The influence of natural biostimulants on the organoleptic and microbiological parameters of poultry meat

V.M. Bachinskaya[1*], *E.S.* Baranovich[1], *P.A.* Bocharova[1], *D.V.* Gonchar[2], and *N.A.* Bachinskaya[3]

[1]Russian State Agrarian University – Moscow Timiryazev Agricultural Academy; Moscow, Russia
[2]Moscow State Academy of Veterinary Medicine and Biotechnology – MBA named after K.I. Skryabin, Moscow, Russia
[3]All-Russian State Center for Quality and Standardization of Veterinary Medicines and Feed, Moscow, Russia

Abstract. This study examined the effect of a feed additive based on a mixture of taurine and succinic acid on the productivity and quality of broiler chicken meat. The study analyzed the specifics of formulating a diet with the inclusion of the studied additive at two dosages - 1.5 mg/L and 2 mg/L. The additive's effect on live weight gain in poultry was assessed, reaching 19.7% and 15.7%, respectively, relative to the control group. A positive effect of the additive on meat quality was revealed: at a dosage of 2 mg/L, the product reached first-grade standards. All meat samples were determined to meet the requirements of regulatory and technical documentation for organoleptic properties. A comprehensive study of the microbiological safety of the products was conducted, including an analysis of the number of mesophilic aerobic, facultative anaerobic and pathogenic microorganisms. It was determined that in the samples of the experimental and control groups, the number of mesophilic aerobic and facultative anaerobic microorganisms was $1.1 \pm 0.12 \times 10^3$ CFU/g, $1.2 \pm 0.07 \times 10^3$ CFU/g and $1.5 \pm 0.07 \times 10^3$ CFU/g, respectively, which does not exceed the standard values. In all the poultry meat samples tested, bacteria of the genus *Salmonella* and *Listeria monocytogenes* were not detected. The additive had no negative impact on the organoleptic and microbiological properties of meat.

1 Introduction

Poultry farming is one of the most dynamically developing sectors of the agro-industrial complex of the Russian Federation, providing the population with high-quality meat and egg products. According to the latest statistics from the Ministry of Agriculture of the Russian Federation and Rosstat, in 2024, the volume of poultry meat production in Russia reached 5.7 million tons, which is 7.5% higher than the 2022 figure (5.3 million tons) and 8.4% higher than the 2021 figure [1]. In the world ranking of gross poultry meat

* Corresponding author:bachinskaya@rgau-msha.ru

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production, the Russian Federation retained 4th -place based on the results of 2024, behind only the United States, Brazil and China. The production of edible eggs also demonstrates steady growth: in 2024, output volumes amounted to 47.8 billion units, which is 3.4% higher than the 2022 level (46.2 billion units) and 4.6% higher than the 2021 level [2,3]. Per capita egg consumption in the Russian Federation in 2024 reached 302 eggs per year, with a production level of 328 eggs per capita, indicating a product surplus and potential for export deliveries. Projected indicators for 2025, according to the strategy for the development of the agro-industrial complex until 2030, suggest further growth in the industry: poultry meat production is expected to reach at least 5.9 million tons (+3.5% compared to 2024), and the production of edible eggs will reach 48.9 billion (+2.3%). Key growth drivers include the introduction of innovative housing and feeding technologies, selective breeding to create high-yielding crosses, and optimization of the feed base through the use of biologically active additives (BAA) [1-3].

Broiler poultry farming, a key industry, is demonstrating steady growth amid high demand for broiler meat. Broiler poultry products are distinguished by their high nutritional value: broiler meat contains approximately 20–22% protein, 10–15% fat, up to 70% water, and a significant amount of dry matter (approximately 20–25%). The meat contains important vitamins (B, E, and A), as well as macro- and microelements such as phosphorus, potassium, iron, zinc, and selenium. Furthermore, broiler meat is rich in essential amino acids and is low in calories compared to other types of meat, making it a popular dietary product [4-5].

The industry's key challenges remain reduced productivity due to -metabolic disorders caused by vitamin and mineral deficiencies in feed, which leads to weakened poultry immunity, deteriorating meat and egg quality, and increased veterinary costs. Another serious problem is the accumulation of antibiotics in products due to their widespread use for disease prevention, which creates risks to human health and reduces the competitiveness of Russian products in the international market. Furthermore, there has been increasing resistance of pathogenic microorganisms (Salmonella, E. coli , Campylobacter , Listeria) to traditional antibacterial drugs [5-7].

In recent years, multifunctional feed additives combining vitamin -and mineral complexes, probiotics, organic acids, and amino acids have been actively introduced into the poultry industry. One promising approach is the use of succinic acid, which inhibits the growth of pathogenic microflora by lowering the pH of the environment. It penetrates bacterial cells in an undissociated form, disrupting their metabolism, and increases the acidity of the cytoplasm, leading to the death or slowing of the growth of microorganisms (Salmonella, E. coli , etc.). Another important component is taurine, a sulfur-containing amino acid involved in regulating metabolism, improving antioxidant protection, increasing the stress resistance of poultry, and optimizing lipid metabolism [6-8].

