The effective application of a complex of essential elements (Se, Zn, I) to increase the meat productivity of poultry feeding on diets with a high level of cadmium

S V Lebedev, O A Zavyalov* and A N Frolov
Federal Research Center of Biological Systems and Agricultural Technologies of the Russian Academy of Sciences, 29, January 9 st., Orenburg, 460000, Russia

*E-mail: Oleg-zavyalov83@mail.ru

Abstract. The research was carried out in the conditions of LLC “Poultry farm Orenburgskaya”, the Orenburg region, Russia. For the experiment, 120 hens of the Hisex-Brown cross were selected, of which, according to the principle of analog pairs, 4 groups were formed (n=30): one control and three experimental. According to the experimental method, the poultry was under conditions of the preparatory period up to 13 weeks of age. In the period from 14 to 16 weeks of age, the poultry from the experimental group I took, in addition to the main diet, cadmium sulfate salt (CdSO₄) at a dosage of 40 mg / kg of feed, the poultry from the experimental group II took cadmium sulfate at the same dosage and a complex of essential elements: Se in the form of sodium selenite 0.44 mg / kg feed; Zn (zinc sulfate 178 mg / kg feed); the poultry from the experimental group I (potassium iodide - 0.46 mg / kg feed); the poultry from the experimental group III took only a complex of essential elements (Se, Zn, I). It was found that the weight of the gutted poultry carcass and the ratio of the edible and inedible parts of the poultry of the experimental group I, which took cadmium sulfate in the diet, exceeded the analogs from the control group by 5.5 (P≤0.01) and 8.1% (P≤0.05), while the total weight of the digestive tract in poultry of the experimental groups I, II and III were higher than the same indicator established for individuals from the control group by 27.0% (P≤0.05); 44.9% (P≤0.05) and 30.5% (P≤0.05), respectively. By the meat content index, the poultry of the experimental group I exceeded the control one by 9.3% (P≤0.05), while the chickens of the experimental groups II and III, on the contrary, were inferior to the control one by 5.6 (P≤0.05) and 2.5% (P≤0.05), respectively. There were no significant differences in the slaughter yield between the poultry of the experimental and control groups.

1. Introduction
It is well known that minerals (Co, Cu, Fe, I, Mn, Mo, Se and Zn, etc.) are necessary for the normal functioning of almost all biochemical processes in the body [1-3]. They are part of various enzymes, coordinate many biological processes and affect the health and productivity of farm animals [4-6]. However, not all microelements are useful for the body. Numerous studies have established that some toxic elements and, in particular, cadmium (Cd) can contribute to serious damage to some organs, disrupting their functions and causing a wide range of diseases [7,8]. So, due to its ability to bioaccumulate in the body [9], cadmium is associated with kidney disease, anemia, osteoporosis, osteomalacia, chronic rhinitis and eosinophilia [10,11], causes leukemia [12,13]. The toxic effect of cadmium can be expressed in a decrease in indicators of reproductive function, cause structural and
functional disorders in the reproductive system, and also reduce the productivity of farm animals and poultry [14].

In this regard, one of the important tasks facing zootechnical science is the development of ways to reduce the level of toxic load of cadmium on the body of farm animals and poultry in order to improve productive qualities. One of these methods is the formation of neutral complexes of cadmium with essential elements by introducing the latter into the diet at different periods of growing. The most studied elements capable of preventing the absorption, transport and use of cadmium in the body are such essential elements as selenium [15], zinc [16] and iodine [17,18]. However, the existing experimental material, as well as theoretical concepts, on this issue, contain contradictions, which determined the relevance of the studies carried out.

2. Materials and methods
The research was carried out in the conditions of LLC “Poultry farm Orenburgskaya”, the Orenburg region, Russia. For the experiment, 120 hens of the Hisex-Brown cross were selected, of which, according to the principle of analog pairs, 4 groups were formed (n=30): one control and three experimental. According to the experimental method, the poultry was under conditions of the preparatory period up to 13 weeks of age. In the period from 14 to 16 weeks of age, the poultry from the experimental group I took, in addition to the main diet, cadmium sulfate salt (CdSO4) at a dosage of 40 mg / kg of feed, the poultry from the experimental group II took cadmium sulfate at the same dosage and a complex of essential elements: Se in the form of sodium selenite 0.44 mg / kg feed; Zn (zinc sulfate 178 mg / kg feed); the poultry from the experimental group I (potassium iodide - 0.46 mg / kg feed); the poultry from the experimental group III took only a complex of essential elements (Se, Zn, I).

