

## RESEARCH ON THE EFFECT OF ORGANIC SELENIUM ADMINISTRATION ON BODY WEIGHT AND SOME HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS IN BROILER CHICKENS

### CERCETĂRI PRIVIND EFECTUL ADMINISTRĂRII SELENIULUI ORGANIC ASUPRA GREUTĂȚII CORPORALE ȘI A UNOR PARAMETRI HEMATOLOGICI ȘI BIOCHIMICI LA PUII DE CARNE

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#### ABSTRACT | REZUMAT

Research was carried out on 20 broiler chickens (Cobb 500, 3 weeks old), divided into two groups, ten individuals in each group. Both groups were fed with the 21/1 broiler chicken feed ration, finishing period. The experimental group received, in addition to the standard diet, an organic selenium supplement (ALKOSEL R397), 0.25 grams/1 kg combined feed (i.e., 0.5 ppm Se). The duration of the experiment was four weeks. Determinations consisted of haematological and biochemical investigations, and assessment of body weight every week. At the end of the experimental period, it was found that the body weight of broiler chicks in the experimental group was higher than the value recorded in the control group. Haematological and biochemical investigations showed positive aspects following supplementation of the feed ration with selenium in the experimental group. All individuals showed an increase in the number of erythrocytes, haemoglobin, haematocrit, and leukocytes. As concerning the biochemical profile, increased calcium, magnesium and selenium values were noted.

**Key words:** body weight, broiler chicken, diet, selenium

Cercetările au fost efectuate pe 20 de pui broiler (Cobb 500, în vârstă de 3 săptămâni), împărțiți în două grupuri de câte zece indivizi în fiecare grup. Ambele grupuri au fost hrănite cu rația de hrană 21/1 pentru pui broiler, perioada de finisare. Grupul experimental a primit în plus față de dieta standard un supliment organic de seleniu (ALKOSEL R397), 0,25 grame /1 kg hrană combinată (adică 0,5 ppm Se). Durata experimentului a fost de patru săptămâni. Determinările au constat în investigații hematologice, biochimice și în evaluarea săptămânală a greutății corporale. La sfârșitul perioadei experimentale s-a constatat că greutatea corporală a puilor de carne din lotul experimental a fost mai mare decât valoarea înregistrată la lotul martor. Investigațiile hematologice și biochimice au evidențiat aspecte pozitive în urma suplimentării rației de furaj cu seleniu în lotul experimental. Grupul a avut creșteri ale numărului de eritrocite, hemoglobină, hematocrit și leucocite. În profilul biochimic s-au observat creșteri ale calciului, magneziului și seleniului.

**Cuvinte cheie:** greutate corporală, pui broiler, dietă, seleniu

Broiler chickens in the meat industry are genetically selected for the fastest growth rate with the most efficient feed intake. For this purpose, in modern animal husbandry, a whole series of vitamin-mineral supplements that have positive effects on growth, but also on haematological and biochemical parameters, are used (3, 4, 7, 11). At the same time, these vitamin-mineral supplements improve the intestinal absorption of nutrients, thus ensuring a better feed conversion (24). The accelerated metabolic rate of these chickens, coupled with the industrial breeding system and high temperatures, can have negative effects on the health of the broiler chickens and on the meat as a finished product (26). Worth mentioning is also the fact that ensuring the optimal temperature is particularly important in animal husbandry, exceeding the limit of thermal comfort and having negative effects on

production (8, 16, 17, 18). The chicken meat is a nutritional product, with a high digestibility derived from its protein and, respectively, from its amino acid richness, the maintenance of its physicochemical and microbiological characteristics being a very important aspect (20, 21, 22, 29, 33). Growth and the immune system's well-functioning are negatively affected by different types of stress, leading to molecular and hormonal dysfunctions (1, 10, 13, 14, 15, 30). The use of antioxidants is recommended to assist different biological systems in scavenging reactive oxygen, resulting in further reduction of lipid peroxidation and improved antioxidant barrier activity (23). Several researchers have demonstrated that supplementing the feed ration with organic selenium in broiler chickens reduces the effects of reactive oxygen species on lipids, as well as on various metabolic processes (2, 6, 28). Selenium is an element that protects the haemoglobin molecule against peroxidation through the activity of three enzymes: superoxide dismutase (SOD), catalase and glutathione peroxidase (GSH-Px) (27, 28).

This experiment aims to demonstrate the effect of organic selenium on body weight as well as on haema-

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tological and biochemical indicators in broiler chickens.