The aim of this study was to investigate the effect of a mixture of taurine and succinic acid on the organoleptic properties of poultry meat (taste, aroma, color, consistency), and microbiological characteristics. The objectives of the study were to evaluate the organoleptic properties of broiler poultry products fed with feed additives containing succinic acid and taurine; to investigate the microbiological safety of the products; and to analyze the dynamics of poultry productivity when the mixture was included in the diet.

2 Materials and methods

The object of the study were day-old broiler chickens of the meat cross "Smena-9", which were kept in the same conditions throughout the experiment. The broiler chickens had free access to feed and drinking water. All microclimate parameters, light and temperature regimes, housing conditions, stocking density complied with the recommendations of the

All-Russian Research Institute of Poultry Breeding for growing the cross "Smena-9". Throughout the experiment, the chickens of the control group received only standard compound feed (1-14 days start; 15-28 days - growth; 29-42 days - finish); the 1st experimental group received the same feed + 1.5 mg / l taurine + 1.5 mg / l succinic acid; the 2nd group of chickens received the same feed + 2 mg / l taurine + 2 mg / l succinic acid. The mixture was dissolved in warm water, stirring thoroughly until the contents were completely dissolved. The feed mixture was added to the birds' water from days 5 to 20 of life.

The material for the veterinary and sanitary examination was chicken carcasses slaughtered at 42 days. Post-mortem veterinary and sanitary inspection of the broiler carcasses was conducted in accordance with current Veterinary Regulations. First, the carcass was inspected externally, and after evisceration, the internal organs were examined. Special attention was paid to the spleen, heart, lungs, and liver. After maturation, the meat was subjected to comprehensive organoleptic and laboratory testing methods. GOST 31962-2013 "Chicken Meat (Chicken Carcasses, Broiler Chickens, and Their Parts). Specifications" and GOST R 51944-2002 "Poultry Meat. Methods for Determining Organoleptic Indicators, Temperature, and Weight" were used to determine the fatness, freshness, and quality of the chicken meat. Microbiological testing of meat was carried out in accordance with GOST 7702.2.0-2016, "Poultry Slaughter Products, Semi-Finished Poultry Meat Products, and Production Environment Objects. Sampling Methods and Preparation for Microbiological Tests." *Salmonella bacteria* were detected in accordance with GOST 31468-2012, "Poultry Meat, By-Products, and Semi-Finished Poultry Meat Products. Salmonella Detection Method. *Listeria Determination." monocytogenes* was carried out according to GOST 32031-2022 Food products. Methods for detecting Listeria bacteria monocytogenes and other species of Listeria (Listeria pp.) [9-13].

3 Results

At the initial stage of the study, the weight of broiler chickens before slaughter was analyzed and it was found that the greatest increase in live weight was observed in experimental group 1 (2872.4 ± 314.58 g), which received the additive at a dosage of 1.5 mg/l. This is 19.7% higher than the control group (2399 ± 236.95 g). In experimental group 2 (2776.1 ± 224.34 g), at a dosage of 2 mg/l, the increase was 15.7% relative to the control. Thus, the lower dosage of the additive proved to be more effective in increasing the live weight of birds. Differences in fatness were revealed between the groups. In the control and experimental groups, muscle development was satisfactory: the pectoral muscles formed an angle with the keel of the sternum without depressions, and there was no subcutaneous fat, corresponding to - grade 2 according to GOST 31962-2013. In experimental group 2, body condition was higher: muscles were well developed, the chest was rounded, the keel of the sternum was not prominent, and there were minor deposits of subcutaneous fat in the lower abdomen - these characteristics correspond to grade 1. Therefore, a dosage of 2 mg/L contributed to improved body condition, despite a less pronounced weight gain compared to the first experimental group.

Then, organoleptic studies of the meat of broiler chickens “Smena-9” from the experimental and control groups were carried out in accordance with GOST R 51944-2002. During organoleptic evaluation. The broth's appearance and color, muscle tissue on the cut surface, consistency, odor, clarity, and aroma were determined. The results are presented in Table 1.

Table 1. Organoleptic study of broiler chicken carcasses.

Indicator	Study group		
	Control	Experiment 1	Experiment 2
Appearance and color: Carcass surface	Dry, whitish-yellow with a pink tint	Dry, whitish-yellow with a pink tint	Dry, whitish-yellow with a pink tint
Subcutaneous and internal adipose tissue	Pale yellow	Pale yellow	Pale yellow
Serous membrane of the thoracoabdominal cavity	Moist, shiny, free of slime and mold	Moist, shiny, free of slime and mold	Moist, shiny, free of slime and mold
Muscles on section	Slightly damp, does not leave a damp spot on filter paper, pale pink	Slightly damp, does not leave a damp spot on filter paper, pale pink	Slightly damp, does not leave a damp spot on filter paper, pale pink
Muscle tissue consistency	The muscles are dense and elastic, and when pressed, the dimple quickly evens out.	The muscles are dense and elastic, and when pressed, the dimple quickly evens out.	The muscles are dense and elastic, and when pressed, the dimple quickly evens out.
Smell	Specific, characteristic of fresh poultry meat	Specific, characteristic of fresh poultry meat	Specific, characteristic of fresh poultry meat
Clarity and aroma of the broth	Transparent, fragrant	Transparent, fragrant	Transparent, fragrant

