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The Effect of Dietary Nonphytate Phosphorous and Vitamin D_3 on Performance and Egg Shell Quality of Laying Hens During Late Laying Period

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Abstract: This experiment was conducted to determine the effect of Nonphytate Phosphorus (NPP) and vitamin-D_3 on performance and egg shell quality of laying hens in late egg production period. 70 weeks old Lohman LSL laying hens (n=192) were randomly allocated to eight diets in a 2x4 factorial arrangement of treatments. Two levels of vitamin-D_3 (0 and 5000 IU kg^{-1}) and four levels of NPP (0, 0.15, 0.30 and 0.45%) were fed for 8 weeks. Feed Consumption (FC), Egg Production (EP), Feed Efficiency (FE), Egg Weight (EW), Shell Thickness (ST), Shell Breaking Strength (SBS), Egg Specific Gravity (ESG), Breakage Egg Rate (BER) and Egg Shape Index (ESI) were evaluated. In this study, shell thickness, shell breaking strength and breakage egg rate were influenced from dietary treatments but, egg production, feed consumption, feed efficiency, egg weight, specific gravity and egg shape indexes were not influenced from dietary treatments statistically significant ($p>0.05$). However, egg weight increased linearly from 68.2 to 70.54 gr as dietary NPP was increased from 0 to 0.45%. But this differences were not statistically ($p>0.05$) significant. Supplemental P negatively influenced egg quality but there were no any adverse effect on performance. Supplemental vitamin-D_3 had no beneficial effect on production performance parameter but causing some significant differences on shell quality parameters.

Key words: Nonphytate phosphorous, Vitamin D_3, laying hen, shell quality, egg production

INTRODUCTION

Previous studies have established that phosphorus is an essential nutrient for laying hens because of its role in egg shell formation and metabolism[1,2]. But resent data indicates that phosphorus in the laying hens diet greater than that needed for maximum egg production is detrimental to egg shell quality[3]. However, there are considerable variations in NPP recommendations for the laying hens. Sohail and Roland[4] mentioned that NPP requirement for commercial leghorns has constantly declined during the last 40 yr. and the NRC recommendation on NPP has been reduced from 429 mgr per hen/d in 1960 to 350 mgr per hen/d in 1984. In 1994 NRC further reduced the dietary NPP requirements for white leghorns from 350 mgr per hen/d[5] to 250 mgr per hen/d[6]. But can utilize only one-third of the P contained feedstuffs of plant origin[7] an improvement in the utilization of pyhtin P will reduce the cost of adding inorganic P sources in the feeds lower the P excretion in the manure and subsequently reduce pollution problems with regard to P a number of investigators reported that dietary P can be reduced with the hen = s age without an adverse effect on performance[8-10]. Furthermore a number of reports indicated shell quality response may be obtained by reducing the dietary P[11-13]. The main mechanism by which vitamin D facilitates calcification of bone and formation of egg shell is believed to be a result of the effects of the physiologically active form of vitamin D, 1,25-Dhydroxycholecalciferol [1,25 $(OH)_2$ D_3] on intestinal function[14]. It is well established that in laying hens a vitamin D_3 dependent Ca-binding protein is involved in the active transport of Ca across the intestinal membrane and probably across the uterine membrane. Dietary and endogenous vitamin D_3 is first hydroxylated position 25 of the vitamin D_3 molecule in the liver to produce 25-OH cholecalciferol (25-OH-D_3) which is the main circulating vitamin D_3 metabolite in the blood. The circulating 25-OH-D_3 is then further hydroxylated in position of the molecule in the kidney to produce 1, 25 $(OH)_2$ D_3. This active form of vitamin D_3 is involved in the biosyntheses of Ca-binding protein, which is involved in active transport of Ca across the intestinal wall. This active form is promoting absorption of Ca for bone and egg shell formation[14-16]. 1,25 $(OH)_2D_3$ also influence alkaline phosphates activity in duodenal mucosa[17].

This current study was conducted to determine the effect of the additional dietary NPP and vitamin D_3 on performance egg shell quality of laying hens in late egg production period.

