The effectiveness of the Madufor® feed additive in hyperthermia conditions for broiler chickens

M I Slozhenkina, Z B Komarova, V V Golovin, O E Krotova and E N Tarasov
Volga Research Institute of Production and processing of meat and dairy products, Volgograd

E-mail: niimmp@mail.ru

Abstract. Among the severe lightning-fast pathological processes that affect farm animals and poultry of all age categories, it is worthwhile to highlight overheating and dehydration, which are especially common in the southern regions of the country. The paper presents the results of studies on the effectiveness of Madufor® feed additives in heat stress of broiler chickens. According to the results of hematological studies, it was found that the content of red blood cells, hemoglobin, hematocrit and platelets in the blood of chickens of the control group was at the upper boundary of the physiological norm or slightly exceeded them. Thus, the level of red blood cells in the control group was $4.18 \times 10^{12} / l$, hemoglobin $107.11 g / l$, hematocrit $39.32\%$ and platelets $232.85 \times 10^9 / l$, and in the experimental group these indicators were within the physiological norm and amounted to $3.47 \times 10^{12} / l$, $103.89 g / l$, $34.48\%$ and $168.85 \times 10^9 / l$, respectively, which indicates the normalization of metabolic processes in the body of broiler chickens under the influence of the Madufor® feed additive. In the blood serum of broiler chickens in the control group, an increased total protein content of $5.28 g / l$ ($11.91\%; P<0.01$) was compared with the experimental group. The AST level in the control group also exceeded the similar values of the experimental group by 15.06 units / l at $P<0.01$. During the experiment, the mineral composition of the blood serum of the chickens of the experimental group improved in relation to the control. The concentration of calcium, sodium and potassium significantly exceeded the control by 14.78 ($P<0.05$), 1.65 ($P<0.05$) and 8.15% ($P<0.01$), and the level of phosphorus tended to increase with an unreliable difference. Throughout the cultivation, the live weight of the chickens of the experimental group exceeded the control values. During the finishing fattening of broilers of the experimental group at the age of 28 and 35 days, their live weight exceeded the same indicator in the control group by 171.7 (13.06\%; $P<0.001$) and 288.2 g (15.42\%; $P<0.001$) Accordingly, feed consumption per 1 kg of growth in the control group was significantly higher than in the experimental group by 0.26 kg.

1. Introduction
Overheating is characterized by a severe general condition, metabolic disorder, accumulation of heat by the body with delayed heat transfer. As a result of heat exposure, heat transfer in the body is disturbed, circulatory disorders develop with impaired cerebral circulation, venous congestion of the blood occurs, accompanied by pulmonary edema, oxygen starvation, increased heart rate, and respiratory pathology [1,2,3,4].
In the body of a bird, products of impaired metabolism accumulate, auto-toxicity develops due to thermal denaturation of blood and tissue proteins, and the content of lactic, pyruvic acid, ketone bodies, and ammonia increases [5].

Despite the solution of a complex of problems in industrial poultry farming, a whole series requires study and scientific development, including taking into account zonal features like. For example, overcoming the negative effects of high summer temperatures or using unconventional feed in poultry diets [6,7,8].

Birds in energy exchange, in which there is a fundamental regulation of appetite satisfaction. During the heat stress, feed intake drops sharply, which leads to an imbalance of minerals, including calcium, potassium and chlorine (violation of acid-base balance) [9,10,11].

To stop the pathological processes described above in broiler chickens, NITA-PHARM LLC developed Madufor® feed additive containing sodium and potassium chlorides, starch, dextrose, sucrose, prebiotics, water-soluble vitamins and natural plant extracts as active ingredients.

Scientific and industrial experience in studying the effectiveness of the Madufor® feed additive as a means of restoring the water-electrolyte balance of the body during overheating of broiler chickens in the conditions of the MegaMix Research Center (RC). For the experiment, two groups of chickens were formed, 50 goals each. The bird of the control group received a general farm ration (OR), a 5% glucose solution was simultaneously fed, the bird of the experimental group received OR and Madufor® feed additive, at the rate of 4g/l of water.

A recorded level of ambient temperature above 32°C in the territory of the Lower Volga region in the summer is considered to be characteristic of this geographical area and which is often a predisposing factor for the development of severe pathological conditions in birds.

The aim of the research was to study the effectiveness of the influence of the Madufor® feed additive when growing broiler chickens under heat stress.

2. Results and discussion

According to the results of hematological studies, it was found that the content of red blood cells, hemoglobin, hematocrit and platelets in the blood of chickens of the control group was at the upper boundary of the physiological norm or slightly exceeded them (table 1).

| Indicators                      | control        | experimental   |
|--------------------------------|----------------|----------------|
| Red blood cells, 1012/l        | 4.18±0.19      | 3.47±0.25      |
| Hematocrit, %                  | 39.32±1.84     | 34.48±1.49     |
| Hemoglobin, gr/l               | 107.11±2.51    | 103.89±3.18    |
| White blood cells, 109/l       | 40.17±1.23     | 39.25±1.13     |
| Platelets, 109/l               | 232.85±7.62    | 168.85±7.24    |

Thus, the level of red blood cells in the control group was 4.18•10¹²/l, hemoglobin 107.11g/l, hematocrit 39.32% and platelets 232.85•10⁹/l, and in the experimental group these indicators were within the physiological norm and amounted to 3.47•10¹²/l, 103.89g/l, 34.48% and 168.85•10⁹/l, respectively, which indicates the normalization of metabolic processes in the body of broiler chickens under the influence of the Madufor® feed additive.

