Meat productivity of chicken broilers when using stress protectors during the pre-slaughter period

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Abstract: Industrial birds experience stress factors which decrease productivity and cause economic damages to the food security of Russia. However, the modern agrarian science develops and applies stress protectors which increase growth, development and safety of chickens and their meat productivity. The “PIK Antistress” at doses of 1269 and 1693 g/t used 5 days before slaughter increased the average daily weight gain by 0.7-6.6%, the absolute weight gain by 2.3-9.4%, livability by 1.5-2.3%, the ratio of feeding efficiency by 4.5-24.6%, the amount of meat by 0.6-1.2%, the category of meat by 18.5-20.0%.

1. Introduction
The development of domestic industrial poultry meat is accompanied by an increase in the number of stress factors that decrease immunity and productivity of birds. The stress factors cause significant economic damages to the food security of Russia. Feed supplements of protective action enhance the livability of poultry and meat productivity

   Industrial chickens have a high genetic potential; however, stresses are a potential danger. It is almost impossible to avoid stressful conditions, especially in the industrial poultry industry [1].

   The main role in the development of stress belongs to the sympathicoadrenal and hypothalamic-pituitary-adrenal systems [2, 3].

   Clinically, stresses are accompanied by a loss of appetite, pecking and cannibalism [4] and decrease productivity, deteriorate a product quality, increase feed conversion, morbidity and waste [5, 6]. Stress before slaughter reduces a meat quality [7, 8].

   In the poultry industry, numerous pharmacological agents of natural and synthetic origin are used to reduce stress effects [9, 10].

   The article aims to analyze productivity of chickens when using a stress protector in the pre-slaughter period. It also analyzes the food supply; growth, development and livability of chickens, the morphological composition of chickens of the experimental and control groups.

2. Materials and methods
The experimental part of the work was carried out at the Department of Morphology, Physiology and Pharmacology, Laboratory of the Innovative Research Center of the South Ural State Agrarian University. The study “Development and testing of an anti-stress feed supplements to increase the yield of first category chicken carcasses and reduce economic losses during slaughter” was ordered by the Ministry of Agriculture of the Russian Federation (AAAA-A18-118103000045-7).
Production experiments were carried out on chickens Arbor Acres in the conditions of JSC "PRODO Tyumen Broiler", Tyumen region.

In the experiments, clinically healthy animals were used.

The first group of chickens was a control one (control 1); the second group of chickens was fed with “PIC Anti-Stress” at a dose of 1269 g/1 ton 5 days before slaughter (test 1); the third group was feed with “PIK Antistress” and L-carnitine at a dose of 1,693 g/1 ton 5 days before slaughter (experiment 2). When evaluating the growth and weight characteristics of chickens, the fourth control group was formed (control 2), and the results for the third group were compared with the results for the fourth group.

The feed was analyzed in the laboratory of the innovative research center of the Southern Ural SAI'; the content of fat was determined using a SER 148-6 fat extractor, protein - an automatic system for detecting nitrogen, fiber – a FIWE 6 analyzer, moisture – in the AL-80-01 oven, and amino acids – using the system of capillary electrophoresis KAPEL-105. The weight characteristics of chickens were evaluated using a Roxell scale.

On the 38th day after hatching, chickens were slaughtered using the equipment manufactured by STORK company (a line capacity is 9000 heads/h).

Economic efficiency was calculated according to the Methodology for determining economic efficiency of veterinary measures and recommendations by I.N. Nikitin [11], N.A. Zhuravel, and A.V. Miftahutdinov [12].

3. Results and discussion

To evaluate poultry productivity, it was necessary to analyze the diet of chickens. The moisture content was 10.5% which is evidence of compliance with food storage rules. The level of exchange energy amounted to 1.44 MJ; the crude protein content was 19.0%. Compound feed with these characteristics satisfies energy needs of the bird and does not allow for protein starvation. The calcium-phosphorus ratio was 1.9: 1. It is optimal for assimilation of macronutrients and their use by the body. The content of amino acids in relation to lysine (100 %) was as follows: methionine + cystine - 77%, threonine - 69%, tryptophan 10%. This amino acid profile is optimal for this cross-breed.

Thus, the feeding of poultry met the GOST 18221-99, recommendations for growing the cross-breed and recommendations developed by the All-Russian Scientific Research and Technological Institute of Poultry Breeding.

3.1. Growth, development and safety of chickens.

For the whole cycle of chicken production, performance indicators are presented in Table 1.

The supplement at a dose of 1269 g/t (experiment 1) had an impact on the growth and development of chickens. This is evidenced by an increase in the average daily weight by 0.7% compared with the first control group, while the absolute total increase in weight of chickens of the first experimental group was 2.3% (288 kg), the average chicken weight increased by 0.7%. The increase in livability increased by 1.5% in the first experimental group which indicates an increase in the immunity. The efficiency ratio amounted to 373.1 units. In increased by 4.5% compared to the ratio in the first control group.

