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Organic selenium effect on body temperature and body weight in broilers

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Abstract

The research was conducted on a group of 20 3-weeks-old chicken from the Cobb breed that were divided into two batches. Both batches received a 21/1 ratio feed diet for broiler chicken in their finishing period. The experimental group feed was supplemented with 0.5 ppm selenium, with 0.25 ALKOSEL R397 g/kg mixed fodder. 30 days into this feeding regime, the following determinations were made weekly: body weight, body temperature and computerized thermography of the comb and wattle. The obtained results were tabled and bio statistically analyzed revealing that individuals in the experimental batch showed statistically significant increases of the values for body weight (average body weight was 14.78% larger than that of the control batch) and of the temperature measured in the combs (average temperature was 12.97% higher) and wattles (average temperature was 4.12% higher). The experimental group also registered a higher core body temperature, but not statistically significant in comparison with the control group. Association of the higher values of core and peripheral body temperature with increased body weight in the individuals from the experimental group, correlated with an increased number of red blood cells and lower cholesterol levels suggest an improved basal metabolism and a better feed conversion.

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Introduction

Commercial broilers that were genetically selected for a higher growth rate and provided with a balanced diet and superior health care measures showed an increase in body weight. Open-sided poultry houses can affect the birds' productive performances (1), meat quality and their immunity and can cause stress through constant dynamic variations in temperature and humidity of the environment.

Another major stressor for chicken is heat, due to the birds' high metabolic rate and increased body temperature, associated with the lack of sweat glands (2).

In tropical countries, the high temperature of the environment causes severe financial losses to poultry through reduced feed intake and decreased efficiency of the feed conversion (3). One solution for minimizing these adversities in the tropics is the supplementation of the feeding diet with organic selenium (Se).

The normal cell metabolism continuously produces and releases free radicals and reactive oxygen species (ROS) in the biological system (4, 5).

Use of appropriate antioxidants is recommended to help the biological system by scavenging reactive oxygen, subsequently reducing lipid peroxidation (LP) and increasing the activity of the biological antioxidant defense system (6).

Weight gain and good function of the immune system are negatively impacted by different type of stress, leading to hormonal and molecular alterations as well as lipid peroxidation. (7, 8).

Research has shown that supplementation of broilers' diets with antioxidants reduces the effects of ROS on lipid peroxidation and metabolism (9, 10).

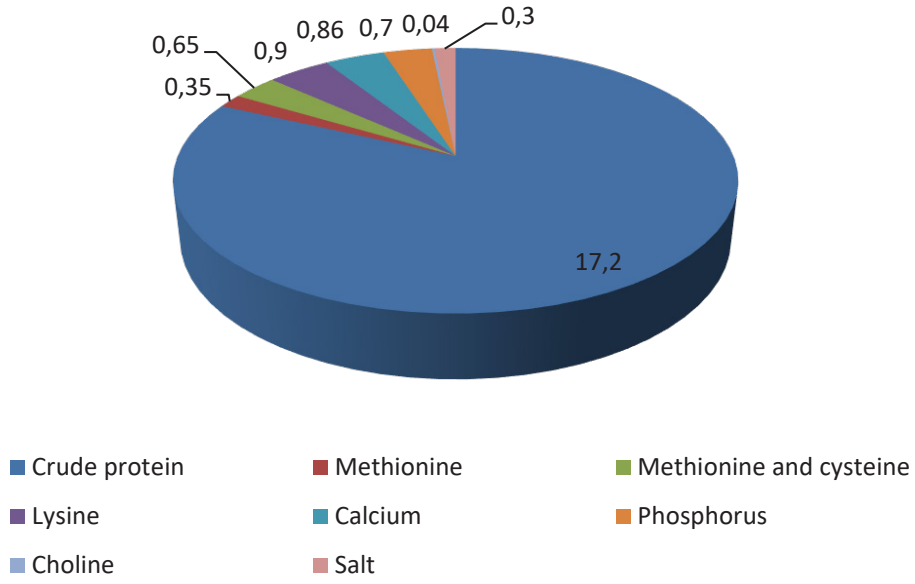

Figure 1. 21/1 finishing period, fodder recipe.

Selenium helps protect the hemoglobin against peroxidation by means of three enzymes: superoxide dismutase (SOD), glutathione peroxidase (GSH-Px) and catalase (11, 12).

The experiment was meant to demonstrate the effects that organic selenium has on the development of the body and on body, comb and wattle temperatures in the experimental batch. The conclusions are supported by other scientists that have conducted research on the subject and obtained similar results.

