The Metabolic Profile in Laying Hens of the Rosso Race After 180 Days of Feed Supplement With Organic Selenium

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Abstract

Selenium is a trace mineral with antioxidant proprieties, which, by mediating the glutathione, indirectly protects the hemoglobin against the risk of oxidation by peroxides through three antioxidant enzymes: superoxide dismutase (SOD), glutathione peroxidase (GSH-Px) and catalase

The experiment was done on 20 laying chicks from the Rosso race, 6 weeks old at the start. The chicks were divided in 2 batches, and one of the batches received feed enriched with organic selenium (Sel-Plex). After 180 days, biological samples were collected by cubital vein puncture and hematological and biochemical determinations were made. The results were tabled, graphically represented and biostatistically interpreted. In the experimental batch significant growths were observed in the erythrocyte constants: erithremie, hemoglobinemy, hematocrite and MCH. Of the biochemical markers significant growths were observed in the case of ascorbic acid, alkaline phosphatase and selenium. The following parameters decrease significantly: proteinemia, amylase and MCV. Changes were also observed in the case of cholesterol, calcium, magnesium and other parameters, but without statistical value.

In the present paper we have shown the beneficial role of organic selenium on some haematological and biochemical markers, resulting in a growth of erythropoiesis, and at the same time an intensification of the metabolic processes in the experimental group.

Keywords: *biochemistry, haematology, laying hens, selenium.*

INTRODUCTION

The role of selenium as an antioxidant is well documented, helping to protect haemoglobin against peroxidation. This is possible with the help of three enzymes: glutathione peroxidase (GSH-PX), superoxide dismutase (SOD) and catalase. (Curcă, 2008; Răduță, 2015). A deficiency of this element can lead to the peroxidation of cellular membranes and so to the release of prostaglandins (Răduță, 2011).

The peroxidation of cellular membranes will lead to the decline of several molecules, including

DNA molecules, and this phenomenon will lead to the progressive appearance of neoplastic diseases (Ghergariu, 1980, Cantor, 2003, Curcă, 2005).

Disorders such as anemia and / or erythrocyte lysis were reported to be directly related to a deficiency in selenium, especially in rats, dogs, primates and also chickens. Supplementation with selenium of the feed regime could lead to the prevention of conditions such as myopathy effusion, bleeding diathesis etc.

The bioavailability of selenium is much better when administered in its organic form

(selenomethionine), the total amount of selenium retained increases because these amino acids are not excreted in urine (Surai, 2006).

MATERIALS AND METHODS

The experiment was conducted in the biobase of the Veterinary Medicine Faculty of Bucharest, on two batches of laying hens, each batch consisting of 10 subjects 16 weeks old, in the period before egg laying. Both batches received the same feed regime, combined feed 21/5, the feed recipe being : protein minerals and vitamins complex 10%, corn 48%, grain 27%, soy 8%, fish wheat 1%, sunflower meal 6% (figure 1). The feed recipe has the following nutritional values : metabolizable energy 2870,15 Kcal/Kg, raw protein 15,60%, methionine 0,29%, lysine 0,70%, fat 2,68%, calcium 1,07%, phosphorus 0,70%.

One of the batches received the feed ration supplemented with organic selenium 1,38 ppm as Sel-Plex, made by AllTech, selenium yeast. After 180 days from the start of the experiment, biological samples were harvested, by cubital vein puncture, with EDTA anticoagulant, 1 – 2 mg/ml blood, and respectively heparin, in order to perform biochemical and hematological determinations.

The count was made with a Coulter Counter automated machine, ACT 5 diff CP-Beckman analyser and respective with the wet Eppendorff

ECOM 1022 analyzer at the Diagnostic and Animal Health Institute in Bucharest.

