THE EFFECTS OF SODIUM SELENITE AND SELENIZED YEAST SUPPLEMENTATION INTO DIET FOR LAYING HENS ON SELECTED QUALITATIVE PARAMETERS OF TABLE EGGS

EFECTELE SUPLIMENTĂRII RAȚIEI GĂINILOR OUĂTOARE CU SELENIT DE SODIU ȘI DROJDIILĂ CU SELENIU ASUPRA UNOR PARAMETRII CALITATIVI AI PRODUCȚIEI DE OUĂ PENTRU CONSUM

HENRIETA ARPĂȘOVĂ¹, JÁN WEIS¹, P. HAŠČÍK², MIROSLAVA KAČĂNIOVÁ³

¹Department of Poultry Science and Small Animal Husbandry, Slovak Agricultural University
²**Department of Animal Products Evaluation and Processing, Slovak Agricultural University
³***Department of Microbiology, Slovak Agricultural University
Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic

In this experiment the effects of supplementation of the diet for laying hens with sodium selenite (SS) or selenized yeast (SY) on whole egg and egg shell quality of layers were studied. The chickens of Shaver Starcross 288 strain were randomly divided at the day of hatching into 4 groups (n=12; in each). The birds were fed from Day 1 of life to 9 months of age with diets differing in amounts and/or forms of selenium. Control group received basal diet (BD) containing selenium naturally occurring in feeds (0.1 mg Se/kg of dry matter (DM)). First and second experimental group of chickens were fed with a same BD enriched with equivalent dose of Se 0.4 mg/kg DM in form of sodium selenite or selenized yeast, respectively. The feed for third experimental group of birds consisted of BD supplemented with selenized yeast to the final amount of selenium 1.0 mg/kg DM. The egg weight was significantly higher in the groups with SY supplementation only. On the contrary the egg shell ratio was significantly lower in the groups with SY supplementation in both amounts. The width of egg was significantly increased in the groups with selenium supplementation in both forms. The value of egg shell strength was significantly decreased in group with SY in the highest amount 0.9 mg/kg DM. The average egg shell thickness was the highest in the experimental group with Se-yeast in amount 0.9 mg/kg DM, however different was not significant compared with control group. The results showed that the most of selected parameters of egg quality appeared to be significantly influenced by selenium supplementation into laying hen’s basal diet.

Keywords: laying hens, sodium selenite, selenized yeast, egg weight, egg shell
Introduction

Selenium is recognized as an essential nutrient for domestic livestock, wild animals and humans (Combs, 2001). Given the prohibition of the use of feed antibiotics in the production of poultry meat and eggs, increasing the need to seek a suitable and safe alternative especially as phytobiotics, probiotics (Capcarová et al. 2008) whether supplementation feed mixture of organic forms of elements. Adequate intake of selenium is needed for immunocompetence. Inadequate selenium (Se) supply in combination with low vitamin E status causes deficiency symptoms in many species (Zuberbuehler et al. 2002). Selenium (Se) has a special place among the feed-derived natural antioxidants, being an integral part of selenoproteins participating in the regulation of various physiological processes in the body. As a part of glutathione peroxidase (GSH-Px) (Surai, 2002). Selenium metabolism is complex, and not all chemical forms of Se will induce the same metabolic pathway (Finley, 2007). Although sodium selenite is absorbed from GIT by a simple diffusion process, little is retained in the tissues and enormous part is excreted in faeces of birds in contrast to selenomethionine.

Eggs are a good source of nutrients and play an important role as a functional food in human nutrition (Sparks, 2006). Selenomethionine (so-called 21st aminoacid) increases egg production, improves fertility, antioxidant status, accelerating growth after feather loss in young laying hens and have a positive influence on storage ability of eggs (Edens, 2002). Selenium excess could be detrimental for egg production and shell quality (Stoewsand et al. 1978). Replacement of sodium selenite by organic selenium in the laying hen diet was shown to: improve feed conversion ratio, shell quality, egg freshness during storage, decrease lipid peroxidation during storage. Inclusion of organic selenium in the commercial diet significantly increased the Se level in the perivitelline membrane (Surai, 2006). Golubkina and Papazyan (2006) examined the accumulation of both selenium forms into eggshell of fertile eggs. Incubation of fertile eggs decreased the amount of selenium in eggshell. It was concluded that eggshell might be an additional source of Se for an embryo.

The aims of this study were to determine the effects of diet supplementation with sodium selenite and selenised yeast on the qualitative parameters of whole egg and egg shell of laying hens table eggs.