Materials and Methods

The experiment took place in the bio base of the Faculty of Veterinary Medicine of Bucharest and was conducted on two batches of broiler chickens of the Cobb 500 breed. One batch for the experimental procedure and one batch for the control group. Each lot contained 10 3-weeks-old individuals at the beginning of the experimental period, both sexes in each lot. We did not take into account the sexes of the broiler chickens because in the intensive system they are to be sacrificed when they reach the optimum weight without regarding male and female chicken

Both the experimental group and the control group received the same feed regime: 21/1 ratio feed diet for broiler chicken, finisher stage. The feed regime was administrated ad libitum. The diet was purchased from National Research Development Institute for Animal Biology and Nutrition, Romania (IBNA) (**Fig. 1**).

The fodder (diet, feed regime) contained cereals, soybean meal, sunflower meal, corn gluten meal, calcium phosphate, calcium carbonate, salt, amino acids and vitamins and minerals premix.

The feed had the following nutritional values: crude protein – 17.20%, metabolizable energy – 3140 kcal/kg, methionine and cysteine – 0.65%, lysine 0 0.90%, calcium – 0.86%, phosphorus – 0.70%, choline – 0.004%, salt – 0.30%. It did not contain coccidiostats.

The experimental group had its feed supplemented with 0.25 g/kg M.F, 0.5 ppm organic selenium as ALKOSEL R397, obtained from Lallemand Animal Nutrition SA France. The control group received the normal feed.

The experiment was performed in June 2016 and the air temperature in the bio base was between 25 and 28°C for the experimental period (30 days).

After 30 days, the following determinations were made: computerized thermography of the comb and wattle, body weight control and measurements of the body temperature at the cloacal region. The results were tabled and bio statistically interpreted using the ANOVA program and Microsoft office 2010 software (**Table 1**). Weighing of individuals was made us-

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

Parameters	T Test	Mean dif.	Critical dif.	P value	Dif.
Body weight	M. vs. Se	-.510	.375	**.0105**	**↑S**
Body temperature	M. vs. Se	-.190	.338	**.2525**	**NS**
Combs temperature	M. vs. Se	-.996	.598	**.0026**	**↑S**
Wattels temperature	M. vs. Se	-1.350	.483	**<.0001**	**↑S**

M. vs. Se: Martor vs. Selenium; NS: insignificant

ing a regular scale. Body temperature measurement was made using a regular electronic thermometer at the cloacal region. Computerized thermography was possible by kindness of the Faculty of Veterinary Medicine, Bucharest, Surgery Department. The computer thermograph is a MMS Med 2000 edition. The computer thermograph was used for determination the temperature in the combs and wattles area. The image is captured by an infrared sensor and send to a computer where with the special software (MMS Med 2000) the interpretation of the temperatures could be read. The determinations were made for each individual bird and at the end of the experiment average arithmetic mean was made.

Results

Average body weight was with 14.78% higher in the experimental group. Temperatures at the combs and wattles were 12.97% and 4.12% higher in the group that received the organic selenium supplemented fodder.

At the beginning of the experimental period the mean body weight value of the control group was 0.609 kg and the mean bodyweight value of the experimental group was 0.613 kg.

In the supplemented group we could see after the experimental period an increase in chickens body weight (**Fig. 2**). The mean body weight of the control group was 3.45 kg and at the experimental group was 3.96 kg.

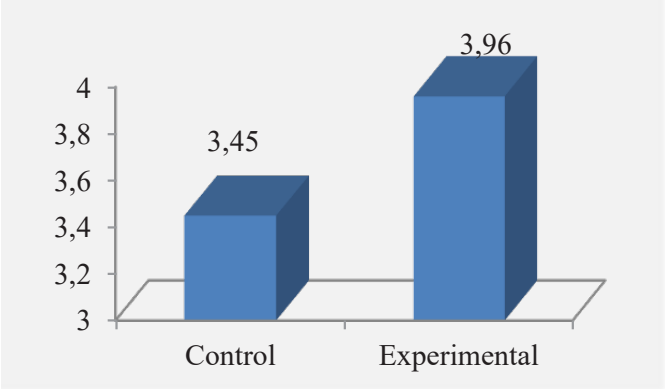

Figure 2. Body weight value (kg) in the experimental and control group.

Thermographic investigations have shown statistically relevant differences regarding comb and wattle temperatures in the control group (**Fig. 3**).

