Safety monitoring of broiler chicken meat when correcting pre-slaughter stress using feed supplement "PIK-Antistress"

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Abstract. The research purpose is to assess safety of broiler chicken meat when correcting pre-slaughter stress using feed supplement "PIK-Antistress". In the conditions of the poultry farm, three groups of broiler chickens were formed: the control group, experimental groups 1 and 2. Broiler chicken meat of all groups met GOST 31470-2012 by veterinary and sanitary characteristics. There was a statistically significant increase in the fat and protein content in white meat of experimental groups 1 and 2 by 5.9 and 0.6 %, respectively, a decrease in moisture in red meat by 0.6 %; a decrease in fat and protein content by 2.2 and 1.4 %, an increase in moisture and ash content by 0.9 and 0.8 %, respectively. There was an increase in the content of zinc, manganese and copper, while the concentrations of ionized forms of metals were significantly lower than the maximum allowable levels. The concentration of lithium in the pectoralis major muscle statistically significantly increased by 50.0 %, in the pectoralis minor – by 33.6 %, in red meat by 104.2 %.

1. Introduction

Industrial broiler farming is accompanied by stresses that have a negative effect on meat. High production losses are observed in the pre-slaughter period. Heat stress, trapping, loading, transportation, starvation have a negative impact on the physical condition of birds and quality of meat. Low pH, pale color are observed in birds transported for a longer time [1, 2]. Heat stress can cause acute hyperthermia, respiratory alkalosis, electrolyte imbalance, decreased food intake, decreased growth, increased mortality, and negative impacts on meat quality, especially organoleptic and technological properties [3]. Heat stress before slaughter leads to changes in the chemical composition and pH of meat, which leads to a meat defect – PSE. Obviously, the use of various anti-stress measures ensures the well-being of animals and high quality of meat [4, 5]. Due to poor physical conditions and injuries during the pre-slaughter period, broiler chickens experience additional stresses [6–8]. The capture process can lead to stresses, injuries, deaths. Trapping is a critical phase, and the methods of trapping and transportation affect the physiological state of broilers [9]. Different terms of transportation and the location of cages for chickens affect the biochemical and hematological profile, color and pH of meat and can cause a meat defect – DFD [10]. Stress factors that occur before slaughter affect the concentrations of Ca, Mg, Na, K, P, and Fe in the blood serum and pectoral muscles of broiler chickens. There was an increase in the level of these elements in the blood serum after transportation. The opposite trend was observed in the pectoral muscles [11].

The research purpose is to assess safety of broiler chicken meat when correcting pre-slaughter stress using feed supplement "PIK-Antistress". The research objectives are as follows: to study
veterinary and sanitary indicators and the chemical composition of broiler chicken meat, assess the residual amount of macro- and microelements in poultry meat.

2. Materials and methods

Production experiments were conducted in the conditions of the industrial poultry farm on broiler chickens Arbor Acres.

For the experiment, three groups of broiler chickens were formed: control group (main diet); experimental group 1 (main diet with "PIK-Antistress" at a dose of 1269 g/ton of supplement 5 days before the slaughter); experimental group 2 (main diet with "PIK-Antistress" at a dose of 1693 g/ton of feed 5 days before the slaughter). Broiler chickens were slaughtered on the 38th day according to the technological instructions of the enterprise.

Veterinary and sanitary indicators of broiler chicken meat were determined by the generally accepted methods according to GOST 31470-2012. To assess the chemical composition of poultry meat, the fat content was determined using an “SER 148-6” automatic fat extractor, protein – using an automatic system for determining nitrogen content by wet ashing followed by steam distillation and titration, and moisture – by drying the sample in the oven to constant mass, ash – by the method of dry ashing of the sample. The content of macro- and microelements was determined spectrometrically using Quant 2.

Statistical processing of the research results was carried out using the STATISTICA 12 program. The processed data were presented both in the form of an arithmetic mean and standard deviation, as well as in relative values. For statistical evaluation of intergroup differences, Student t-test (p = 0.05) and Mann-Whitney U-test (p = 0.05) were used.

3. Results and discussion

3.1. Veterinary and sanitary characteristics and chemical composition of broiler chicken meat

The veterinary and sanitary state of meat of broilers of all groups corresponded to the category "fresh" (GOST 31470-2012). No statistically significant differences were found between the experimental and control groups: on average, the content of volatile fatty acids and the acid number of fat were 1.87 and 0.032 mg KOH, respectively, pH was 5.82, and peroxide was 0.008 % iodine.

During veterinary and sanitary assessment of broiler chicken meat, PSE and DFD defects were not observed, which indicated compliance with the poultry slaughter requirements.

Assessment of the chemical composition of poultry meat made it possible to assess qualitative changes that occurred under the influence of the feed supplement.