Selenium calcium magnesium pyruvic acid and ascorbic acid levels were analyzed at the same institute using a spectrometer uv vis, wet biochemistry. Proteins, glucose, phospholipids, lipids, amylase, lipase alkaline phosphatase, and GOT levels were analyzed using the Idexx VetTest Chemistry Analyzer with the kits from Nova Group.

The statistical count of the determinations results were realised using the ANOVA program, and the data were processed using several programs from the Microsoft Office 2010 suite. The results were tabulated, plotted and interpreted biostatistically.

RESULTS AND DISCUSSION

In the batch whose feed was supplemented with organic selenium were found statistically significant increases in erythrocyte constants: erytremie, hemoglobin, hematocrit and MCH (fig. 1) . The following biochemical parameters increased statistically: acid ascorbic, alkaline phosphatase and serum selenium. (Table 1).

A statistically significant decrease was seen in the following parameters : MCV, proteins and amylasemia (fig. 2 and fig. 3).

Modifications of other parameters were seen, comparative between the two batches but without any statistical relevance. Upward trend compared

Tab. 1. The statistically modified parameters (the control group and the experimental group)

Parameters	T Test	Mean dif.	Critical dif.	P value	Dif.
E	M.vs.S	-.625	.143	<.0001	↑S
Hb	M.vs.S	-1.077	.493	.0002	↑S
Ht	M.vs.S	-2.450	1.072	.0001	↑S
MCV	M.vs.S	11.900	5.794	.0004	↑S
MCH	M.vs.S	3.310	1.977	.0025	↑S
Ascorbic acid	M.vs.S	-.468	.422	.0317	↑S
Proteins	M. vs. S	.538	.448	.0213	↓S
Amylase	M. vs. S	100.467	78.085	0.146	↓S
Alkaline phosphatase	M.vs.S	-2.394	2.162	.0319	↑S
Selenium	M.vs.S	-13.947	1.901	<.0001	↑S

E – erytremia (RBC); Hb – hemoglobin; Ht – Hematocrit; MCV – mean corpuscular volume
MCH – mean corpuscular haemoglobin; M. vs. S – martor vs. selenium

Fig. 1. The percentage changes of hematological parameters in chickens whose diet was supplemented with selenium compared with the values of the control batch

Fig. 2. Percentage changes of biochemical indices in chickens whose diet was supplemented with organic selenium

Fig. 3. The percentage changes in indices related to enzymes in chickens whose diet was supplemented with organic selenium

to the control group showed: MCHC, lipids, calcium, magnesium, GOT, acid phosphatase and pseudocholinesterase.

Downward trend compared to the values registered in the control group showed: leukocytes, blood glucose, phospholipids, cholesterol and pyruvic acid levels.

Organic selenium intake in the diet led to an increased erythropoiesis so erythremia shows an increase compared to the group not receiving the selenium supplement by 16.1%. (Curcă and Răduță, 2015)

Also hemoglobin level increases by 9.69%, due to increased number of young red blood cells from the bloodstream. Thus mean erythrocyte hemoglobin (MCH) is higher by 0.15% compared to the value recorded in the control group, the higher erythrocyte count in the hemoglobin is relevant and statistically. (Smith and Picciano, 1987).

Consecutive with the intensification of eritrogenesis, the blood-forming marrow issues a greater number of young red blood cells, the hematocrit value increases in the experimental group by 19.1%. This statistically significant increase in hematocrit suggests an increase in cell mass at the expense of plasma mass. (Surai, 2002)

Decreased mean corpuscular volume (MCV) is due to the large number of young red blood cells recently put into circulation. These present a lower volume than normal volume of a mature red blood cell, MCV has a 11,24% decrease than the control group. (Popescu and Popescu, 1990).

The value increased by 2.43% of the mean corpuscular hemoglobin concentration (MCHC) can be explained by correlating this value, statistically significant with elevated hemoglobin, hematocrit and erythremia levels. Leukocytes count shows a downward trend, but insignificant in statistical terms.