Feeding and keeping of poultry was carried out in accordance with the recommendations of All-Russian Scientific Research and Technological Institute of Poultry (2009) [19]. At the end of experimental studies (16 months), experimental poultry were slaughtered, 5 heads from each group according to the method of All-Russian Scientific Research and Technological Institute of Poultry (1992) [20]. Studies to assess the quality of meat were carried out at the Center for Shared Use, created on the basis of the Federal Scientific Center for Biological Systems and Agricultural Technologies of the Russian Academy of Sciences.

The essentiality of differences was checked using the Mann-Whitney U test. Significance level (P) was taken to be less than or equal to 0.05. The data were processed using the Statistica 10.0 software package («Stat Soft Inc.», USA).

3. Results
Comparative analysis of the data obtained during the experiment revealed a significant effect of the studied mineral additives on the slaughter qualities of the experimental poultry (figure 1).

In particular, it was found that by the weight of the gutted carcass and the ratio of edible and inedible parts, the poultry of the experimental group I, which took cadmium sulfate in the diet, exceeded the analogs from the control group by 5.5 (P≤0.01) and 8.1% (P≤0.05), while the total weight of the digestive tract of poultry of the I, II and III experimental groups was higher than the same indicator established for individuals from the control group by 27.0% (P≤0.05); 44.9% (P≤0.05) and 30.5% (P≤0.05), respectively.

On meat content index, the poultry of the I experimental group exceeded the control one by 9.3% (P≤0.05), while the chickens of the II and III experimental groups, on the contrary, were inferior to the control by 5.6 (P≤0.05) and 2.5% (P≤0.05), respectively. In terms of slaughter yield, the poultry taking cadmium sulfate (group I) was 2-2.8% ahead of the poultry from the control group, as well as from the second and third experimental groups.
Figure 1. Results of control slaughter of experimental poultry, g.

It should be noted that the feeding of mineral supplements with different biological roles during the period of 14-16 weeks influenced the chemical composition of the experimental poultry body (figure 2).

Figure 2. Chemical composition of the empty body of the experimental poultry: a - water; b - dry substance; c - protein; d - fat
It was found that the poultry of the experimental group I was inferior to the control by the percentage of dry substance in the body by 4.0% (P≤0.05), protein by 5.1% (P≤0.05) and fat by 20.7% (P≤0.05), while the experimental group III, on the contrary, exceeded the indicators for dry substance by 5.6% (P≤0.05) and fat by 20.7% (P≤0.05).

When comparing the absolute values of the content of chemical substances in the poultry body no substantial differences were recorded (figure 3).

![Figure 3. The content of chemicals in the empty body of the experimental poultry, g / head](image)

4. Discussion of the results

Comparative characteristics of the research results showed that the poultry of the experimental groups that received mineral elements with different biological roles exceeded their peers from the control group in terms of the weight of the gastrointestinal tract by 27.0 - 44.9%. At the same time, the fact that the maximum values of the studied indicator were noted for a poultry group that consumed a complex of essential elements together with cadmium deserves some attention. It can be assumed that an increase in the productive qualities and mass of internal organs under the influence of feeding complexes of essential elements was a consequence of the influence of the latter on metabolic, enzymatic and biochemical processes in the body [21, 22], however, the fact of a significant increase in the mass of the gastrointestinal tract and the mass of half-gutted carcass of young chicken when feeding toxic cadmium, has not been previously described in the available literature and requires further study.

In our experiment, a difference was found in the value of the meat content index of the studied groups. So, the maximum value of the studied indicator was characterized by young poultry that received cadmium sulfate (CdSO₄) in the diet at a dosage of 40 mg / kg of feed. An explanation of this phenomenon is possible, taking into account the accumulated data on violations of bone mineralization against the background of the inclusion of cadmium in the diet. So, it was found that as a result of the consumption of cadmium increased doses, it is possible that the activity of the system of absorption and transportation of calcium decreases, which is a manifestation of antagonistic relationships between these elements.

It was found that the body of a poultry that consumed cadmium sulfate contained less dry substance, protein and fat, while a chicken that took a complex of essential elements, on the contrary, had the highest rates, while a chicken that took cadmium sulfate in combination with a complex of essential elements occupied an intermediate position. This fact indirectly indicates a decrease in the level of toxic load of cadmium under the action of a complex of essential elements, which confirms the previously described antagonistic nature of the interaction between toxic cadmium with essential zinc, iodine and selenium [15-18].
5. Conclusion

Thus, the research results showed the ambiguous nature of the influence of the complex of essential elements on the productive qualities of poultry feeding on diet with high level of cadmium. At the same time, the fact of a significant increase in the weight of the gastrointestinal tract and the weight of a half-gutted poultry carcass when feeding toxic cadmium has not been previously described in the available literature and requires further study.

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