Compared with the control group, a decrease in the moisture content in the pectoralis major muscle of broiler chickens was 0.9 % (p ≤ 0.05) in both experimental groups (see Figure 1). The moisture content in red meat of experimental groups 1 and 2 exceeded the control values by 0.5 and 0.8 % (p ≤ 0.05), respectively (see Figure 2). In experimental group 1, the moisture content was 4.0 % higher than the recommended norms, in the second group, it was 4.1 % higher, and in the control group, it was 4.2 % higher.

The fat content in white meat of broiler chickens of the experimental groups did not change (see Figure 3). In red meat of broiler chickens of experimental group 2, the fat content decreased by 0.4 % (p ≤ 0.05) (see Figure 4). The fat content in red meat of chickens of experimental group 2 was closer to the standard values.

The protein content corresponded to the recommended standard values. Relative to the control group, a significant increase in protein content in the pectoralis major muscle of broilers of experimental group 1 (see Figure 5) by 0.3 % (p ≤ 0.05) and a decrease in red meat of experimental group 2 (see Figure 6) by 0.4 % (p ≤ 0.05) were observed.
Significant differences were observed in the ash content of the pectoralis minor muscle of experimental group 1 (see Figure 7) whose level was higher than in the control group by 0.1 % (p ≤ 0.05). Differences in the ash content of red meat were not statistically significant (see Figure 8). The
mass fraction of ash in white meat of broiler chickens of the experimental groups was higher than the average standard indicators by 0.1 ... 0.2 %, in red meat – by 0.1 %.

**Figure 7.** Ash content in white meat, %

**Figure 8.** Ash content of red meat, %

Due to the accumulation of protein and fat in white meat of the experimental groups, the moisture content decreased due to the use of a feed supplement whose components replenish body's resources spent in the pre-slaughter period characterized by maximum stress.

### 3.2. Residual amounts of micro and macro elements in broiler meat

When analyzing the content of the residual amount of microelements that make up the feed additive in broiler meat, certain statistical trends were revealed to increase the content of copper in the pectoralis minor muscle, zinc and manganese in white and red meat. The data obtained indirectly indicate the enrichment of meat with these trace elements, however, this issue requires further studies. When comparing experimental groups 1 and 2, there was a statistical tendency to increase the iron content in red meat in experimental group 2.

Copper, manganese and zinc protect the body from oxidative stress and are consumed in the pre-slaughter period. However, macro- and micronutrients are a source of necessary substances for the poultry organism. They can also reduce safety of products if their content exceeds the allowable level.

**Figure 9.** The relative content of macro- and microelements in the pectoralis major muscle, % of PDU

**Figure 10.** The relative content of macro- and micronutrients in the pectoralis minor muscle, % of PDU

**Figure 11.** The relative content of macro- and microelements in red meat, % of PDU

The level of heavy metals in the meat of broiler chickens from the experimental and control groups was below the maximum allowable level regulated by regulatory documents and described in the
reference books. In white and red meat, the average copper content was 2.5 and 3.8 %, the iron content was 6.8 and 12.2 %, the zinc content was 6.6 and 18.5 %, the nickel content was 3.3 and 1.6 %, the cadmium content was 7.4 and 7.8, the lead content was 8.3 and 8.0 % of the allowable level, respectively.

Since lithium is not highly toxic and is quickly excreted from the body, its maximum allowable concentration in food products has not been determined. Nevertheless, lithium has a high biological effect, so it is necessary to assess its content in food.

**Figure 12. The lithium content in the meat of broiler chickens, mg / kg**

The use of PIK-Antistress in experimental groups 1 and 2 increased the concentration of lithium in meat: by 50.0 % in the pectoral muscle, by 33.6 % in the pectoral muscle, and by 104.2 in red meat % (p ≤ 0.05).

The recommended dose of lithium for a person with an average weight of 70 kg is 1 mg/day, with a meat consumption rate of 200-300 g / day. Eating broiler chicken meat produced using PIK-Antistress, it is possible to satisfy up to 30-50 % of the daily intake of ionized lithium.

4. **Conclusion**

1. Meat of broiler chickens of the experimental and control groups met GOST 31470-2012 and can be used for food purposes without restrictions.

2. There was a statistically significant increase in fat and protein content in white meat of broiler chickens of the experimental groups by 5.9 and 0.6 %, respectively, and a decrease in moisture by 0.6 %; a decrease in fat and protein content by 2.2 and 1.4 %, an increase in moisture and ash content by 0.9 and 0.8 %, respectively.

3. As a result of the addition of PIK-Antistress, there was an increase in zinc, manganese and copper content in poultry meat, while the concentrations of ionized forms of metals were significantly lower than the maximum allowable levels; the concentration of lithium in the pectoralis major muscle increased by 50.0 %, in small poultry – by 33.6 %, in red meat – by 104.2 % (p ≤ 0.05).

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