Comparative effects of inorganic and organic selenium sources on performance, eggshell quality and egg selenium content of laying hens

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Abbreviated title: Electrical stunning conditions in broilers

Summary

A total of 150 Hy-Line W-36 laying hens at 38 week of age were randomly assigned into 5 dietary treatments and 3 replicates each with 10 birds. Hens were fed diets including: low-selenium diet without selenium supplementation (basal diet), basal diet plus 0.3 ppm Na-selenite, or basal diet plus 0.1, 0.2 and 0.3 ppm Sel-Plex. The hens performance, eggshell quality and egg selenium content were evaluated on the one-28 period. Egg weight, egg mass, eggshell quality and egg selenium concentration were not affected by the dietary treatments (P>0.05). Overall, feed intake, hen-day egg production and feed conversion ratio were significantly (P<0.05) different among treatment groups. Feed intake was higher in the hens fed 0.3 ppm Na-selenite and 0.2 ppm Sel-Plex diets compared to the basal diet. Feeding diets containing 0.3 ppm Na-selenite and 0.1 ppm Sel-Plex significantly increased feed conversion ratio compared to feeding the basal diet (P<0.05). Percentage of hen-day egg production was lower in 0.1 ppm Sel-Plex diet compared to the basal diet. The results showe that adding the higher levels of Sel-Plex had no adverse effects on layer performance and eggshell quality at the peak of egg mass.

Keywords: selenium, egg, production, layer

Introduction

Selenium has been recognized as an essential dietary nutrient. It is required for maintenance of health, growth, and physiological functions (Cantor et al., 1982). The laying hen's requirement for selenium ranges from 0.05 to 0.08 ppm depending on daily feed intake (NRC, 1994). This selenium requirement can be met by a typical corn-soybean meal diet without additional supplementation. However, selenium content of feed grains widely varies from region to region (NRC, 1994), and thus it is common practice in the poultry industry to supplement laying hen diets.

Traditionally, selenium has been added to poultry diets via inorganic sources, such as sodium selenite. Research has shown that organic selenium is more bioavailable than selenium in sodium selenite (Cantor et al., 1982). Therefore, organic sources of selenium, such as selenium yeast, have been explored as an alternative to inorganic supplementation (Payne et al., 2005). The use of organic selenium results in less selenium being transferred to the environment through feces, and more selenium is deposited into body tissues and eggs. Previously, eggs have been very useful in studying the absorption of various selenium compounds (Latshaw and Osman, 1975). The objective of this study was to evaluate the effect of an organic selenium yeast product when compared with inorganic sodium selenite on performance, eggshell quality and selenium content of laying hens.

Materials and methods

One hundred and fifty 38 weeks old Hy-Line W-36 hens were randomly divided into 5 groups. Each group consisted of 3 replicates with 10 hens per replicate. The hens were fed a low selenium corn-wheat-soybean meal diet calculated to contain 0.07 ppm selenium using NRC (1994) values for a 1-wk pretest period (Table 1). At the end of the pretest period, hens were placed on 1 of 5 experimental treatments: low-selenium diet without supplementation (basal diet), basal diet plus 0.3 ppm of selenium from sodium selenite, basal diet plus 0.1, 0.2 and 0.3 ppm of selenium from Sel-Plex. The hens were housed in a caged layer house of commercial design with water and feed provided *ad libitum* and were exposed to a 16-h daily photoperiod prior to the start of the experiment. Experimental diets were fed to the hens for 4 wk. Selenium content of the diets was measured pretrial. Egg production and mortality were recorded daily. Nine eggs per treatment were randomly selected at the end of the experiment to measure egg weight, shell weight, shell thickness, egg specific gravity, yolk weight, albumin weight and selenium contents of whole eggs. Feed consumption was measured every week, and birds were weighed at the beginning and the end of the experiment. The eggs were cracked and the shells were discarded. The liquid eggs were mixed and homogenized with a malt blender and stored frozen in 12-mL plastic cups until selenium analysis could be conducted. The homogenized eggs and diets were analyzed for selenium by atomic absorption apparatus. All samples were wet digested in nitric and perchloric acids. Data were analyzed using the GLM procedure of SAS software (1998). Mean values were compared by a Duncan's multiple range test. The level of significance was $p<0.05$.

Results and discussion

Overall, feed intake, feed conversion ratio, egg production, egg mass and egg weight data are shown in Table 2. Egg weight and egg mass were not affected by source or level of selenium ($P > 0.05$). Our results for egg weight and egg mass agree with that of De Lange and Elferink (2005) who reported no difference in egg weight and egg mass when hens were fed a basal diet supplemented with Selenite, Selenate or Sel-Plex. Feed intake and feed conversion ratio were affected by source or level of selenium ($P < 0.05$). However, percentage hen-day production was not affected by source of selenium ($P>0.05$), but it was increased in hens fed the basal diet compared with that supplemented with 0.1ppm Sel-Plex ($P<0.05$). This is in support with results obtained by Cantor and Scott (1974). Egg quality parameters (except albumin weight) were not significantly different among treatment groups ($P>0.05$; Table 3). Albumin weight was decreased in hens fed the 0.2 ppm Sel-Plex diet than the others ($P<0.05$).

Conclusion

The results showe that adding the higher levels of Sel-Plex had no adverse effects on layer performance and eggshell quality at the peak of egg mass.

