Effects of Heat Stress on Some Physiological Indicators to the Broilers Cobb

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Abstract

Four groups of Cobb broilers aged 14 days and average body weight of 480 g, grown in terms of age-appropriate diets were exposed to elevated ambient temperatures 38º-40ºC, varying by experimental scheme for a period of three weeks. Weekly body weight, rectal temperature, haematocrit and haemoglobin were determined and the results compared with those obtained in the control group. Body weight recorded significant drops of 7% in group 3 starting from the first experimental week. Rectal temperature increased on average by 5.5% for groups 2 and 3 and for group 4 the increase was insignificant. In the dynamics of haematocrit there was a significant decrease of 7.2% in lot 3 in the first experimental week. Haemoglobin recorded in group 2, a significant decrease in the first two weeks averaged 5.8%, and 6.8% in group 3. It was found that the adaptation to the high temperature of the environment was achieved by the reduction of energy metabolism following low food ingestion and biochemical changes at the cellular level.

Keywords: Cobb broilers, haematocrit, haemoglobin, heat stress

1. Introduction

Neuroendocrine mechanisms initiated to the action of various stressors are relatively stereotyped: the first is simpatico-adrenal system and then second the hypothalamic-adenohypophysis-adrenal system that are able to preserve or restore homeostasis [1].

In many geographical areas in the world, heat stress is an important aggressor factor for the welfare and productivity of birds [2]. Climate changes in the last years that have affected Romania, forcing the bird's body to adapt at the new conditions especially in the hen farming households.

Birds perceive environmental stimulus as stressors differently, depending on their individual experience regarding the duration, intensity and frequency of contact with them, depending on the degree of phenotypic expression of genotype at the action of a stimulus [3-5]. In this context the phenomenon of heat tolerance can be a manifestation of the ability of some birds breeds to considerably increase heat loss by convection and radiation or may be a genetic advantage [6]. Thermo tolerance can be increased by acclimatizing birds after repeated exposure to high ambient temperatures [7, 8]. The study looked at adaptive physiological response of birds under repeated exposure to heat stress.

2. Materials and methods

From a population Cobb were selected 120 broilers males and females aged 14 days to close the average body weight (480 g) and were formed four groups of 30 chickens each. The experimental period was three weeks.

At the first, control group, the growing program included 23 hours of light and a standard diet for broilers (starter, grower and finisher).

For starter diet, the protein was 23% (lysine+methionine), for grower diet the protein was 21% (lysine+methionine) and for finisher diet the protein was 19%. For the first group, the

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environmental temperature was 30°C during the first week, the second week 28ºC and 26ºC in the third week, and a relative humidity of 55-65%. Water and food were administered ad libitum. Weekly body weight, rectal temperature, haematocrit, and haemoglobin were determined.

In the second group, the program of environmental temperature was the same but for two hours weekly (between 12^{oo}–14^{oo} p.m.), broilers were exposed to 38ºC. On the last day experimental ambient temperature was increased to 40°C for two hours. At 30-45 minutes after each weekly exposure, the following determinations were performed: body weight, rectal temperature, haematocrit, and haemoglobin.

Broilers of the third group, had the same program ambient temperature as those of the control group, but were exposed daily for two hours (at noon, between 12-14 PM) at an environmental temperature of 38ºC. Also the last day of the experiment the environmental temperature was raised at 40°C for two hours. Adaptive capacity of broilers was assessed by the same physiological indicators determined weekly, as the other groups on days 21, 28 and 35.

Last group, the fourth group, was exposed daily for one hour at ambient temperature of 38ºC and in the rest of time the ambient temperature coincided with the control group. In the 35th day of the experiment, ambient temperature was increased to 40°C for two hours. The same determinations were made, under the same conditions.

Blood samples were collected individually from the axillary vein, in EDTA syringes, heparinised capillary tubes were used for haematocrit and for haemoglobin the blood was analysed by the colorimetric method with cyanmethhemoglobin. Data were statistically interpreted using the Student test.

3. Results and discussion

In heat stress conditions thermoregulation in birds is mainly done by decreasing thermogenesis, because the possibilities for thermolysis (radiation, convection, conduction) are lower compared to mammals. Exposure of birds to heat stress has directly effect a reduction in energy metabolism by decreasing feed intake and feed efficiency with delayed growth rate [9]. In order to increase the body's birds resistance to the action of the heat stress it was followed the development of a thermotolerance by their acclimatization to high ambient temperatures [10].

In the first two weeks, the exposure of broilers to elevated ambient temperatures caused significant increases in rectal temperature by 5% in group 2 and by 6% in group 3.

The reaction to temperature stress was more intense in group 3 than in group 2, because the exposure to heat had a higher frequency. For broiler group 4, the daily exposures at 38°C during one hour did not trigger significant changes in the rectal temperature value (Figure 1), which means that the frequency and duration of the heat stress was optimal, thus achieving a much better heat condition.

At the 35th experimental day when heat shock was induced by raising the ambient temperature to 40°C for two hours, significant increases in rectal temperature (on average 6.5%) were recorded, only for broilers in group 2, (Figure 1). In broilers of groups 3 and 4 the variation of the rectal temperature was insignificant. It can be argued that through the daily exposures of broilers at 38ºC, for duration of 1-2 hours, it is possible to install thermotolerance.