## MATERIALS AND METHODS

The experiment took place in the biobase of the Faculty of Veterinary Medicine in Bucharest and was conducted on two groups of Cobb 500 broiler chickens: a control group (n=10) and an experimental group (n=10). The experiment was conducted in the warm season, the total duration of the research being 4 weeks. Each group consisted of 10 subjects aged three weeks old at the beginning of the experimental period. The sex of the individuals in the two groups was not taken into account because, in intensive rearing systems, birds are slaughtered when they reach the optimum weight, regardless of sex. Both experimental and control flocks received the same feed regime: 21/1 broiler combined feed, finishing period. Feed was administered ad libitum.

The feed was purchased from the National Research and Development Institute for Animal Biology and Nutrition, Romania (IBNA Balotesti). The recipe of the compound feed was as follows: cereals, soybean and sunflower meal, calcium phosphate, calcium carbonate, salt, amino acids and vitamins and minerals premix. The feed ration had the following nutritional characteristics: crude protein 17.20%, metabolisable energy 3140 kcal/kg, methionine 0.35%, methionine and cystine 0.65%, lysine 0.90%, calcium 0.86%, phosphorus 0.70%, choline 0.004%, and salt 0.30%. It did not contain coccidiostats.

The experimental group was fed with 0.25 g/kg combined feed, i.e., 0.5 ppm organic selenium in the form of ALKOSEL R397 from Lallemand Animal Nutrition SA, France. The control group received the diet without this supplement.

Body weight was determined for both groups during each week of the experimental period.

At the end of the experimental period, blood samples were collected for haematological and biochemical examination. A cubital vein puncture was performed, with 1-2 ml of blood on EDTA and, respectively, heparin being collected.

The red blood cell count was performed at the IDSA

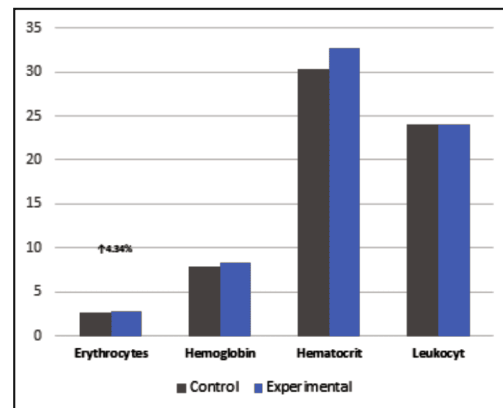
(Institute of Diagnostics and Animal Health) in Bucharest with an ACT5 diff CP-Beckman machine. Leukocythemia was performed in the Physiopathology laboratory at the Faculty of Veterinary Medicine, Bucharest.

The determination of glucose, cholesterol, GOT/ASAT, GPT/ALAT, ALKP, calcium, magnesium and selenium was carried out at the Institute of Diagnostics and Animal Health Bucharest by the chlorimetric method. Determinations of total protein, amylase and lipase were carried out in the Laboratory of the Faculty of Veterinary Medicine Clinic, Bucharest, using special kits and VeTTest from Idexx Laboratory.

The determinations were carried out for each individual, and the average value was calculated for the respective group. The statistical interpretation of the obtained data was performed using the standard T test (Student test).

## RESULTS AND DISCUSSIONS

The haematological investigations in the group that received organic selenium-supplemented feed revealed higher values of the following parameters: RBCs, haemoglobin (Hb), haematocrit (HCT) and MCH. The MCV and MCHC showed a slight decreasing trend (Table 1, Fig. 1 and Fig. 2).



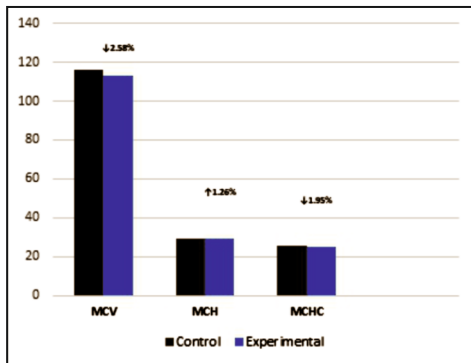
**Fig. 1.** Mean values of some haematological parameters in broiler chickens - primary erythrocyte constants

