Exchange processes in the organism of goslings of different ages feeding with selenium-containing fodder supplement

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Abstract. Blood counts vary significantly under the influence of feeding and keeping conditions. According to hematological indicators, one can determine the degree of metabolism in the body. The studies were aimed to identify the effect of selenium-containing feed supplement Bio-Sorb-Selenium on hematological indicators of goslings at different age periods (one-day-old goslings, 30 day-old and 60 day-old goslings). It was established that in one-day old goslings the morphological composition of blood was within the physiological norm and no difference between the groups was observed. At the age of 60 days, the goslings of the control group had less erythrocytes than ones of the experimental groups by 3.57 and 4.64 \%, the hemoglobin content decreased by 4.37 and 7.28 \%, the number of leukocytes – by 5.77 and 7.31 \%, the total nitrogen content decreased by 3.73 and 7.41 \%, the total protein content decreased by 5.67 and 7.21 \%. The introduction of various dosages of Bio-Sorb-Selen into feed increased the content of calcium and inorganic phosphorus due to mineral components. The results obtained indicate the active nature of redox processes in the body of goslings of the experimental groups and increased activity of the hematopoiesis apparatus due to the intensive growth of goslings.

1. Introduction
The main task of industrial poultry farming is to increase production by improving productive indicators and safety of meat. The use of functional feed supplements can prevent poultry diseases, expand the feed supply, realize the full potential of poultry and contribute to the production of environmentally friendly meat. Among the substances that are used to feed birds, microelements, including selenium, play a crucial role. They are necessary for growth, hematopoiesis and endocrine glands, regulation of metabolism, permeability of cell membranes, protective reactions of the body, etc. Selenium is a vital biologically active ultramicroelement, ensures genetic homeostasis of the physico-biochemical status of the body, and its deficiency causes various complications. The body can be supplied with selenium through the use of feed enriched with this element in the form of selenium-containing supplements. The use of selenium-containing preparations can increase productivity of birds, quality of products, physiological and biochemical parameters and protective reactions of the...
body. The use of biologically active substances, including those containing selenium, is a promising direction in poultry farming [1–8].

Quantitative and qualitative indicators of blood are affected by feeding and keeping conditions. According to hematological indicators, one can determine the degree of metabolism which determines the physiological state and productivity of goslings, as well as the effectiveness of feed supplements [9, 10].

However, many issues on the use of feed supplements containing selenium and sorbents are relevant. Among these supplements, one can mention Bio-Sorb-Selen, a feed supplement absorbing toxins and enriching feed with organic selenium. It is necessary to identify the effect of this feed supplement on the body of birds, including geese. Its effect on productivity of geese, morphobiochemical blood parameters have not been studied. In this regard, the use of Bio-Sorb-Selenium as part of compound feeds for goslings-broilers is relevant and has scientific and practical value.

2. Materials and methods
Scientific and economic experiments were conducted on 3000 Italian white breed broiler goslings, divided into 3 groups including 1000 birds. The growing period was 60 days, the growing conditions were similar for all the groups. The entire period of keeping (9 weeks, or 63 days) was divided into two ones: weeks 1–4, weeks 5–9. For goslings of the control group, compound feed (OR) was used, for goslings of experimental group 1 compound feed supplemented by Bio-Sorb-Selenium at a dose of 500 g/t was used; for experimental group 2 compound feed supplemented by Bio-Sorb-Selenium at a dose of 1000 g/t was used.

The study was conducted according to the scheme presented in Table 1.

| Group            | Number of geese | Feeding characteristics                        |
|------------------|-----------------|------------------------------------------------|
| Control          | 1000            | Complete combined feed (CCF)                   |
| Experimental 1   | 1000            | CCF containing Bio-Sorb-Selenium at a dose of 500 g/t |
| Experimental 2   | 1000            | CCF containing Bio-Sorb-Selenium at a dose of 1000 g/t |

Features of the feed supplement. Bio-Sorb-Selenium is a feed supplement absorbing toxins and enriching feed with organic selenium. The producer is LLC Rus-Bio, Moscow. The feed supplement consists of sorbents, namely: shungite, clinoptilolite, montmorillonite, diacetophenonylselenide. It is a loose powder of gray and dark gray color with a specific smell. 1 kg of Bio-Sorb-Selenium contains 250 mg of organic selenium.

