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Effect of Different Levels of Mineral and Vitamin Premix on Laying Hens Performance during the First Laying Phase

Short Communicaion

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ABSTRACT

An experiment was conducted to evaluate the effects of different levels of mineral and vitamin premix on performance and egg traits of laying hens from 37 to 49 weeks of age. Two hundred and forty laying hens (Hy-Line W-36 strain) were randomly assigned to 5 dietary treatments of four replicates each with 12 hens per replicate). The levels of mineral and vitamin premixes in the experiment were 0, 0.15, 0.25 (as recommended by manufacturer), 0.35 and 0.45% of diets and fed to laying hens for 12 weeks. The results showed that the supplementation of different concentration of mineral and vitamin premix improved (P>0.05) the performance of laying hens. The highest percentage of egg production (83.48), the highest amount of egg mass (47.89 g), the best feed conversion (ratio 2.09 g:g) and the lowest price for production per kilogram of (6760 Rials) were observed in group fed: 0.45% of mineral and vitamin premix. Different levels of dietary mineral and vitamin premix did not affect the eggs weight, the amount of daily feed intake and egg traits of laying hens. The overall results of the present study indicate that during the first phase of egg production in laying hens, increasing the levels of dietary mineral and vitamin premix up to 0.45% can improve the performance and reduce the feed cost of egg production.

KEY WORDS egg quality, laying hen, mineral and vitamin premix, performance.

INTRODUCTION

Vitamins and microminerals are defined as groups of complex organic compounds present in small amounts in natural foodstuff that are essential for normal metabolism, and their deficiencies in the diet cause certain diseases (Scott *et al.* 1982). In the recent years, considerable research has carried out to determine the appropriate levels of these nutrients in poultry diets (Inal *et al.* 2001; Nobakht and Taghizadeh, 2008; Nobakht, 2013). Most of these studies are about the reduction or elimination of these compounds from poultry diets (Jafari *et al.* 2005; Afshar *et al.* 2006; Nobakht *et al.* 2008). Removing dietary minerals and vitamins supplements form broiler diets in growing period is possible (Nobakht *et al.* 2008). Also, it was shown that in late laying period noninclusion of dietary minerals and vitamins premixes did not affect the productive parameters and egg traits (Nobakht and Taghizadeh, 2008).

In the first phase of egg production, the nutrients requirements are higher. Therefore, providing sufficient amounts of essential nutrients such as microminerals and vitamins are necessary for health and production of layers (Inal *et al.* 2001). In the first phase of egg production, using two- fold of NRC recommended vitamin levels significantly improved the performance and reduced the cost of production (Afshar *et al.* 2006). Similarly, Nobakht (2013) reported that in the first phase of egg production, using 0.55% of dietary minerals and vitamin premixes improved the performance and egg quality traits of laying hens. Lack of vitamin A in the breeder diets had negative effects on

egg production, egg fertility and hatchability (Bermudez *et al.* 1993). Removing vitamin A from layer diets after 12 weeks, reduced egg production (Sato *et al.* 1994). Laying hens were found to tolerate short term deficiency of riboflavin, but in the long term the production declined (Scott *et al.* 1982). Exclusion of some vitamins and micro minerals from laying hens diets in peak production period (30 weeks) reduced the amount of feed intake and egg production (Inal *et al.* 2001). However, dietary supplements of vitamins C and E above NRC levels could not improve the performance of laying hens (Zagari and Mohiti Asli, 2011). Very less information is available about the precise levels of minerals and vitamin premixes in laying hens diets (especially in the first phase of egg production). Therefore, the present experiment was carried out to see the supplemental effects of increasing levels of these premixes on production performance and egg quality traits of laying hens.

MATERIALS AND METHODS

Two hundred and forty laying hens (Hy-Line W36 strain) were randomly assigned to 5 dietary treatments with four replicates of 12 hens each level of mineral and vitamin premixes in the experiment were 0, 0.15, 0.25 (factory recommended level), 0.35 and 0.45% of diets and fed to laying hens for 12 weeks.

The diets were formulated to meet the requirements of birds established by the NRC (1994) for laying hens (Table 1) and 16L: 8D lighting programme was provided. Environmental temperature and humidity were maintained respectively at 18 °C and 70%. Weekly feed intake, feed conversion ratio, egg production percentage, mass and weight were determined.