**Table 1**

**Mean values of the haematological investigations, comparatively, in both study groups of broiler chickens**

Parameter	Control Group	Experimental Group	Variation percentage (%)
<b>E x 10<sup>6</sup> / <math>\mu</math>L</b>	2.7	2.82	<b>↑4.34*</b>
<b>Hb g/dL</b>	7.86	8.3	<b>↑5.44*</b>
<b>HTC %</b>	30.3	32.72	<b>↑7.68*</b>
<b>MCV <math>\mu</math><sup>3</sup></b>	116.17	113.6	<b>↓2.58</b>
<b>MCH pg Hb/E</b>	29.1	29.47	<b>↑1.26</b>
<b>MCHC g Hb/dL E</b>	25.7	24.9	<b>↓1.95</b>
<b>Leucocyte x 10<sup>3</sup>/<math>\mu</math>L</b>	23.97	24.1	<b>↑1.29</b>

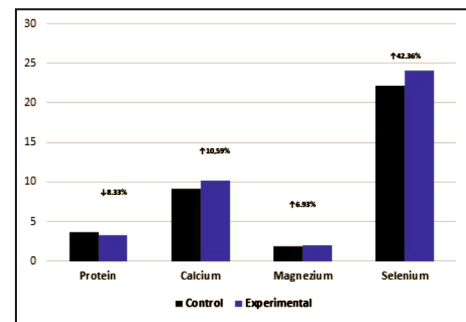
\**p*<0.05 – significant differences



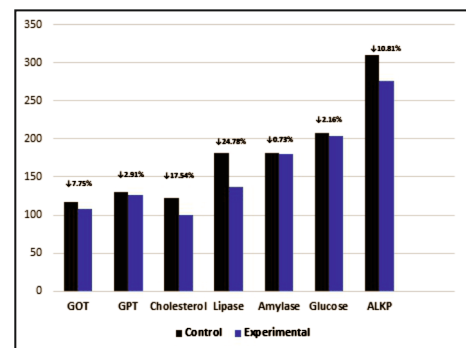
**Fig. 2.** Mean values of some haematological parameters in broiler chickens - secondary erythrocyte constants

Supplementing the feed ration with selenium enhances erythropoiesis; thus, in the experimental group, the mean RBC number shows an increasing trend compared to the control group by 4.34% ( $p < 0.05$ ). At the same time, the haemoglobin mean value increased by 5.44% ( $p < 0.05$ ), leading also to an increase of the mean erythrocyte haemoglobin (MCH) value, this value being 1.26% higher than the one recorded for the control group, thus showing a better haemoglobin loading of the erythrocytes. Similar results following the effect of the intake of organic selenium in broiler chickens were also obtained by other authors (4, 9, 12). As a result of increased erythropoiesis, younger erythrocytes are released from the haematogenous bone marrow, resulting in a 7.68% increase of the mean haematocrit value ( $p < 0.05$ ) compared to the control group. The increased haematocrit values can indicate an improvement in cell mass at the expense of plasma mass and an improvement in the antioxidant status of the birds in the experimental group (25). The decreasing trend of the MCV and MCHC mean values in the experimental group can be explained by the appearance of new red blood elements in the blood circulation, which have a smaller vo-

lume. A slight increase in the number of leukocytes can also be observed, which can be explained by the improvement of the immune system in the experimental group. As concerning the biochemical parameters, there were recorded higher values of calcium, magnesium and selenium. In the experimental group, the following parameters showed lower values: total proteins, alkaline phosphatase, GOT, GPT, cholesterol, glucose, amylase and lipase. (Table 2, Fig. 3, Fig. 4).



**Fig. 3.** Mean values of some biochemical parameters (total protein, Ca, Mg, Se) in the two groups of broiler chickens



**Fig. 4.** Mean values of some biochemical parameters (GOT, GPT, Chol, Glu, Amy, Lip) in the two groups of broiler chickens  
The decrease of the serum proteins mean values in

**Table 2**  
Mean values of the biochemical parameters in the two study groups of broiler chickens

Parameter / measurement unit	Control Group	Experimental Group	Variation percentage (%)
Prot. g/dl	3.6	3.3	↓8.33
ALKP U/L	309.8	276.3	↓10.81
GOT U/L	117.5	108.6	↓7.75
GPT U/L	130.6	126.8	↓2.91
Chol. mg/dL	122	100.6	↓17.54*
GLU mg/dL	208.3	203.8	↓2.16
Amylase U/L	181.16	179.83	↓0.73
Lipase U/L	181.6	136.6	↓24.78*
Ca µg /dL	9.201	10.176	↑10.59*
Mg µg/dL	1.888	2.019	↑6.93
Se µg/dL	22.21	31.62	↑42.36*