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Table 1: Composition of experimental basal diet

Feed	Quantity (%)
Corn	45.4
Wheat	14.4
Soybean meal (44%)	23
Meat meal (50%)	2.15
Oil	3.1
Dicalcium phosphate	1.4
Oystershell	9.55
Common salt	0.18
Mineral premix[1] (Without Se)	0.25
Vitamin premix[2]	0.25
DL-Methionine	0.17
Vit. D3	0.1
Vit. E	0.1
Total	100.05
Calculated analysis	
ME (Kcal/kg)	2800
Crude protein (%)	16.75
Calcium (%)	4.19
Available phosphorous(%)	0.47
Sodium(%)	0.14
Selenium (mg/kg)	0.07
Methionine (%)	0.44
Lysine (%)	0.84
TSAA(%)	0.7

[1.] Provides per kilogram of diet: Mn, 74.4 mg; Fe, 75 mg; Zn, 64.675 mg; Cu, 6 mg; I, 0.867 mg and Choline chloride, 200 mg.
[2.] Provides per kilogram of diet: Vit A, 8800 IU; Vit D_3, 2500 IU; Vit E, 11 IU; Vit K_3, 2.2 mg; Vit B_1, 1.477 mg; Vit B_2, 4 mg; Vit B_3, 7.84 mg; Vit B_5, 34.65 mg; Vit B_6, 2.462 mg; Vit B_9, 0.48 mg; Vit B_{12}, 0.01 mg; Biotin, 0. 15 mg; Choline chloride, 200 mg; Antioxidant, 1 mg.

Table 2: Treatment effects on performance

Parameters	Basal	0.3ppm SS	0.1ppm SY	0.2ppm SY	0.3ppm SY	SEM
Feed intake (g/h/d)	107.05^{b}	108.9^{a}	107.5^{b}	108.4^{a}	107.2^{b}	0.218
Hen-day production (%)	84.9^{a}	83.8^{ab}	82.8^{b}	84.6^{a}	84.5^{a}	0.256
Egg weight (g)	60.7	60.7	60.7	60.6	60.5	0.218
Egg mass (g//h/d)	51.5	50.9	50.2	51.3	51.1	0.189
Feed conversion ratio(g/g)	2.08^{b}	2.14^{a}	2.14^{a}	2.11^{ab}	2.1^{b}	0.008

$^{a\text{-}b}$Means within a row with no common superscript different significantly(P<0.05).

Table 3: Treatment effects on egg quality

Parameters	Basal	0.3ppm SS	0.1ppm SY	0.2ppm SY	0.3ppm SY	SEM
Egg weight (g)	61.1	61.3	60.9	60	61.1	0.21
Shell weight (g)	5.4	5.5	5.6	5.4	5.4	0.11
Shell percent (%)	8.8	8.9	9.2	9.01	8.7	0.16
Shell thickness (0.01mm)	0.299	0.3	0.299	0.298	0.299	0.001
Egg specific gravity	1.08	1.08	1.082	1.081	1.08	0.001
Albumin weight (g)	39.22^{a}	39.26^{a}	39.28^{a}	38.32^{b}	39.22^{a}	0.152
Yolk weight (g)	16.56	16.52	17.03	16.27	16.56	0.118
Whole-egg Selenium(μg/l)	120.67	135.74	127.4	131.89	145.25	3.655

$^{a\text{-}b}$Means within a row with no common superscript different significantly(P<0.05).

Figure 1: Treatment effects on layer performance

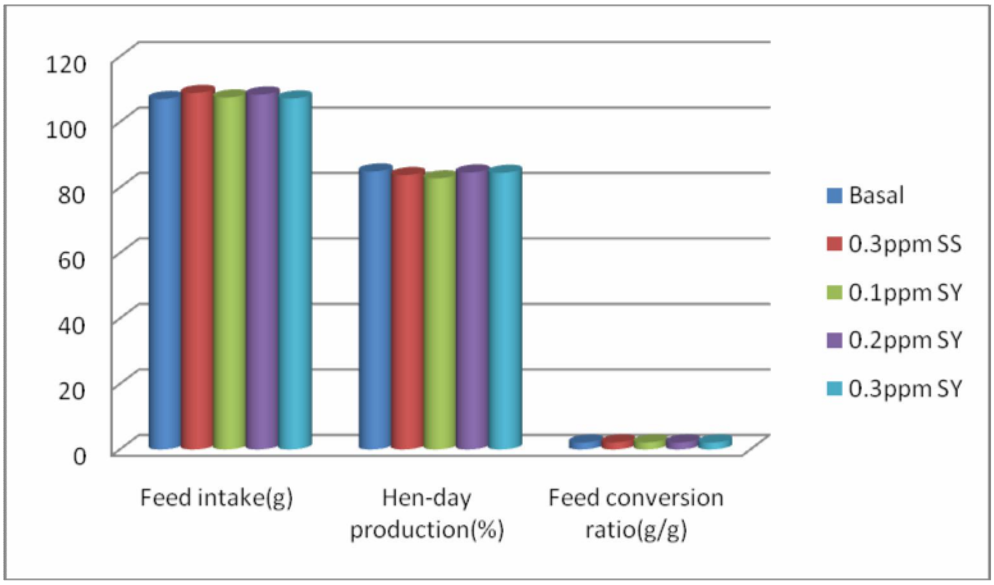

Figure 2: Treatment effect on albumin weight