As to the biochemical aspect ascorbic acid levels, presented an outstanding growth trend in the batch of chicks whose diet was supplemented with organic selenium, mean of the ascorbic acid levels in the experimental group was 2.99 mg / dl blood, with a growth of 13.95%.

The pyruvic acid level, had a decreasing trend, the decrease was 8.21%. Lipids in the experimental group, reached the value of 513.9 mg / dl blood serum, thus registering an increase of 3.42% compared to the control group.

The downward trend of the lipase, denotes a better absorption of lipids and a thereof increased hydrolysis in the digestive tract, resulting in a higher absorption of vitamin E, thus avoiding pancreas necrosis dystrophy (Aye *et al.*, 1999, Agate *et al.*, 2000, Apsite, *et al.*, 1993, Mahan, 1995, Poll, 1968).

Increased activity of the acid phosphatase and alkaline phosphatase show an increase in the permeability of cell membranes and in particular in the sarcolemma, so that the enzymes leave the cytosol passing into the bloodstream, this can lead to the establishment of muscle degeneration without evidence of this in the necropsy. (Oster and Prellwitz 1990, Bansal and Kaur, 2002, Pappas, *et al.*, 2004).

The mean values of the amylase in the batch of chickens in the experimental group was 723.575 UA-Smith-Roe, meaning a significant downward trend, with 12.98% from the average values recorded in the control group.

Cholesterolaemia shows a downward trend in the group that received supplementation of the feed regime with selenium, but statistically insignificant, the average value determinations of 78.2 mg / dl in the experimental group opposed to 109.1 mg / dl in the control group (Cornell University College of Veterinary Medicine, 2011)

This values can be interpreted as improving the production of lipid metabolites without intermediaries. In the experimental group was observed a marked decrease in blood glucose this being 223.1 mg / dl blood, 7.30% lower than the control group.

Both calcium and magnesium have a tendency of increasing in the experimental group. Mean serum calcium in the experimental group was 15.08 mg / dL blood and the mean in the control group was 1.7 mg / dl blood. Magnesium also tended to increase, its value being 12.58% higher in the experimental group.

The trend of increase in calcium and magnesium in the control group, indicates a higher mineral metabolism unlike the control group. This is especially beneficial to specialized birds for egg production, they lose a significant amount of minerals in eggshell formation. Thus improving mineral metabolism, different osteoarticular affections are avoided in birds reared in batteries (Allan *et al.* 2000, Apsite, 1994).

The mean peak serum selenium in the group of chickens that received feed supplemented with organic selenium was 21.63%, opposed to 10.36% the average recorded in the control group (21.63% is the distinct difference statistically significant).

Selenium presents a very defined role in its synergy with vitamin E, thus ensuring the body defenses against oxidative stress (Surai, 2000). Also selenium, according to the literature has a particularly important role in preventing many types of nutritional disorders, including: diathesis exudative, muscular atrophy, pancreatic atrophy, necrosis of the liver, reproductive disorders, immune deficiency disorders, osteo-articular disorders etc. (Wepruk, 2003).

CONCLUSION

In the conditions of the current experiment we can see the beneficial effect of feed supplementing with Sel-Plex, by improving certain biochemical and haematological markers, which are factors in preventing states of myopathy exudative, hemorrhagic diathesis and encephalomalacia also ensuring better body development, an index of feed conversion best reared in the experimental group.

Also, one of the biological roles of selenium could be observed, that of its implication in the acceleration of the hematopoietic bone marrow activity, and so its role in the formation of new red blood cells.

By stimulating the erythropoiesis, increasing the red blood cell count, and the haemoglobin, selenium may help to a better tissue oxygenation, so to an increase of the basal metabolism, therefore promoting the growing processes, but also optimizing the productive parameters.

The increase or decrease of these biochemical parameters subsequently to the supplementation of the fodder with organic selenium will result in the prevention of oxidative stress and into a higher efficiency of fodder conversion rate.

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