For the experimental group the average temperature was 34.40°C, while the average temperature registered for the control group was 30.45°C, which is 12.97% lower (**Fig. 4**). These results were statisticaly significant.

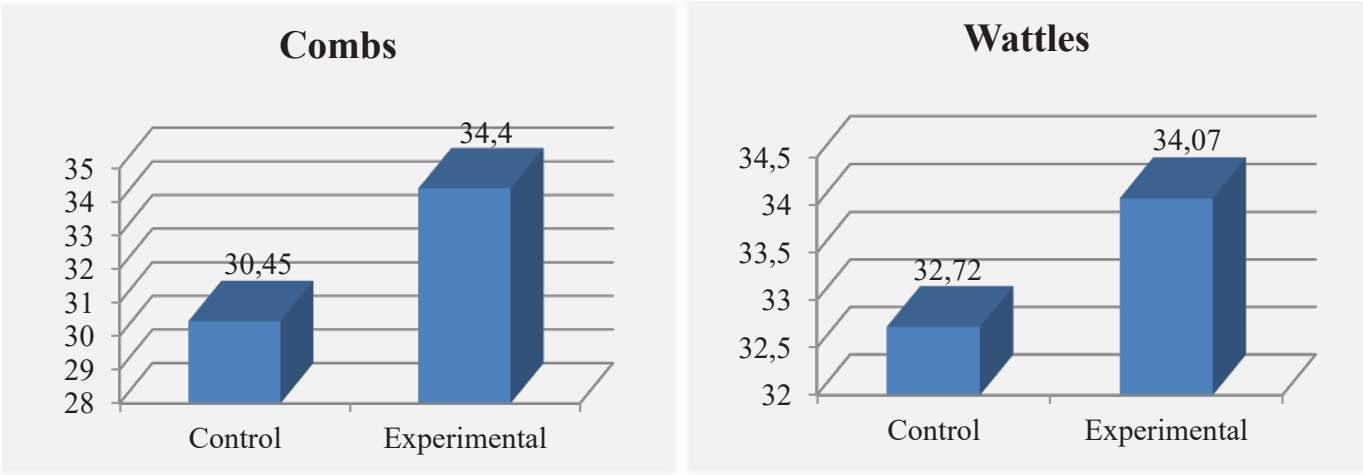

Figure 3. Thermographyc exam in comb and wattle (°C).

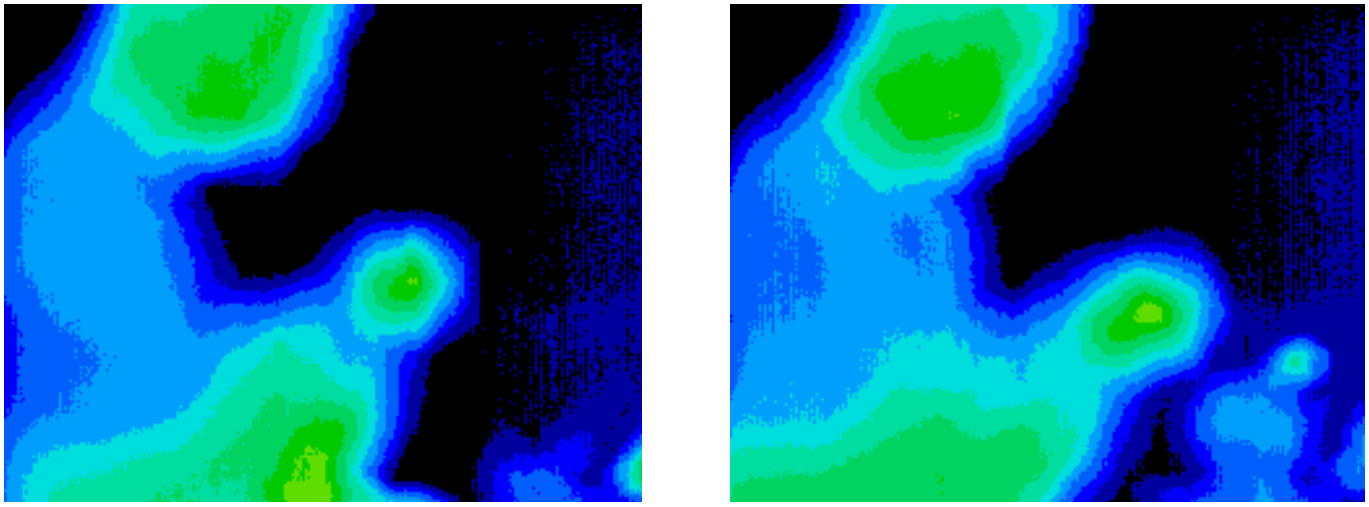

Figure 4. Thermographic aspects of broiler's comb and wattles (left-control group, right experimental group).