Bio-Sorb-Selenium performs several protective functions: enterosorption protection, antioxidant protection, protection against organic peroxides and decay products, stabilization of hormonal disorders, normalization of metabolism, stimulation of the immune system, stimulation of the muscle tissue growth, increase and stimulation of the reproductive functions. The feed supplement was added into the feed by the four-stage method, which allowed the additives to be evenly distributed.

Conditions of keeping and feeding, microclimate parameters were similar in all the groups. During the experiments, zootechnical, hematological, economic and statistical research methods were used.

Monitoring of feeding and the state of health was carried out by studying the blood composition. To study the morphological and biochemical parameters of blood, blood was taken from the wing vein in goslings aged 24, 30 and 60 days one hour before feeding. The following indicators were determined: the number of red blood cells in the counting chamber of Goryaev; the number of white blood cells – in vitro; hemoglobin content with a transforming solution; the color indicator – by calculation; the alkaline reserve – according to the Ponisyak’s method; total protein, residual nitrogen – by a colorimetric analysis on FEC; total nitrogen – by the Kjeldahl’s method; protein fractions in blood serum – with phosphate
buffer for turbidity solutions; calcium – according to the de Waardu’s method; inorganic phosphorus – by the Birgs’ colorimetric method changed by V.Ya. Yudelovich.

3. Results

It is known that the live weight of the experimental bird accurately determines the research conditions, namely the nature and level of feeding. To study the live weight, individual weighing of goslings aged one day was carried out. Then the goslings were weighed every 10 days.

When tested (daily age), the live weight of goslings of all groups was approximately the same and amounted to 92 g. With an increase in age, changes in the live weight, including the difference between the groups, were observed.

At the age of 10 days, the live weight of the control group (546 g) was larger compared with experimental group 1 by 10.92 g, or 2.0 %. In comparison with experimental 2, it was larger by 13.14 g, or 2.41 %. At the age of 20 days, the broiler goslings of the control group (1213 g) were lighter than those from the experimental groups by 30.08 g or 2.48 % and 59.78 g or 4.93 % (P <0.05) respectively. At the age of 30 days, the live weight of goslings-broilers in the control group (2302 g) was less by 85.84 g, or 3.73 %, and 104.54 g, or 4.54 % (P <0.05), respectively.

At the age of 40 days, the live weight of goslings-broilers of experimental group 1 (2964 g) was 109.18 g or 3.82 % (P <0.05) more than in the control group, and in experimental group 2, it was 142.86 g or 5.00 % (P <0.01) more. The live weight of experimental goslings aged 50 days was 148.18 g, or 4.49 % (P <0.05) and 195.16 g, or 5.91 % more than the weight of the control ones (3303 g) P <0.01).

At the end of the experiment (the age of 60 days), the live weight of goose broilers in the control group (3787 g) was less by 207.84 g, or 5.49 % in comparison with experimental group 1 (P <0.01 ), and by 241.50 g, or 6.38 % (P <0.01) in comparison with experimental group 2. The gross and average daily gain in live weight of goslings in the control group (3695 g and 61.58 g) was less than that of experimental group 1 by 5.62 % (P <0.01), and that of experimental group 2 – by 6.54 % ( P <0.01).

The analysis of the live weight dynamics showed that the experimental groups exceeded the control one by this indicator. The live weight in all age periods was larger in goslings fed with Bio-Sorb-Selen. The largest live weight was observed in experimental group 2.

The morphobiochemical blood parameters of experimental goslings are shown in Table 2. The studies have shown that at the age of 24, the morphological composition of blood was within the physiological norm and there was no difference between the groups ( $\overline{X} \pm S\overline{X}$ )

At the age of 30 days, the control group was inferior to experimental groups 1 and 2 by 1.35 and 2.03 % in terms of the number of red blood cells. By the age of 60 days, the number of red blood cells decreased and amounted to (2.80–2.93) x 1012/L. At this age, in the control group, the number of red blood cells was less than in the experimental groups by 3.57 and 4.64 %, respectively. The goslings of experimental group 2 were superior to peers from experimental group 1 by the number of red blood cells (it was larger by 1.03 %).

At the age of 24, goslings had hemoglobin which amounted to 139 g/l. At the age of 30 days, the maximum hemoglobin content was observed in goslings of experimental group 2 – 145.68 g/l, which is more by 4.24 % compared with the control group and by 1.03 % compared with experimental group 1. By the age of 60 days, the hemoglobin content decreased. Moreover, the maximum hemoglobin content (140.48 g/l) was observed in birds of the experimental group 2 that consumed Bio-Sorb-Selenium at a dose of 1000 g/t. At this age, goslings of the control group had a hemoglobin content of 4.37 % less than in those from experimental group 1, and 7.28 % than those from experimental group 2.