The similar dynamics was observed in the second experimental group where the average daily weight increased by 6.6%, livability – by 2.3%, and absolute weight gain - by 9.4% (1040 kg). Despite this, in the second control group, the average daily weight gain was 51.23 g/day. Based on the data obtained, chickens of the second control group cannot be used for further experimental studies. We accounted only for the indicators obtained in the first control group, and first and second experimental groups.
Table 1. Growth, development and livability indicators for chicken broilers

| Indicators                  | Groups                          |
|-----------------------------|---------------------------------|
|                             | control group 1 | experimental group 1 | control group 2 | experimental group 2 |
| Average daily weight, g     | 57.16             | 57.54                | 51.23            | 54.61                |
| Livability, %               | 95.8              | 97.26                | 95.18            | 97.38                |
| Absolute total weight, kg   | 12414             | 12702                | 11013            | 12053                |
| Average weight of 1 chicken, g | 2154             | 2169                 | 1928             | 2058                 |
| Efficiency ratio, units     | 356.9             | 373.1                | 283.4            | 353.2                |

3.2. Meat productivity and morphological composition of chickens

The meat productivity of chickens (Table 1) is directly related to their growth and development during breeding and pre-slaughter periods when the bird is under considerable stress losing weight.

Table 2. Meat productivity and morphological composition of chicken bodies

| Indicators                  | control group | experimental group 1 | experimental group 2 |
|-----------------------------|---------------|----------------------|----------------------|
|                             | kg            | % of live weight     | kg                   | % of live weight     | kg                   | % of live weight     |
| Chilled meat                | 75.72         | 72.8                 | 85.90                | 74.1                 | 77.77                | 73.4                 |
| – incl. category 1          | 48.34         | 63.8                 | 70.70                | 82.3                 | 65.17                | 83.8                 |
| – category 1                | 27.38         | 36.2                 | 15.20                | 17.7                 | 12.60                | 16.2                 |
| First category offals       | 5.72          | 5.5                  | 5.96                 | 5.1                  | 5.91                 | 5.6                  |
| – incl. stomach             | 0.83          | 14.5                 | 0.93                 | 15.6                 | 0.98                 | 16.5                 |
| – neck without skin         | 1.76          | 30.8                 | 1.82                 | 30.5                 | 1.79                 | 30.3                 |
| – raw fat                   | 0.30          | 5.2                  | 0.32                 | 5.4                  | 0.31                 | 5.2                  |
| – heart                     | 0.51          | 8.9                  | 0.59                 | 9.9                  | 0.60                 | 10.2                 |
| – liver                     | 2.32          | 40.6                 | 2.30                 | 38.6                 | 2.23                 | 37.8                 |
| – incl. for recycling       | 0.22          | 3.8                  | 0.00                 | 0.0                  | 0.05                 | 0.8                  |
| Second category offals      | 6.36          | 6.1                  | 6.02                 | 5.2                  | 6.21                 | 5.9                  |
| – heads                     | 2.66          | 41.8                 | 2.48                 | 41.2                 | 2.63                 | 42.4                 |
| – legs                      | 3.70          | 58.2                 | 3.54                 | 58.8                 | 3.58                 | 57.6                 |
| Technical waste             | 16.20         | 15.6                 | 18.12                | 15.6                 | 16.12                | 15.2                 |
| – gut                       | 7.26          | 44.8                 | 7.82                 | 43.1                 | 7.14                 | 44.3                 |
| – feather, blood            | 8.94          | 55.2                 | 10.30                | 56.9                 | 8.98                 | 55.7                 |
| Total                       | 104.00        | 100.00               | 116.00               | 100.00               | 106.00               | 100.00               |

Meat productivity of the first experimental group was highest - 85.90 kg (74.1%) of the live weight; in the second experimental group, it was 77.77 kg (73.4%), in the control group, it was 75.72 kg (72.8%). In the first and second experimental groups, the share of chickens of the first category increased and amounted to 82.3 and 83.8%, respectively. In the control group, the quality of meat was lower and the output of category 1 was 63.8%. When evaluating differences between the experimental groups, it was found that in the first experimental group, the amount of meat was higher by 0.7%, whereas category 2 prevailed. The use of supplements in the first and second experimental groups increased productivity by 1.2 and 0.6% and the share of high-quality meat - by 18.5 and 20.0%, respectively.
The use of supplements increased the output of poultry meat and decreased the amount of first and second category by-products and technical waste. In the first experimental group, the share of by-products decreased by 0.4% and 0.9%. In the second experimental group, there was a decrease in the share of second category by-products and technical waste by 0.3 and 0.4%, respectively. In the first experimental groups, the share of first and second category by-products decreased by 0.4 and 0.7%, respectively.