Table 1 The composition of basic diet

Ingredients	(%)	Calculated composition	Total
Corn	50	ME (kcal/kg)	2800
Wheat	23.64	Crude protein (%)	14
Soybean meal	16.37	Ca (%)	3.28
Oyster shell	7.14	Available phosphorus (%)	0.31
Bone meal	1.67	Sodium (%)	0.15
Salt	0.28	Lysine (%)	0.67
Inert (sand)	0.40	Methionine + cysteine (%)	0.55
Vitamin premix[1]	0.25	Triptophan (%)	0.19
Mineral premix[2]	0.25		

[1] Vitamin premix per kg of diet: vitamin A (retinol): 8500000 IU; vitamin D_3 (cholecalciferol): 2500000 IU; vitamin E (tocopheryl acetate): 11000 IU; vitamin k_3: 2200 mg; Thiamine: 1477 mg; Riboflavin: 4000 mg; Pantothenic acid: 7840 mg; Pyridoxine: 7840 mg; Cyanocobalamin: 10 mg; Folic acid: 110 mg and Choline chloride: 400000 mg.

[2] Mineral premix per kg of diet: Fe ($FeSO_4.7H_2O$, 20.09% Fe): 75000 mg; Mn ($MnSO_4.H_2O$, 32.49% Mn): 74.4 mg; Zn (ZnO, 80.35% Zn): 64.675 mg; Cu ($CuSO_4.5H_2O$): 6000 mg; I (KI, 58% I): 867 mg; Se ($NaSeO_3$, 45.56% Se): 200 mg.

The amounts of dietary minerals and vitamins premixes were 0, 0.15%, 0.25%, 0.35% and 0.45% in 1 to 5 experimental groups.

The price of feed cost in 1 to 5 groups were 3160 Rails, 3190 Rails, 3250 Rails and 3280 Rails in 1 to 5 experimental groups.

Mortality was recorded as and when it occurred. Eggs collected were classified as normal or damaged; the later including fully cracked eggs (an egg with broken shell and destroyed membrane), hair cracked eggs (an egg with broken shell but intact membrane), and eggs without shell (an egg without shell but with intact membrane). Egg specific gravity was determined through floating the eggs in salty water (Courtis and Wilson, 1990). Content of egg shells was cleaned and shells were maintained at environmental temperature for 48 h until dried, then weighed with a digital scale with an accuracy of 0.01 (g). The thickness of egg shell was measured with a micrometer with an accuracy of 0.001 (mm) in the middle of the egg and in three spots on four eggs. The average was considered as final thickness of egg shell for each experimental unit. Color index of the yolk (Roche color index), yolk index, egg albumin index, Haugh units were determined (Courtis and Wilson, 1990). By multiplying the price of each kilogram of feed by feed conversion ratio, the price of feed for production per kilogram of egg was obtained.

Statistical analysis

The data were subjected to one-way analysis of variance procedures appropriate for a completely randomized design using the General Linear Model procedures of SAS Institute (2005). Means were compared using the Duncan multiple range test. Statements of statistical significance are based on $P < 0.05$.

RESULTS AND DISCUSSION

The effects of different levels of mineral and vitamin premixes on the performance of laying hens are summarized in Table 2.

Use of different levels of dietary mineral and vitamin premix significantly improved ($P<0.05$) the production performance of laying hens. Adding 0.45% mineral and vitamin premix in the diets, improved ($P<0.05$) egg production, egg mass, and feed conversion ratio and decreased ($P<0.05$) the feed cost to each kilogram of egg production. However, different levels of the mineral and vitamin premixes did not affect the egg weight and feed intake in the present experiment. The effects of different levels of mineral and vitamin premix on the egg quality traits are presented in Table 3. Different levels of mineral and vitamin premix in layer diets did not ($P>0.05$) affect the egg quality traits among the various dietary groups of laying hens.