As shown in Table 1, the carcass surfaces of all broiler chicken groups tested were dry, whitish - yellow with a pink tint; the muscles were slightly moist on cross-section, leaving no wet spot on filter paper, and were pale pink. The muscle tissue was firm and elastic; the indentation quickly flattened when pressed. The meat had a distinctive odor, typical of fresh poultry, and the broth was clear and aromatic. Visual characteristics (condition of the skin, adipose tissue, and serous membrane of the thoracoabdominal cavity) revealed no deviations from the norm in any of the groups.

Thus, all - broiler chicken carcass samples tested, including control and experimental ones, complied with the requirements of GOST R 51944-2002.

The next stage of the study involved assessing the microbial contamination. This is an important step in veterinary and sanitary inspection, allowing us to determine the presence of indicator and pathogenic microorganisms, as well as to assess and determine the safety of raw materials for consumers. For this purpose, samples were collected from the deep layers of the thigh and chest muscles of the carcasses under study in accordance with GOST 7702.2.0-2016.

Table 2. Study of microbiological safety of broiler chicken meat (n = 3).

Name of the indicator being determined	Test result		
	Experiment 1	Experiment 2	Control
KMAFAnM /CFU/g (M ± m)	$1.1 \pm 0.12 \times 10^3$	$1.2 \pm 0.07 \times 10^3$	$1.5 \pm 0.07 \times 10^3$
Pathogenic microorganisms, including salmonella / 25 g	Not found	Not found	Not found
Listeria monocytogenes /25 g	Not found	Not found	Not found

Based on the results presented in Table 2, in the samples of the experimental and control groups, the number of mesophilic aerobic and facultative anaerobic microorganisms was $1.1 \pm 0.12 \times 10^3$ CFU/g, $1.2 \pm 0.07 \times 10^3$ CFU/g and $1.5 \pm 0.07 \times 10^3$ CFU/g, respectively, which does not exceed the standard values and indicates a high level of hygiene at all stages of production (growing, slaughtering, processing), compliance with temperature conditions during storage and transportation, as well as the absence of factors

contributing to the active proliferation of saprophytic microflora. When testing for *Listeria Monocytogenes* (not allowed in 25 g of product) was also not detected in any of the samples, confirming the meat's safety against one of the most dangerous foodborne pathogens, known for its resistance to low temperatures and its ability to multiply in refrigerated storage conditions . Analysis for pathogenic microorganisms, including *Salmonella* (not allowed in 25 g), revealed the absence of these pathogens in all groups. This indicates effective veterinary -preventive measures during the growing period, compliance with sanitary standards during slaughter and processing of poultry, and the absence of product contamination with pathogens at any stage of the technological process. It should be noted that these microbiological safety indicators are standardized by the Technical Regulations of the Customs Union of the Eurasian Economic Union "On the safety of poultry meat and its processed products" (EAEU TR 051/2021): QMAFAnM in unpackaged chilled poultry carcasses and their parts should not be more than 10^4 CFU/g (cm^3), bacteria of the genus Salmonella and Listeria are pathogenic microorganisms, the presence of which is prohibited in 25 g of meat products [14].

4 Conclusions

Based on the comprehensive studies conducted on the impact of a feed additive containing a mixture of taurine and succinic acid on the productivity and quality indicators of broiler chicken meat, the following scientifically based conclusions can be formulated:

1. The experimental study revealed a statistically significant increase in productivity in the experimental groups. At a dosage of 1.5 mg/L, the maximum live weight gain was recorded - 19.7% relative to the control group, indicating high efficiency. This concentration of the additive stimulates the growth of poultry. The group with a dosage of 2 mg/l demonstrated an increase of 15.7%, which also significantly exceeds the control values.

2. The organoleptic evaluation of the meat demonstrated that all samples tested met the requirements of current regulatory and technical documents. Particularly noteworthy was the improvement in quality indicators in the 2 mg/L dosage group, where products achieved first-grade quality, while the control group and the lower dosage group achieved second-grade quality.

3. Analysis of microbiological parameters confirmed the safety of products in all study groups. The studies revealed no exceedances of permissible limits for the following parameters: the number of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM); pathogenic microorganisms , including bacteria of the genus Salmonella And Listeria monocytogenes . It was established that the use of the studied feed additive does not negatively affect the microbiological parameters of meat and does not reduce its safety. Products of all groups fully comply with the requirements of EAEU TR 051/2021 and are permitted for sale without restrictions.

The obtained results indicate the potential of using a mixture of taurine and succinic acid as a feed additive in industrial poultry farming. The optimal dosage for achieving maximum effect is 1.5 mg/L to increase productivity and 2 mg/L to improve meat quality. Further research is recommended to study the effect of this additive on other indicators of meat productivity and quality, as well as to determine optimal modes of its use in various technological production conditions.

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