At the age of one day, the color indicator was the same in all the groups and amounted to1.63. At the age of 30 days, this indicator was large in goslings of the experimental groups. In the 1st experimental group, the color indicator was greater than in the control group by 1.41 %, but less than in experimental group 2 – by 0.69 %. In experimental group 2, this indicator was greater than in the
control group by 2.11% At the age of 60 days, the same picture was observed: the control group was inferior to experimental group 1 by 1.43 %, and to experimental group 2 – by 3.57 %.

At the age of 24, the number of leukocytes in the birds of all the groups was in the range of (23.43–24.29) x 10⁹/L and there was no significant difference. At the age of 30 days, the number of leukocytes in goslings fed with Bio-Sorb-Selenium is higher compared to the control ones. The number of leukocytes increases significantly with a more intense metabolism associated increased productivity, namely with an increase in the live weight. In the experimental groups, the number of leukocytes is higher by 1.30 and 1.43 %, respectively. At the age of 60 days, the number of leukocytes in the control group was 5.77 and 7.31 % less, compared with experimental groups 1 and 2, respectively. The change in the number of leukocytes in goslings fed with Bio-Sorb-Selenium indicates an increase in the activity of the blood-forming apparatus associated with the intensive growth.

Table 2. Hematological indicators of goslings

| Indicator                        | control           | Group            | Group            |
|----------------------------------|-------------------|------------------|------------------|
|                                  | Daily broiler goslings | Experimental 1 | Experimental 2  |
| Red blood cells x 10¹²/l         | 2.54 ± 0.07       | 2.57 ± 0.06      | 2.55± 0.05       |
| White blood cells, x 10⁹/l       | 23.43 ± 1.33      | 24.29 ± 0.43     | 23.70±0.39       |
| Hemoglobin, g/l                  | 139.66 ± 4.12     | 138.31±2.35      | 139.66± 1.79     |
| Color indicator                  | 1.65 ± 0.01       | 1.62±0.06        | 1.64±0.02        |
| Alkaline reserve, mg %           | 691.31±9.63       | 687.40±3.39      | 692.29± 11.89    |
| Residual nitrogen, mg %          | 18.67±0.51        | 18.47±1.27       | 19.11±0.23       |
| Total nitrogen, mg %             | 1166.99±67.81     | 1133.35±75.54    | 1099.70±76.30    |
|                                  | 30-day goslings   |                  |                  |
| Red blood cells, x 10¹²/l        | 2.96 ± 0.04       | 3.00 ± 0.04      | 3.02± 0.07       |
| White blood cells, x 10⁹/l       | 23.76 ± 0.30      | 24.07 ± 0.39     | 24.10±0.31       |
| Hemoglobin, g/l                  | 139.75 ± 4.22     | 144.20 ± 2.75    | 145.68 ± 1.78    |
| Color indicator                  | 1.42 ± 0.04       | 1.44 ± 0.02      | 1.45±0.04        |
| Alkaline reserve, mg %           | 726.13 ± 14.69    | 729.65 ± 11.43   | 736.69 ± 1.52    |
| Total protein, g/l               | 59.42 ± 4.55      | 61.00 ± 3.41     | 63.50 ± 3.12     |
| Residual nitrogen, mg %          | 18.67 ± 0.67      | 19.14 ± 0.87     | 19.18±0.34       |
| Total nitrogen, mg %             | 969.33 ± 73.14    | 976.25 ± 54.60   | 1035.14 ± 49.09  |
| Calcium, mmol/l                  | 4.23 ± 0.08       | 4.24 ± 0.04      | 4.27±0.08        |
| Inorganic phosphorus, mmol/l     | 0.97 ± 0.03       | 1.00 ± 0.03      | 1.02±0.03        |
|                                  | 60-day goslings   |                  |                  |
| Red blood cells, x 10¹²/l        | 2.80 ± 0.07       | 2.90 ± 0.14      | 2.93±0.11        |
| White blood cells, x 10⁹/l       | 22.72 ± 0.59      | 24.03 ± 0.19     | 24.38±0.39       |
| Hemoglobin, g/l                  | 130.95 ± 5.61     | 136.67 ± 2.90    | 140.48 ± 2.52    |
| Color indicator                  | 1.40 ± 0.07       | 1.42 ± 0.05      | 1.45±0.06        |
| Alkaline reserve, mg %           | 717.26 ± 8.60     | 723.97 ± 18.05   | 724.96 ± 2.40    |
| Total protein, g/l               | 60.63 ± 0.91      | 64.07 ± 2.13     | 65.00 ± 1.59     |
| Residual nitrogen, mg %          | 18.29 ± 1.19      | 21.71 ± 0.87     | 21.90 ± 2.52     |
| Total nitrogen, mg %             | 988.42 ± 13.55    | 1025.26 ± 34.08  | 1061.71 ± 26.23  |
| Calcium, mmol/l                  | 4.37 ± 0.17       | 4.58 ± 0.09      | 4.67±0.09        |
| Inorganic phosphorus, mmol/l     | 1.11 ± 0.02       | 1.13 ± 0.03      | 1.18±0.03        |