\* $p < 0.05$  – significant differences

**Table 3**  
**Temperature and body weight values for the individuals**  
**from the two study groups in weeks 1-4 of the experiment**

Week	Group	kg	%
<b>I</b>	Control Group	1.89	↑10.43*
	Experimental Group	2.1	
<b>II</b>	Control Group	2.48	↑7.81*
	Experimental Group	2.69	
<b>III</b>	Control Group	2.77	↑15.29*
	Experimental Group	3.77	
<b>IV</b>	Control Group	3.45	↑12.8*
	Experimental Group	3.96	

\* $p < 0.05$  – significant differences

the experimental group is explained by the increased basal metabolism. The decrease of the lipase, GOT, alkaline phosphatase and GPT activity in the experimental group, compared to the control group, indicates that in the control group, there is an increase in the permeability of the cell membranes, particularly the sarcolemma, so that the enzymes leave the cytosol and enter the bloodstream, which favours muscle degeneration (5, 19).

In the experimental group, a decrease in blood glucose levels could be observed, the mean value being 2.16% lower than in the control group. The decrease of the blood glucose concentration can be explained by a reduction of its availability due to the intensive use of glucose in cellular metabolic activities (19). Amylase values in the group of chickens fed with selenium supplementation had a slight decrease (0.73%) compared to the control group. The mean cholesterol value was 100.6 mg/dL blood, which represents a decrease of 17.54% ( $p < 0.05$ ) compared to the control group receiving the regular feed ration without selenium supplementation. This low cholesterol value can be interpreted in the context of an improved lipid metabolism.

Lipase in chickens fed with organic selenium supplementation had lower levels, with an average value of 136.6 U/L, a difference of 24.78% ( $p < 0.05$ ) compared to the control group. Selenium deficiency can lead to poor lipid absorption and lipid hydrolysis in the digestive tract. This aspect leads to a marked decrease in the absorption of vitamin E, the deficiency of this vitamin can evolve with a necrotic dystrophy of the pancreas (27). A marked increase in calcemia and selenium concentration can also be observed in the experimental group, the mean value of calcium being 10.176 µg/dL, an increase of 10.59% ( $p < 0.05$ ) compared to the control group.

The selenium mean value in the control group was 22.21 µg/dL, in contrast to the group that received the feed diet together with organic selenium supplementation, where the mean selenium value was 31.62 µg/dL, 42.36% higher ( $p < 0.05$ ). This aspect indicates an improvement of the mineral metabolism. An additional intake of organic selenium in the diet of broiler chickens, which have a very fast growth rate, is desirable to prevent the occurrence of osteoarticular disorders (30).

At the end of the first week of the experimental pe-

riod (Table 3), the mean body weight of the experimental group individuals was 2.11 kg, in contrast to the control group, which recorded a 10.43% lower value ( $p < 0.05$ ).

After the second week of the experimental period, the average weight of the experimental group was 2.60 kg, and the weight of the control group was 2.48 kg. The difference was 7.81% in favour of the experimental group ( $p < 0.05$ ).

Data on body weight at the end of the 3<sup>rd</sup> week of the experiment were as follows: the experimental group had an average body weight of 3.27 kg, while the control group had an average of 2.27 kg. Thus, broiler chicks from the group receiving the diet supplemented with organic selenium had a 15.29% higher body weight than the control group ( $p < 0.05$ ).

In the last week (week 4) of the experiment, the average body weight of the experimental group was 3.96 kg, 12.8% higher than the control group which had an average of 3.45 kg ( $p < 0.05$ ). This finding can be explained by a better feed conversion rate and a better assimilation of nutrients in the experimental group (31). The faster and extensive growth spurt can be explained by the effect of selenium on the haematogenous bone marrow, which intensifies the process of erythropoiesis and thus releases a greater number of erythrocytes.

The effect of selenium on phospho-calcic metabolism was reported by several researchers. They noted that SeO<sub>2</sub> is able to decrease calcium and phosphorus excretion, increase their resorption and incorporation into bone. This may be one of the effects of selenium involved in stimulating the growth rate (2, 32).

## CONCLUSIONS

Supplementation of the feed ration with organic selenium resulted in higher body weight gain in the experimental group, for every week of the experimental period. In the experimental group we found higher values for RBCs, haemoglobin, hematocrit, and MCH and lower values for MCV and MCHC. We observed in the experimental group lower values for proteinemia, alkaline phosphatase, GOT, GPT, cholesterolaemia, glycaemia, amylase and lipase, and higher values for calcemia, magnesia and selenemia.

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