MATERIALS AND METHODS

One hundred ninety-two 70 weeks old white Lohman LSL laying hens were used in this experiment. Bird were randomly assigned to eight groups equally (n = 24) and

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Table 1: Ingredients and calculated nutrient composition of experimental diets

NPP (%)	0		0.15		0.30		0.45	
Vitamin D IU Kg^{-1}	0	5000	0	5000	0	5000	0	5000
Ingredients/groups	T-0	T-1	T-2	T-3	T-4	T-5	T-6	T-7
Corn	40	40	40	40	40	40	40	40
Soybean meal	17	17	17	17	17	17	17	17
Wheat	20	20	20	20	20	20	20	20
Wheat bran	5	5	5	5	5	5	5	5
Meat bone meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sunflower meal	5	5	5	5	5	5	5	5
Lime stone	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Narble meal	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65
Vitamin premix	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Lysine	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Methionin Cystine	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Phosphorus	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Calculated Analysis								
Crude protein	16	16	16	16	16	16	16	16
ME Kcal kg^{-1}	2650	2650	2650	2650	2650	2650	2650	2650
Ca(%)	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Total P(%)	0.5	0.5	0.65	0.65	0.80	0.80	0.95	0.95

housed environmonentally controlled laying house, each treatment was replicated six times, four birds were settled down per cage (50x46x46 cm). Groups were equally distributed in the upper and lower cage levels to minimize cage-level effect.

There were eight dietary treatments (one control and seven experimental groups). Control birds were fed on a basal diet containing about 16% CP, 2650 kcal ME kg^{-1}, 3.75% Ca and 0.5% P (Table 1) (T-0) other seven experimental diets were supplemented with 5000 IU Kg^{-1} Vit-D3 (T-1), 0.15% NPP (T-2), 0.15% NPP+5000 IU kg^{-1} Vit-D3 (T-3), 0.30% NPP (T-4), 0.30% NPP+5000 IU Kg^{-1} Vit-D3 (T-5), 0.45% NPP (T-6) and 0.45% NPP+5000 IU Kg^{-1} Vit-D3 (T-7), respectively, feed and water supplied for *ad libitum* consumption and bird were exposed to 16 h of light/day during the experiment. And this study lasted for eight-weeks. Egg Production (EP) was recorded daily. Whereas, Feed Consumption (FC) and egg weight were measured biweekly. Egg weight was determined using all eggs produced during 2 consecutive day per two weeks. The parameters of egg shell quality were determined biweekly, egg thickness was determined using micrometer, egg shell breaking strength was determined using breaking strength instrument, egg specific gravity was determined by a floatation method as described by Harms *et al*.,[18].

Statistical analyses was performed by the statistical package SPSS for windows, version 10.0 Multiple comparison of the data was done by using the Duncan test after one-way analysis of variance (one-way ANOVA).

RESULTS AND DISCUSSION

In this study, egg production, feed consumption, feed efficiency, egg weight, egg specific gravity and egg shape index were not different among dietary treatments by statistically significant ($p>0.05$) (Table 2).

This information indicates that dietary treatments were not adverse effects on their performance. In fact, there were numerically differences on feed consumption, feed efficiency, egg production and egg weight of among dietary treatments. Consequently additional P and vitamin-D3 for example, egg weight increased linearly from 68.2 to 70.54 g as dietary P levels were increased from 0 to 0.45%. However, egg production decreased linearly from 81 to 79.6% dependent increasing of dietary P levels. Also there were some differences in feed efficiency values. But, these differences were not found statistically significant ($p>0.05$). These results are in agreement with a report of Mikaelian and Sell[18].

Dietary treatments had no significant effect on average specific gravity units Table 2. These data of the hens fed T-6 were numerically greather than those fed the other diets. These results are consistent with a report of Roland and Farmer[17]. But not in agreement with others[3, 4]. Shell thickness, shell breaking strength and breakage egg rate were influenced from dietary treatments significantly ($p<0.05$) (Table 2).

Shell thickness and shell breaking strength increased dependent on increasing to supplemental P levels from 0 to 0.30%. The highest shell thickness and breaking strength were obtained from eggs collected from hens fed the diets containing 0.30 P%+5000 IU Kg^{-1}

Table 2: The effect of dietary treatments on hen performance and egg shell quality

Treatments	Egg production (%)	Feed consumption gr d	Feed efficiency kg feed kg egg	Egg weight gr	Breakage egg rate (%)	Shell thickness µm	Shell breaking strength Kg cm3	Egg specific gravity Gr cm3	Egg shape index
T-0	80.9	129.9	2.35	68.21	4.20[a]	346[b]	0.98[ab]	1.084	75.3
T-1	80.7	128.6	2.33	68.66	1.80[c]	348[b]	1.10[ab]	1.084	74.7
T-2	81.1	130.4	2.34	69.70	1.04[d]	351[b]	1.09[ab]	1.083	74.3
T-3	80.5	129.3	2.34	68.62	0.97[d]	356[a]	1.18[b]	1.084	74.1
T-4	79.2	132.1	2.40	69.21	1.48[c]	353[a]	1.26[a]	1.084	74.4
T-5	80.0	130.9	2.37	68.63	0.77[e]	364[a]	1.28[a]	1.086	75.1
T-6	80.1	130	2.36	69.20	2.55[b]	344[b]	1.10[ab]	1.082	75.2
T-7	79.6	128.2	2.30	70.5	1.62[c]	358[a]	1.14[b]	1.084	75.9
SEM	0.628	0.519	0.024	0.218	0.154[d]	1.928	0.22	0.003	0.189
P	NS	NS	NS	NS	**	*	*	NS	NS

NS:Not Significant *: $p< 0.01$

Vit-D3 (Table 2). Also, the lowest breakage egg rate were obtained from eggs collected from hens fed same diet. However, the highest breakage rate and the lowest shell breaking strength was obtained from eggs collected from hens fed basal diet. This results are consistent with a report of Milles *et al.*,[3], Said and Sullivan [1] and Roland and Farmer[17].

