

The effect of a complex fortified preparation on the quality indicators of broiler chicken meat

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Abstract. The article presents the results of the conducted studies on the effect of the complex fortified preparation "Nitamin" on the quality indicators of meat of broiler chickens of the Cobb-500 cross. The preparation was administered with drinking water at a dose of 1 ml per 1 liter of drinking water, according to the scheme from 2 day to 5 day of keeping and from 15 to 18 day, poultry slaughter was carried out on 42 day of keeping. The composition of the preparation includes vitamins A; D3; E; trace elements organic iodine and selenium. The research material was the muscle tissue of broiler chickens of the studied groups, according to generally accepted methods, the content of amino acid composition and trace elements of selenium and iron was determined according to GOST R 55569-2013 Feed, compound feed, compound feed raw materials. Determination of proteinogenic amino acids by capillary electrophoresis, GOST 31707-2012 (EN 14627:2005) Trace element food products. Determination of total arsenic and selenium by atomic absorption spectrometry with generation of hydrides with preliminary mineralization of the sample under pressure and GOST 30178-96 Raw materials and food products. Atomic absorption method for the determination of toxic elements. According to the results obtained, the meat of broiler chickens treated with Nitamin was superior in amino acid composition to the meat of broiler chickens of the control group (essential amino acids by 14.38%, nonessential amino acids by 10.9%). When studying the content of trace elements in the muscle tissue of broiler chickens treated with Nitamin, an increase in the iron content of 10 mg/kg was noted, no iron was found in the muscle tissue of broiler chickens of the control group.

1 Introduction

Poultry farming is one of the highly efficient branches of animal husbandry, it is characterized by fast rates of livestock reproduction, high productivity and the lowest labor and material costs per unit of production [17]. The development of poultry farming in Russia is one of the most important areas for ensuring the country's food security [12]. In 2020, poultry meat production in agricultural enterprises of the Russian Federation in live weight amounted to 6.7 million tons, in slaughter - 5 million tons.

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Poultry meat is an important source of protein of animal origin. Proteins serve as the building material of important elements of the body – muscle tissue, enzymes, hormones [6]. The quality of meat products is mainly characterized by the ability to meet the body's need for proteins, minerals, and vitamins [14].

One of the main criteria for the health and productivity of livestock of farm animals and poultry is feeding [9]. Often, the feed quality must meet all the necessary needs of the bird's body in nutrients, vitamins, macro- and microelements. Trace elements enter the body with food, water. In recent years, fortified preparations and feed additives have been increasingly used to improve metabolism and increase the productivity of farm animals and poultry [2].

Veterinary specialists also pay great attention to pharmacological agents based on vitamins, which, after being introduced into the poultry diet, favorably affect the physiological state of poultry, biochemical blood parameters, contribute to weight gain, while not impairing the quality of the products obtained from poultry, which is important for the consumer and producer of livestock products.

The researches of such scientists as D.S. Orlov (1992) [8], V.M. Kosolapova, I.A. Trofimova (2014) [5], A. A. Deltsov, Ts. Ts. Sodboev, V. M. Bachinskaya [et al.] (2021) [3] have been proven that there is often a deficiency of such micro- and macroelements as iodine, magnesium, selenium, and iron in the soil, and this, in turn, affects the insufficiency of these elements in feed. The Nitamin preparation balances the lack of these substances in animal diet.

The Nitamin preparation is the latest modern biostimulant, the effectiveness of which has not been previously studied on any animal model. The preparation we are studying is a source of vitamin A, vitamin D₃, vitamin E, vitamin C, selenium, and iodine. These vitamins contribute to the regulation of the structure, functions and regeneration of epithelial tissues and thereby increase the resistance of a living organism against infection.

Purpose. To study the effect of the Nitamin preparation on the amino acid composition of meat and the content of trace elements in the muscle tissue of broiler chickens.

Tasks. To achieve this goal, it is necessary to determine the amount of nonessential and essential amino acids in meat, to determine the content of selenium and iron in the muscle tissue of broiler chickens.

2 Materials and Methods

The research was carried out at the Department of Parasitology and Veterinary and Sanitary Examination of the FSBEI HE MVAVM&B – MVA named after K.I. Skryabin in the period from July to August 2021, the amino acid composition of meat and the content of trace elements in the muscle tissue of broiler chickens were determined in the FSBI "VNIIZZh".

The object of research was broiler chickens of the Cobb-500 cross, in the amount of 40 heads, divided into two groups according to the principle of analogues, the experimental group with the main diet was given the preparation Nitamin (manufacturer Firm "A-BIO" LLC, Moscow region), the second group was a control.

Chickens were kept in standard cages for this type of bird in similar conditions of maintenance, feeding, and care. Clinical examination revealed that only healthy broiler chickens were used in the experiment.