In the blood serum of broiler chickens in the control group, an increased total protein content of 5.2g/l (11.91%; P<0.01) was compared with the experimental group (table 2).

The AST level in the control group also exceeded the similar values of the experimental group by 15.06 unit/l at P<0.01. The content of urea and creatinine was almost at the same level in both groups.

During the experiment, under the influence of the Madufor® feed additive, the mineral composition of the blood serum of the chickens of the experimental group improved with respect to the control. The concentration of calcium, sodium and potassium significantly exceeded the control by 14.78 (P<0.05),
1.65 (P<0.05) and 8.15% (P<0.01), and the level of phosphorus tended to increase with an unreliable difference.

Table 2. Biochemical parameters of blood serum of chickens (n = 5).

| Indicators          | control      | experimental |
|---------------------|--------------|--------------|
| Total protein, g/l  | 49.63±8.93   | 44.35±0.82** |
| AST, unit/l         | 254.17±3.21  | 239.11±2.95**|
| ALT, unit/l         | 7.69±0.09    | 7.93±0.11    |
| BUN, mmol/l         | 2.93±0.12    | 3.09±0.17    |
| Creatinine, mmol/l  | 31.8±0.07    | 32.4±0.06    |
| Calcium, mmol/l     | 2.91±0.11    | 3.34±0.09*   |
| Phosphorus, mmol/l  | 3.05±0.08    | 3.14±0.09    |
| Natrium, mmol/l     | 157.24±0.69  | 159.83±0.71* |
| Potassium, mmol/l   | 4.17±0.06    | 4.51±0.07**  |

Note here and in table 3: * — p<0.05, ** — p<0.01 and ***— p<0.001.

Studies of the morphological and biochemical parameters of the blood allowed us to conclude that the Madufor® feed supplement helped normalize the metabolism of broilers of the experimental group during heat stress, which in turn had a positive effect on their meat productivity.

Throughout the cultivation, the live weight of the chickens of the experimental group exceeded the control values (table 3).

Starting from the first week of life, a significant difference in live weight of chickens between the experimental and control groups was established, which was 16.6 g (9.55%; P<0.05) in favor of the experimental group, and at the age of 21 days the difference increased to 71.8g (8.42%; P<0.01).

Table 3. Dynamics of live weight (n = 50).

| Age, days | control       | experimental |
|-----------|---------------|--------------|
| Day       |               | 41.4         |
| 7         | 173.8±5.72    | 190.4±4.13*  |
| 14        | 452.6±11.34   | 490.1±10.96* |
| 21        | 853.1±13.97   | 924.9±14.01**|
| 28        | 1314.8±18.21  | 1486.5±19.17***|
| 35        | 1869.0±21.83  | 2157.2±23.17***|

The cost of feed per 1 kg of growth, kg

| Day       | control | experimental |
|-----------|---------|--------------|
| 1.87      |         | 1.61         |

During the finishing fattening of broilers of the experimental group at the age of 28 and 35 days, their live weight exceeded the same indicator in the control group by 171.7 (13.06%; P<0.001) and 288.2g (15.42%; P<0.001) Accordingly, feed consumption per 1 kg of growth in the control group was significantly higher than in the experimental group at 0.26kg.

At the end of the experiment, a control slaughter and anatomical cutting of carcasses of 3 roosters and 3 hens from each group was carried out. The result of the anatomical section showed that the yield from the gutted carcass in the experimental group was 73.12%, which is 1.83% (P <0.01) higher than in the control group. The output of the pectoral muscles exceeded the control indices by 1.94% (P <0.05) and amounted to 24.43%. The ratio of edible parts to inedible in the experimental group was 2.24 against 2.16 in the control. The experience of the organs also turned out to be higher relative to the control: liver by 5.12%, muscle stomach by 6.44 (P <0.05) and heart by 3.29%. It has been established that the Madufor® feed additive has a positive effect on the accumulation of vitamins in the liver during heat stress. The vitamin A content in the experimental group increased by 9.16% (P <0.01), E - by 3.18%, B1 - 4.15% (P <0.05) and B2 by 3.48% (P <0.05) with respect to the control.
The chemical composition of the pectoral muscles obtained as a result of experimental studies has confirmed the positive effect of the studied additives, during heat stress, on the quality indicators of meat. The protein content increased in the pectoral muscles of chickens of the experimental group by 3.28% (P <0.05) and amounted to 22.34%, while reducing fat by 25.17% (P <0.01) in relation to the control. Glycogen level increased relative to the control by 26.53% (P <0.01). The energy value of the meat of broiler chickens of the experimental group decreased slightly due to a decrease in fat and amounted to 443.83 against 446.19 KJ/100g in the control.

3. Conclusion
The use of Madufor® feed additive for fattening broiler chickens during the hot season (ambient temperature over 32°C) had a significant impact on stopping pathological processes against the background of heat stress. The chickens of the experimental group returned to normal metabolism, which significantly affected their meat productivity. Recommended rate of input 4g/l of water.

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