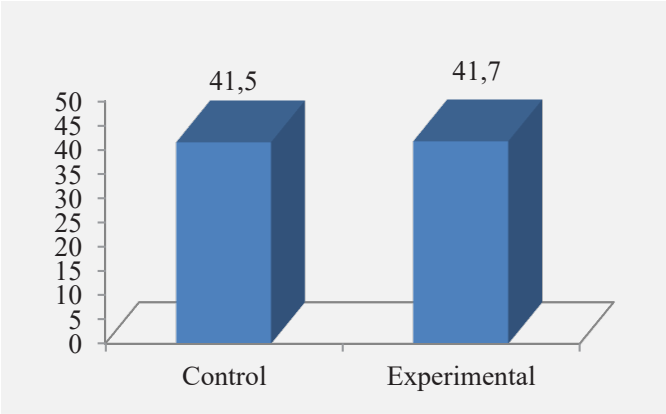

Figure 5. Body temperature in broiler chickens (°C).

We also determined a higher wattle temperature in the experimental group of 34.07°C, which is by 4.12% higher than the one determined in the control group.

Fodder supplementation with organic selenium did not have a statistically significant impact on core body temperature (**Fig. 5**). The average body temperature of the individuals in the control group was 41.5°C, and 41.7°C in the experimental group.

The differences in peripheric temperature between the two batches could easily be observed with the naked eye. The combs and wattles of the individuals in the experimental group were intensely colored in red, while the ones of the individuals in the control batch were paler (**Fig. 6**).

Discussions

The higher values registered for body weight and comb and wattle temperatures can be explained by organic selenium's effect on intensifying blood circulation.

Therefore, a better blood circulation leads to a greater basal metabolic rate, providing tissues and organs with more oxygen and nutrients. Furthermore, the harmonious development of the body is facilitated by avoiding the negative effects of oxidative stress (13). Inclusion of selenium in chicken diet increase the ability to remove oxygen free radicals and lipid peroxide, and alleviated the degree of tissue damage caused by oxygen-free radicals (14).

Similar results were obtained and published by researcher A Naylor et al. in 2009, highlighting the beneficial effects of organic selenium in body weight gain and feed conversion rate.

Antioxidant supplementation (i.e. tocopherol, retinol, selenium, ascorbate, etc) in broiler diets is commonly used as a practice to alleviate the negative effects of heat stress. The relationship between heat stress and the increased production of free radicals (FR) and reactive oxygen species (ROS) is well established. These agents react destructively with cellular molecules (e.g. proteins, DNA, lipids) and cause cell damage.

The use of antioxidants at low concentrations can act as neutralizers of FR and ROS without harming cellular components (15). Antioxidants are present in sufficient amounts in the body to account for the normal rate of FR generation during nutrient oxidation and metabolism (redox homeostasis).

However, in a stressful environment in which inherent antioxidant defenses increase, there may be the need for the addition of antioxidants to the diet (16). While there are reports illustrating the beneficial effects of antioxidant supplementation on improving performance of heat stressed broiler chickens, it is important to keep in mind that many of these studies exposed birds to temperatures as high as 32-35°C for six weeks (long-term heat stress). Furthermore, some studies have used a constantly high temperature during the day and night. These patterns of heat stress seldom occur normally (17, 18)

Chickens reared industrially are subject to various stressors that lead to a decrease of their productive and reproductive performances. Supplementing the fodder with antioxidants proved to be benefic by preventing the negative effects of the diffrent stressors (19, 20). Besides being a natural antioxidant that can be supplemented in poultry feed, organic selenium plays an important role in the first and second level of antioxidant defense mechanisms (21).

Figure 6. Color of the comb and wattle (left control group, right experimental group).

Conclusions

Fodder supplementation with organic selenium leads to a statistically relevant larger body weight of the individuals.

Peripheral temperatures are higher in the individuals from the experimental group than in the individuals from the control group: the average comb temperature is higher by 12.97% and the average wattle temperature is higher by 4.12%.

The supplemented diet does not have a significant impact on core body temperature.

Conflict of interest statement

The authors declare there is no conflict of interest.

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