1.14
Average hen day egg production (%)	75.25 [a]	77.25 [a]	66.00[b]	2.23
Average egg weight (g)	61.03	62.90	63.36	0.67
Egg mass (g hen^{-1} d^{-1})	45.80 [ab]	48.74 [a]	41.97[b]	1.33
Feed conversion ratio[e]	2.31[ab]	2.15 [b]	2.52[a]	0.071
Haugh unit	81.24	83.69	83.17	2.21
Egg specific gravity	1.08	1.08	1.08	0.001
Egg shell thickness (mm)	38.80	38.30	39.17	0.58
Egg shell breaking strength (Newton cm^{-2})	3.06	2.90	2.83	0.16
Egg shell Ash (%)	86.61	87.49	89.16	1.09
Egg Shell ash calcium (%)	30.97	32.82	37.27	1.54
Egg Shell ash phosphorus (%)	0.252	0.240	0.252	0.006
Body weight change during 60 to 72 wk (g)	-1.25	0.00	12.5	0.001
Toe ash (%)	93.42	91.52	93.09	0.63
Toe ash calcium (%)	27.83	24.70	27.28	1.03
Toe ash phosphorus (%)	15.94	15.83	16.61	0.68

[a] Control diet; [b] Diet contained 300 FTU kg^{-1} phytase over the top, [c] Diet contained 300 FTU kg^{-1} phytase which was calculated total nutrient equivalency values for phyatse.
[d] Standard error of the means.
[e] Grams of feed per gram of egg mass.
[a-b] Means not sharing a common superscript letter within a row differ significantly ($p<0.05$).

diet to 0.19% in the 100E diet, no significant difference was observed among dietary treatments on average daily feed intake (Table 4). Wu *et al*. (2006) reported that, in hens from 21 to 33 weeks of age, as dietary NPP decreased from 0.26 to 0.11% in the diet with no addition of phytase, feed intake significantly decrease about 9.35%. In the present study, NPP content of the 100E diet was 0.19%, so NPP intake of each hen was 198.1 mg hen^{-1} day^{-1}, which is lower than the dietary NPP requirement of hens, of 250 mg hen^{-1} day^{-1} recommended by NRC (1994). Therefore, it seems that phytase supplementation prevented the decline in feed intake of hens fed the P deficient diet (100E), release P equivalency value and improved P availability in 60 to 72 week- old hens.

As shown in Table 4, there were no significant differences in the Haugh unit, egg specific gravity, egg shell thickness, shell breaking strength, egg shell ash, egg shell ash Ca and P content, toe ash and toe ash Ca and P content among different dietary treatments. These results are in agreement with results obtained on younger hen by other researchers (Keshavarz, 2003; Roland *et al*., 2003; Wu *et al*., 2006). As discussed above, NPP intake of hens fed C, C+P and 100E diets were 314.9, 313.6 and 198.2 mg hen^{-1} day^{-1}, respectively. For hens fed the 100E diet, NPP intake was not sufficient. It means that the addition of phytase improved shell and bone mineralization in old layer hens fed an NPP deficient diet. In accordance with other studies (Bhanja *et al*., 2005; Scott *et al*., 1999) supplementation of phytase to a diet containing adequate NPP (C+P diet) did not have any additional advantage.

Feed cost per kg egg produced in the 100E treatment was 5.9% higher than that of the C group (Figure 1). In contrast to the 100E diet, supplementing the C diet with phytase over the top (C+P) led to a decrease of 6.4% in feed costs, because phytase slightly increased egg production percentage and improved FCR in the C+P group.

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CONCLUSION

Based on the results of these studies, the use of phytase nutrient equivalency values was beneficial in broiler feed formulation, but did not have any beneficial effect in old layer hens. These results probably occurred because any impact of phytase on protein and energy utilization in the latter part of the production cycle is small. Thus, using similar AME_n and protein equivalent values for broilers and layers is not valid.

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بررسی استفاده از مواد مغذی معادل آنزیم فیتاز در تنظیم جیره جوجه‌های گوشتی و مرغهای تخمگذار

م. زاغری

چکیده

دو آزمایش به منظور بررسی اثر افزودن آنزیم فیتاز به خوراک جوجه‌های گوشتی و مرغهای تخمگذار با لحاظ کردن مواد مغذی معادل آنزیم و مقایسه عملکرد با گروهی که خوراک معمولی دریافت نموده بودند، انجام شد. در آزمایش اول تعداد ۶۴۰ قطعه جوجه گوشتی از سن ۱۱ تا ۴۹ روزگی پرورش یافتند. واحدهای آزمایشی به طور تصادفی به ۴ تیمار غذایی × دو جنس نر و ماده در ۴ تکرار اختصاص یافتند. اولین تیمارغذایی شامل جیره کنترل بدون آنزیم فیتاز (C)، دومین تیمار شامل جیره کنترل حاوی ۵۰۰ واحد آنزیم فیتاز در کیلوگرم خوراک (C+P)، سومین تیمار حاوی ۵۰۰ واحد آنزیم فیتاز بود که نصف مواد مغذی معادل آنزیم در تنظیم جیره محاسبه شد (۵۰E) و چهارمین تیمار غذایی حاوی ۵۰۰ واحد آنزیم فیتاز بود که ۱۰۰٪ موادمغذی حاوی آنزیم درتنظیم جیره محاسبه شد (۱۰۰ E). آزمایش دوم با استفاده از تعداد ۲۸۸ قطعه مرغ تخمگذار سویه‌های لاین W-۳۶ از سن ۶۰ تا ۷۲ هفتگی اجرا شد. تیمارها شامل جیره کنترل (C) بدون افزودن آنزیم فیتاز، جیره کنترل با افزودن ۳۰۰ واحد آنزیم فیتاز (C+P)،

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جیره حاوی ۳۰۰ واحد آنزیم فیتاز که ۱۰۰٪ مواد مغذی معادل آنزیم در تنظیم جیره محاسبه شد (E ۱۰۰). اثر ۴ تیمار غذایی بر وزن بدن در سن ۴۹ روزگی، ضریب تبدیل خوراک و خصوصیات لاشه جوجه‌های گوشتی معنادار نبود (P>۰/۰۵). خاکستر انگشت پا، کلسیم و فسفر محتوی آن با افزودن آنزیم فیتاز به خوراک افزایش یافت (P<۰/۰۵). درصد تولید تخم مرغ در تیمار C، C+P و E ۱۰۰ بترتیب ۷۲/۷۵، ۷۷/۲۵ و ۶۶ درصد بود و با کاهش درصد تولید ضریب تبدیل خوراک افزایش یافت. ضخامت و استحکام پوسته تخم مرغ، همچنین خاکستر و درصد کلسیم و فسفر موجود در خاکستر پوسته و وزن مخصوص تخم مرغ با افزودن آنزیم فیتاز به خوراک تفاوت معنادار نداشت (P>۰/۰۵). نتایج حاکی از این است که افزودن آنزیم فیتاز و محاسبه موادمغذی معادل آنزیم در جیره جوجه‌های گوشتی سودمند است، اما در مرغهای تخمگذار مسن تأثیر مثبت ندارد، در این صورت به نظر می‌رسد که باید برای مرغهای تخمگذار بخصوص در سنین بالا معادل انرژی قابل متابولیسم و پروتئین خام آنزیم به طور مجزا براورد شود.

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