Material and Methods

Animal, Diets and Treatments

Hens (n=48) of the laying strain Shaver Starcross 288 (SS 288) were randomly divided at the day of hatching into 4 groups (n=12) and fed for 9 months with diet containing different amounts and forms of selenium. The appropriate diets were fed ad libitum in rearing and breeding period for healthy development of laying hens. Basal diet (BD) was fortified with Premix HYD–04 for period 0–6 weeks, Premix HYD–05 for period 7–16 weeks, Premix HYD–06 for period 17–22
weeks and Premix HYD–10 for period 23–36 weeks, respectively. All Premixes were prepared and purchased from Agrokonzult a.s., Dvory nad Žitavou. The composition of the final BD with Premix HYD-10 fed to the laying hens from the 23rd week up to the age of 9 months is presented in Table 1.

Chickens in control group were fed with BD with native content 0.1 mg Se /kg of dry matter (DM). First and second experimental group received the same BD supplemented with equivalent dose of Se 0.4 mg/kg DM of either sodium selenite (SS) or selenized yeast (SY) (Sel–Plex, Alltech Inc., USA), respectively. The BD for the third experimental group was supplemented with SY at a dose 0.9 mg Se/kg DM. The diets for all experimental groups were fortified with corresponding amounts of the yeast extract without Se (NUPRO, Alltech, USA), to obtain the same final levels of yeast extract as in the diet for third experimental group (81.9g per 100kg of feed).

At the beginning of the experiment, the chickens were placed in one–level battery in groups. After rearing the age of 4 months, the birds were then kept in three–level battery for laying hens. Rearing of the chickens started with a lighting regime 23L:1D which was adjusted to 16L:8D after the tree weeks of life. The light regime 16L:8D was kept during egg production. The initial room temperature 32–33 °C was reduced every week by 3°C to a final temperature of 23°C. All birds had free access to water and feed. The experiment was carried out in accordance with established standards for use of birds.

Sample Analysis

Eggs of laying hens of Shaver Starcross 288 strain were collected regularly twice a month (n= 30 per group) and were assessed immediately after collection. The egg weight (g), specific egg weight (g/cm³), length of egg (mm), width of egg (mm), egg shell weight (g), egg shell specific weight (g/cm³), egg shell content (%), egg shell strength (N/cm²) and average egg shell thickness (μm) were detected. All these parameters were detected using routine methods (Arpasova et al. 2007).

Weight parameters were detected using analytical weighting machine and the growth intensity and percentage contents were calculated from weight data. Specific weight of egg shell from ratio of egg shell weight on the air and egg shell weight in the water was calculated. The egg shell strength by electronic device Egg crusher 1.1 (VEIT Electronics, Czech Republic) was detected. Thickness of egg shell on the large end, small end as well as in the centre of egg was also investigated. On the basis of these three values the average thickness of egg–shell was estimated.

Statistical Analysis

Statistical analysis was done using one–way analysis of variance (ANOVA) with the post hoc Duncan’s multiple comparison test.
Results and Discussion

The changes in whole egg and egg shell quality caused by Se supplementation are presented in Table 1. The average weight of analyzed eggs in all groups receiving selenium enriched diets was (59.57±4.16a, 59.27±4.43a, 60.63±4.67b, 60.99±4.16b, P<0.05), respectively. A similar increase of egg weight after administration of organic selenium was found by Payne et al. (2005) or Skrivan et al. (2006). On the contrary Utterback et al. (2005) recorded no differences in egg production, egg weight, feed intake, or mortality in favour of group with organic selenium supplementation. Results of their study indicate that use of Se yeast in laying hens diets is very effective for increasing the Se content of eggs. Sahin et al. (2003) observed the beneficial effect of supplementation of inorganic selenium with vitamin E into the diet for laying hens on the egg weight.

Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BD 0.1 mg Se per kg DM</th>
<th>BD + Se 0.4 mg selenite</th>
<th>BD + Se 0.4 mg Se-yeast</th>
<th>BD + Se 0.9 mg Se-yeast</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg weight (g)</td>
<td>59.57±4.16a</td>
<td>59.27±4.43a</td>
<td>60.63±4.67b</td>
<td>60.99±4.16b</td>
<td>0.0012</td>
</tr>
<tr>
<td>Specific egg weight (g/cm^3)</td>
<td>1.09±0.008</td>
<td>1.08±0.008</td>
<td>1.09±0.005</td>
<td>1.09±0.006</td>
<td>0.4793</td>
</tr>
<tr>
<td>Length of egg (mm)</td>
<td>56.12±2.06bc</td>
<td>55.43±1.40a</td>
<td>55.87±1.53b</td>
<td>56.35±1.69a</td>
<td>0.0011</td>
</tr>
<tr>
<td>Width of egg (mm)</td>
<td>42.61±1.06a</td>
<td>43.0±1.33b</td>
<td>43.21±1.23b</td>
<td>43.09±1.14b</td>
<td>0.0001</td>
</tr>
<tr>
<td>Egg shell weight (g)</td>
<td>6.12±0.52ab</td>
<td>6.03±0.45a</td>
<td>6.07±0.46ab</td>
<td>6.15±0.44b</td>
<td>0.1436</td>
</tr>
<tr>
<td>Egg shell specific weight (g/cm^3)</td>
<td>1.99±0.13</td>
<td>2.01±0.14</td>
<td>2.01±0.10</td>
<td>2.00±0.14</td>
<td>0.5956</td>
</tr>
<tr>
<td>Egg shell (%)</td>
<td>10.30±0.90b</td>
<td>10.20±0.69ab</td>
<td>10.04±0.72a</td>
<td>10.10±0.65a</td>
<td>0.0142</td>
</tr>
<tr>
<td>Egg shell strength (N/cm²)</td>
<td>32.67±6.61b</td>
<td>33.33±6.10b</td>
<td>32.48±5.65b</td>
<td>29.52±7.17a</td>
<td>0.3461</td>
</tr>
<tr>
<td>Average egg shell thickness (μm)</td>
<td>399.71±35.8b</td>
<td>391.69±26.4a</td>
<td>388.56±29.1a</td>
<td>400.40±28.1b</td>
<td>0.0007</td>
</tr>
</tbody>
</table>

Distinct letters in superscripts within a row mean significant differences (P<0.05). Values are means±S.D n=150.
The supplementation of Se did not affect the specific egg weight. The length of egg was significantly lower in group with sodium selenite. On the other hand the width of egg was statistically higher in experimental groups with selenium supplementation in both forms (42.61±1.06a, 43.0±1.33b, 43.21±1.23b, 43.09±1.14b, P<0.05), respectively.

Our explanation is based on the antioxidant features of selenium, which is through seleno–enzymes able to reduce the production of harmful free radicals. Free radicals are initiators of uncontrolled oxidation processes which primarily affect lipids, causing lipid peroxidation of unsaturated fatty acids. The damage of lipids can induce further damage of proteins and DNA (Kelly et al. 1998).

In our experiment the egg shell weight was not influenced by selenium addition. On the contrary improvement egg shell weight by organic selenium presented in their article Rutz et al. (2003). Similarly, replacement of 50% selenite in the laying hen diet by organic selenium associated with a significant increase in egg shell weight in experiment Klecker et al. (2001). The egg shell specific weight was not significantly affected by selenium supplementation. In their experiment, Xavier et al. (2004) recorded improvement of egg shell specific weight. Egg shell ratio was significantly lower in groups with SY supplementation to compare with control group. The value of egg shell strength was significantly increased in control group and the groups with supplementation of selenium in both forms however in group with SY in amount 0.9 mg/kg DM was significantly lower. The supplementation of both forms of Se increased egg shell strength (Richter et al. 2006). Skrivan et al. (2006) found out only the tendency of improving the egg shell strength, when Se from organic source was supplemented into the diet for laying hens. Paton et al. (2000) showed increased egg shell strength due to feeding organic selenium to laying hens. Also a 50% substitution of inorganic selenium by its organic form showed a significant increase in the egg shell strength and egg shell thickness (Klecker et al. 1997). On the contrary the higher percentage of dirty and cracked eggs from hens fed with SY compared to those fed with SS was observed by Payne et al. (2005). Average egg shell thickness was statistically higher in control group and experimental group with SY in amount 0.9 mg/kg of DM. The egg shell thickness was positively influenced by organic selenium (Stoewsand et al. 1978, Klecker et al. 2001) and by inorganic selenium and vitamin E supplementation, too (Sahin et al. 2003).

The results suggest that the supplementation of SY into the diet significantly affected the egg weight only. The most of the qualitative parameters of eggs appeared to be significantly influenced by selenium supplementation in both forms into laying hen’s basal diet.

Acknowledgement

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