Production level has determining effects on nutrient demand. So, supplementing higher amounts of mineral and vitamin premix improves the bird's health status and production parameters. No effect of dietary mineral and vitamin premix, supplementation on eggs weight might be due

Table 2 The effects of f different levels dietary mineral and vitamin premix on the performance of laying hens

Premixes levels (%)	Eggweight (g)	Egg production (%)	Egg mass (g)	Feed intake (g)	Feed conversion ratio (g:g)	Feed cost / kg egg (Rails)
Control group	56.19	75.52^{b}	42.42^{cd}	100.23	2.36	7457.60^{a}
0.15%	56.22	73.66^{b}	41.42^{c}	99.12	2.39	7624.10^{a}
0.25%	60.79	75.50^{b}	45.89^{cb}	99.86	2.18	7109.40^{b}
0.35%	56.47	77.14^{b}	43.56^{b}	99.74	2.27	7309.40^{ab}
0.45%	57.37	83.48^{a}	47.90^{a}	99.48	2.08	6760.00^{c}
SEM	2.06	1.17	0.65	0.48	0.07	195.67
P-value	0.152	0.041	0.035	0.485	0.072	0.026

SEM: standard error of the means.
The means within the same column with at least one common letter, do not have significant difference (P<0.05).

Table 3 The effects of f different levels of dietary mineral and vitamin premix on some egg quality traits of laying hens

Premixes levels (%)	Specific gravity (mg/mL^{3})	Yolk color	Shell weight (g)	Shell thickness (mm)	Haugh unit
Control group	1.073	3.62	5.54	0.445	76.75
0.15%	1.076	4.04	5.56	0.454	77.76
0.25%	1.085	3.47	5.57	0.455	77.00
0.35%	1.072	4.08	5.27	0.428	74.25
0.45%	1.079	3.24	5.68	0.446	78.52
SEM	0.002	0.41	0.16	0.013	2.04
P-value	0.232	0.632	0. 171	0.256	0.112

SEM: standard error of the means.

to the efficient supplementation of essential nutrients affecting the egg size. These findings are in contrast with other reports showing that use of higher levels of vitamin B_{12} and vitamin E in laying hen diets can increase the egg size (Michael and Edwards, 1992; Saly *et al.* 1996).

Supplementation of more than 0.45% of mineral and vitamin premix in wheat based diets significantly increased the egg weight of laying hen (Nobakht, 2013), However, in another experiment, the beneficial effects of high levels of vitamins E and C on egg size were not observed (Zagari and Mohiti Asli, 2011). Composition of diets, health and production status of hens, and vitamins quality may be other factors determining egg size and could have also resulted in variation of research results. Energy is the main detrimental factor in the amount of feed intake (Scott *et al.* 1982).

In the present experiment, diets were iso-caloric, so the amount of feed intake has not changed by using different levels of dietary premix. Using higher levels of minerals and vitamin supplement could not significantly change the egg weight of laying hens (Afshar *et al.* 2006). In comparison with the egg weight and feed intake, inclusion of 0.45% mineral and vitamin premix in laying hens diet increased the egg production percentage. It may be related to the better supplementation of essential micro-minerals and vitamins.

Some reports showed that the absence of vitamins A and E reduced the amounts of egg production performance of laying hens will be reduced (Bartov *et al.* 1990; Sato *et al.* 1994). The beneficial effect of high levels of dietary micro-minerals and vitamins on egg production percentages of laying hens obtained in our study is in contrast to the findings of Afshar *et al.* (2006) who realized no effect of two fold increase in vitamin supplementation over NRC recommended levels. The highest amount of egg mass was obtained in bird provided 0.45% vitamin and mineral premix which was in agreement with previous study (Afshar *et al.* 2006). Highest egg mass obtained in 0.45% vitamin and mineral premix supplemented group resulting in best feed conversion ratio was in agreement with previous report (Nobakht, 2013). The highest egg production percentage and the best feed conversion ratio achieved by birds receiving 0.45% vitamin and mineral premix in diet and the resultant lowest feed cost to each kilogram of egg production was resulted in this experimental group. This result was also in agreement with Afshar *et al.* 2006; Nobakht. 2013. Different levels of dietary minerals and vitamins premixes could not change the egg quality traits of laying hens.

These findings are in agreement with reports by (Afshar *et al.* 2006; Nobakht and Taghizadeh, 2008; Nobakht *et al.* 2008). It has been reported that by supplementing 0.55% of dietary minerals and vitamins increased the percentage of egg albumin, while the percentage of egg yolk decreased (Nobakht. 2013). The difference in the results of various researchers may be attributed to different levels, composition and quality of commercial premix in diet ingredient and variation in experiment status.

CONCLUSION

Supplementation of 0.45% mineral and vitamin premix during the first phase layer diets, could improve egg production, egg mass and reduce production cost without any adversely affecting egg quality traits.

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