CONCLUSIONS

In conclusion, under the conditions of the current experiment, supplemental P did not have an important adverse effect on production performances parameters. Besides the egg weight increased dependent of increasing phosphorus levels. Also, supplemental vitamin-D3 have no important beneficial effect on performance parameters but causing some positive effects on shell quality as increasing of shell thickness and shell breaking strength.Thus using of supplemental vitamin D3 may be recommended to laying hens in late laying period.

REFERENCES

1. Said, N.W., T.W. Sullivan, M.L. Sunde and H.R. Bind, 1984. Effect of dietary phosphorus level and source on productive performance and egg quality of two commercial strains of laying hens. Poultry Sci., 63: 2007-2019.
2. Roa, S.K., F.J. Hoerr and D.A. Sr. Ronald, 1992. Response of early and late maturing commercial leghorn pullets to low levels of dietary phosphorus. Poultry Sci., 71: 691-699.
3. Miles, R.D., P.T. Costa and R.H. Harms, 1983. The influence of dietary phosphorus level on laying hen performance, eggshell quality and various blood parameters. Poult. Sci., 62: 1033-1037.
4. Sohail, S.S. and D.A. Sr. Ronald, 2002. Influence of dietary phosphorus on performance of Hi-line W36 hens. Poultry Sci., 81: 75-83.
5. National Research Council, 1984. Nutrient requirements for poultry. 8th Rew. Ed. National Academy Press, Washington, DC.
6. National Research Council, 1994. Nutrient requirements for poultry. 9th Rew. Ed. National Academy Press, Washington, DC.
7. Cromwell, G.L., 1989. Requirements biological for availability of calcium, phosphorous swine evaluated. Feedstuff, 60: 16.
8. Mikalina, K.S. and J.L. Sell, 1981. Performance of laying hen feds various phosphorus levels continuously of phasefed decremental phosphorus. Poultry Sci., 60: 1916-1924.
9. Said, N.W. and T.W. Sullivan, 1985. Comparison of continous and phased levels of dietary phosphorous for commercial laying hens. Poultry Sci., 64: 1765-1771.
10. Sell, J.L., S.E. Scheideler and B.E. Zahn, 1987. Influence of different phosphorus phase feeding program and dietary calcium level on performance and body phosphorus of laying hens. Poutry Sci., 66: 1524-1530.
11. Hunt, J.R. and H.W.R. Chacey, 1970. Influence of dietary phosphorous on shell quality. Br. Poultry Sci., 11: 259-267.
12. Hamilton, R.M.G. and I.R. Sibbald, 1977. The effect of dietary phosphorous on production performance and egg quality of tenstrains of white legorn. Poultry Sci., 56: 1221-1228.
13. Keshavarz, K. and S. Nakajima, 1993. Re Evaluation of calcium and phosphorous requirements of laying hens for optimum performance and egg shell quality. Poultry Sci., 72: 144-153.
14. Vaiano, S.A., J.K. Azuolas and G.B. Arkinson, 1994. Serum total calcium, phosphorous, 1, 25-Dihydroxycholecalciferol and endochondral ossification defect in commercial broiler chickens. Poultry Sci., 73: 1296-1305.

15. Stevens, V. and R. Blair, 1984. Influence of maternal vitamin D3 carry-over on kidney 25 Hydroxy vitamin D3-1-Hydroxylase activity of poults. Poultry Sci., 63: 765-774.
16. Keshavarz, K., 2003. A comparison between cholecalciferol and 25-OH-cholecalciferol on performance and eggshell quality. Poult. Sci., 72: 144-153.
17. Grunder, A.A. and C.P.W. Tsang, 1990. Effect of Vitamin D3 metabolites on physiological traits of white leghorn hens. Poultry Sci., 69: 12004-1208.
18. Haerms, R.H., A.F. Rossi, D.r. Sloan, R.D. Milles and R.B. Christmos, 1990. A Method for Estimating Shell Weight and Correcting Specific Gravity for Egg Weight in Egg Shell Quality Studies. Poultry Sci., 69: 48-52.