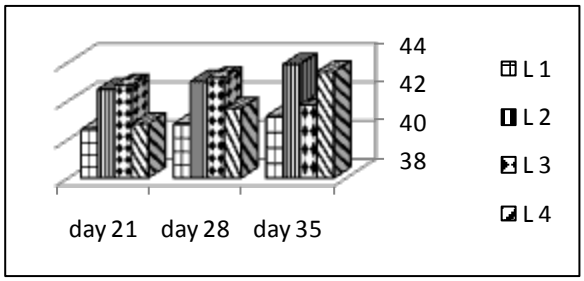

Figure 1. Rectal temperature variation depending on ambient temperature to broilers Cobb

It is known that up to this age of 35 days, broilers do not have full coverage of the body with plumageș it is possible to have better caloric radiation depletion. This can be correlated with the possibility of adapting to thermal shock when the duration and frequency of previous heat exposures were ideal for stimulating cellular thermo tolerance.

Heat conditioning is associated with peripheral blood leukocyte synthesis of some polypeptides known as heat shock proteins (HSPs) but also with increased glycoprotein and glutathione synthesis in liver tissue [8].

In the conditions of the upward fluctuations of the ambient temperature there is a thermal discomfort which causes the reduction of the feed consumption and the decrease of the body weight (Figure 2).

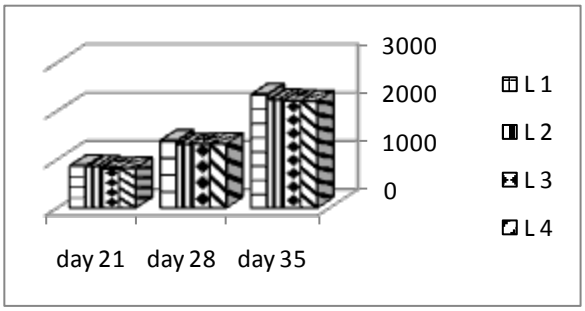

Figure 2. Variation in body weight depending on the ambient temperature to broilers Cobb

Also, the upward variations in ambient temperature have led to an increase in water consumption favouring rapid intestinal transit of fodder, thus reducing their digestion and absorption.

In the first experimental week there was a significant decrease of 7% in the mean body weight in group 3. Over the next two weeks there were significant and uniform decreases (on average 6.5%) in the average body weight at all three experimental lots as a result of decreased appetite, interest in food and the appearance of immobility.

Increased intestinal motility, absorption and defective protein use (intensification of protidic catabolism and mobilization of functional and structural proteins) justify the quantitative decrease in haematocrit and haemoglobin (Figures 3 and 4).

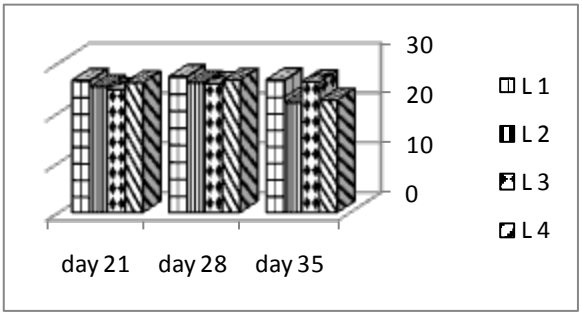

Figure 3. Haematocrit variation depending on ambient temperature to broilers Cobb

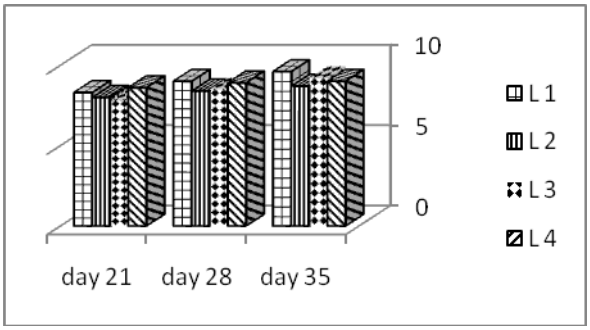

Figure 4. Haemoglobin variation depending on ambient temperature to broilers Cobb

In the first week there was a significant decrease of 7.2% in the value of haematocrit, only in group 3. In the second week there were significant and uniform decreases (on average 5.2%) in all three experimental groups.

In the third week, a significant increase of 5% in the haematocrit value was found in group 2, probably due to the installation of the dehydration state as a result of the heat shock. In groups 3 and 4 there is an insignificant decrease in haematocrit as a result of achieving thermo tolerance and thus the recovery of the protein catabolism (Figure 3).

In haemoglobin variation in the first two experimental weeks there were significant decreases, on average of 5.8% for group 2 and 6.8% for group 3; and for group 4 insignificant decreases.

In the third week there were significant decreases in haemoglobin of 9.4% for group 2 and 6.2% in group 3; and for group 4 insignificant decreases (Figure 4).

4. Conclusions

Adaptation of birds to the elevated temperature of the environment was achieved by reducing the energy metabolism on the basis of low food intake.

The condition of thermo tolerance during a maximum two hours in the three-week experimental interval was daily exposures of chickens from groups 3 and 4 at 38°C.

Decreased haemoglobin in all three groups over the entire experimental period is correlated directly with protein deficiency, which is also mirrored in their low body weight.

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