3.3. Defects of broiler chickens

The increase in the category of chicken meat was due to the decrease in the number of injuries in the pre-slaughter period and defects during the slaughter and carcass processing (Figure 1).

![Figure 1. Defects of chicken carcasses, %](image)

Defects and injuries of chickens before and during slaughter are distributed to the total number of defects and injuries in general in all groups: poor plucking – 13.16-17.78%, “poor bleeding” – 5.26-7.27%, “sprains and closed fractures” – 1.82-2.63%, “bruises and hematomas” – 28.89-31.58%, “scrapes on the back” – 13.16-16.36%.

The defects “excessive scalding”, “skin disruptions”, “petechia”, “open fractures”, “tibiotarsus arthritis”, “dermatitis” were unevenly distributed in the groups.

The control group was characterized by a high percentage of defects “scrapes on the back” - 16.36%, “poor bleeding” - 7.27%, “presence of internal organs” - 1.82%, “open fractures” - 1.82, “tibiotarsus


"...arthritis". Their share was 5.46% in the control group. The experimental groups lacked these defects and injuries.

When comparing the number of defects and injuries in the control and experimental groups, there was a significant decrease in defects and injuries before slaughter; the difference was 45.45% in the first and 18.18% in the second groups; the shares of injuries during slaughter were 31.58 and 26.32% in the first and second experimental groups, respectively; the shares of defects during carcass processing were 50.0 and 20.0%, respectively; the shares of defects during slaughter were 6.67% for both experimental groups. In general, in the first experimental group, the number of defects decreased by 30.91%; in the second group, it decreased by 18.18%. Thus, the share of defects in experimental group 1 exceeded that in experimental group 2 by 18.42%.

The share of scratches on the back decreased by 22.22-44.44%, bruises and hematomas - by 23.52-29.41%, hemorrhages - by 16.66-33.33%, poor bleeding - by 25.0 -50.0%.

The data obtained allowed us to conclude that the level of poultry injuries during slaughter and the number of carcass defects reduced.

3.4. Cost-effectiveness of supplements

An increase in the average daily weight gain and meat productivity of chickens from the experimental groups increased the economic efficiency of meat production (Table 3).

Table 3. Economic efficiency of chicken broilers from experimental and control groups

| Indicators                          | control group | experimental group 1 | experimental group 2 |
|------------------------------------|---------------|----------------------|----------------------|
| Number of heads                    | 6136          | 6136                 | 6136                 |
| Costs of breeding, slaughter and sales, rub./kg | 65.85          | 66.33                | 66.87                |
| Commercial cost of production, rub./kg | 93.33     | 92.48                | 94.42                |
| Gross income, thousand rubles      | 149.94        | 223.71               | 204.17               |

The costs of breeding, slaughter and sales amounted to 65.85-66.87 rubles per 1 kg of meat, while the costs for the experimental group 1 and 2 were higher by 0.73 and 1.55%, respectively. This is due to the fact that the cost of purchasing the supplements was accounted for. The commercial cost of production decreased for the first experimental group by 0.91%; for the second experimental group, it increased by 2.05%. For the first experimental group, the gross income was 223.71 thousand rubles, which exceeded that in the control group by 49.19% (73.76 thousand rubles and that in the second experimental group by 9.57% (19.54 thousand rubles). When selling broiler chicken meat, the gross income amounted to 204.17 thousand rubles which is 36.16% (54.22 thousand rubles) more than for the control group.

4. Conclusion

Chickens lose their weight in the pre-slaughter period. The use of supplements made it possible to compensate for negative effects of pre-slaughter stress and maintain high rates of the average daily weight gain.

In the first and second experimental groups, the PIK Antistress at doses of 1269 and 1693 g/ton used 5 days before slaughter increased the average daily bird weight gain by 0.7-6, 6%, the absolute weight gain by 288-1040 kg (2.3-9.4%), livability by 1.5-2.3%, and the ratio of feeding efficiency by 16.2-69.8 units (4.5-24.6%).

The PIK Antistress supplement at doses of 1269 and 1693 g/ton used 5 days before slaughter increased the amount of poultry meat by 0.6-1.2% (205-10.18 kg) and reduced the number of poultry injuries during slaughter and carcass defects, increased the meat category by 18.5-20.0%, reduced the share of first and second category by-products by 0.3-0.9%. An increase in meat productivity is due to
the stress protector used 5 days before slaughter. It allowed for preserving and replenishing internal energy reserves of the body.

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