At the age of 30 days, the serum calcium content was lower in the goslings of the control group by 4.23 mmol/L, which is 0.24 % less than in experimental group 1 and by 0.95 % less than in experimental group 2. At the age of 60 days, compared with 30-day old goslings, the calcium content increased in all the groups: by 0.14 mmol/l in the control group, by 0.34 mmol/lv of in experimental
group 1 and by 0.49 mmol/l in experimental group 2. At the age of 60 days, in the control group this indicator was less than in experimental group 1 by 4.81 %, and less than in experimental group 2 – by 6.86 %.

At the age of 30 days, the content of inorganic phosphorus was the smallest in the goslings of the control group – 0.97 mmol/L, which is 3.09 % less than in experimental group 1, and 5.15 % less than in experimental group 2. At the age of 60 days, the content of inorganic phosphorus increased in all the groups. The introduction of the Bio-Sorb-Selenium feed additive into the feed increased the content of inorganic phosphorus in the blood serum of goslings aged (60 days. In the control group, this indicator was less than in experimental group 1 by 1.80 %, less than in experimental group 2 by 6.31 %. Thus, the introduction of Bio-Sorb-Selen into compound feeds increased the content of calcium and inorganic phosphorus in the blood serum, which is associated with the content of mineral components in the supplement.

At the daily age, the alkaline reserve was almost the same in all the groups – 690.33 mg %. By the age of 30 days, compared with the beginning of cultivation, this indicator increased in all groups: in the control group by 34.82 %, in the experimental group – by 42.25 %, in the experimental group – by 44.40 %. The alkaline reserve in the control group was less than in the experimental groups by 0.48 and 1.45 %. By the age of 60 days, alkaline reserve decreased in all the groups: in the control group – by 8.87 %, in experimental group 1 – by 5.68 %, in experimental group 2 – by 11.73 %. The largest alkaline reserve in was observed in goslings of experimental group 2 that consumed Bio-Sorb-Selenium at a dose of 1000 g/t, which is 1.07 and 0.14 % more than in experimental group 1.

At the age of 24 days, the total nitrogen content was 1133.35 mg %. By the age of 30 days, this indicator decreased in all the groups. At this age, the total nitrogen content in the control group was lower than in experimental group 1 by 0.71 and 6.79 %, respectively. By the age of 60 days, this indicator increased in all the groups. At the age of 60 days, the total nitrogen content in the control group was less than in the experimental groups by 3.73 and 7.41 % respectively.

The content of residual nitrogen at the age of one day was almost the same in all the groups and was 18.47–19.11 mg %. By the age of 30 days, its content increased in the experimental groups, while in the control group it remained unchanged. At this age, in the groups where the goslings were fed with Bio-Sorb-Selenium, it was higher than in the control group by 2.52 and 6.11 %, respectively. By the age of 60 days, the content of residual nitrogen increased in the experimental groups, but decreased in the control one. Moreover, its amount was maximum in experimental group 2 (21.90 mg %), which is more than in the control group and experimental group 1 by 19.74 and 0.88 %, respectively. This manifestation is due to the action of Bio-Sorb-Selenium containing organic selenium and sorbents (shungite, clinoptilolite, montmorillonite, diaacetophenonyl selenide).

At the age of 30 days, the total protein content in the control group was less than in the experimental ones by 2.66 and 6.87 %. In the control group, the total protein content increased by 2.04 %, and in the experimental ones, it increased by 5.03 and 2.36 %, respectively. At the age of 60 days, in the control group the total protein content was 5.67 and 7.21 % less compared with experimental groups 1 and 2.

4. Conclusion

The results obtained indicate the active nature of redox processes in the body of goslings of the experimental groups, which might be due to the action of the Bio-Sorb-Selenium supplement, namely, the action of the organic selenium in it.

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