Table 1. Experiment scheme

Group No.	Quantity	Description of actions
1 Experiment	20 heads	Basic diet + Nitamin From 2 days of age to 5 days of age and from 15 days of age to 18 days of age at the rate of 1 ml of the preparation per 1 liter of water
2 Control	20 heads	Basic diet without preparation

Characteristics of Nitamin preparation: vitamin A – 50,000 IU/mL; vitamin D3 – 5000 IU/mL; vitamin E – 50 mg/ml; organic iodine in the form of 3,5-diiod-L-tyrosine – 400 ug/ml; selenium (IV) – in the form of sodium selenite – 170 ug/ml; preserving agent (methylparaben) – 1.5 mg/ml; iron – 2.8 g; antioxidant (ionol) – 0.1 mg/ml; emulsifier (polysorbate 80) – 210 mg/ml; emulsion stabilizer (glycerin) - 60 mg/ml; distilled water up to 1.00 ml.

The amino acid composition of broiler chicken meat was determined according to GOST R 55569-2013 Feed, compound feed, compound feed raw materials. Determination of proteinogenic amino acids by capillary electrophoresis.

The amount of trace elements in the muscle tissue of broiler chickens was determined: selenium - GOST 31707-2012 (EN 14627:2005) Trace element food products. Determination of total arsenic and selenium by atomic absorption spectrometry with generation of hydrides with preliminary mineralization of the sample under pressure; iron - GOST 30178-96 Raw materials and food products. Atomic absorption method for the determination of toxic elements.

The obtained research results were analyzed and processed using standard computer programs for statistical processing.

3 Research results

Meat is a valuable food product and is a source of full-fledged proteins, fats, carbohydrates, and minerals necessary for the normal functioning of the body. The content of these substances depends mainly on the feeding conditions of the animals.

Amino acids are part of proteins that serve as nutrients, regulate metabolism, promote oxygen absorption, play an important role in nervous system functioning, and are the mechanical basis of muscle tissue [11]. In metabolism process, many amino acids are synthesized in the body from other amino acids or compounds and therefore they are called nonessential. Amino acids that are not synthesized in the body or are formed in insufficient amount are called essential [4].

According to the data obtained from the study of the amino acid composition of broiler chicken meat presented in Table 2, the content of essential amino acids in the meat of experimental chickens increased by 14.38%, nonessential by 10.9%.

Table 2. Amino acid composition of broiler chicken meat

Amino acid	Content, % in dry matter	
	Experiment	Control
Essential amino acids		
Arginine	3.1±1.2	3.3±1.3
Valine	2.8±1.1	2.4±0.9
Histidine	2.1±1.0*	1.7±0.9

Leucine + isoleucine	7.9±2.1	6.3±1.6
Lysine	5.7±1.9*	4.5±1.5
Methionine	1.8±0.6*	1.4±0.5
Phenylalanine	2.4±0.7	2.0±0.6
Threonine	3.1±1.2	2.5±1.0
Mass fraction of asparagine and aspartic acid (total)	8.8±3.5*	1.9±0.7
Mass fraction of tryptophane, %	0.7±0.2	0.52±0.16
Sum of essential amino acids	38.4	24.02
Nonessential amino acids		
Alanine	3.3±1.0	3.5±0.9
Glycine	2.7±0.9	2.8±1.0
Proline	2.4±0.6*	2.2±0.6
Tyrosine	2.6±0.8	2.6±0.8
Serine	2.7±0.7	2.3±0.6
Mass fraction of glutamine and glutamic acid (total)	12.8±3.0*	2.9±1.1
Cystine	1.1±0.5	0.4±0.2
Sum of nonessential amino acids	27.6	16.7

Note: the reliability of the difference at $*P \leq 0.05$

Based on the data in Table 2, we can analyze the content of some essential amino acids in the meat of broiler chickens of experimental groups:

Histidine affects the growth and tissue repair. The histidine residue is part of the active centers of many enzymes. Histidine is a precursor in histamine biosynthesis. One of the essential amino acids, promotes the tissue growth and repair. The use of Nitamin determines the tendency to increase the content of the claimed amino acid by 0.4% in representatives of the experimental group of broiler chickens in relation to the control.

Isoleucine accelerates metabolism, provides muscle tissue with energy. It promotes the flow of biochemical processes in which energy is generated. Also according to Bachinskaya V. M., Vasilyeva V. A., and Gonchara D.V. (2021) [1] it prevents the feeling of anxiety, worry, stress in birds. It prevents an increase in the level of insulin in the blood. It promotes the restoration of muscle tissue. It plays a key role in the production of hemoglobin. The metabolism of isoleucine occurs in muscle tissue. *Leucine* also decrease blood sugar levels, provides nitrogen balance, it is necessary for the construction of muscle tissue, protects muscles and all other tissues, except bone, from permanent decay. It is a specific source of energy at the cellular level. It promotes the regeneration of bones, skin and muscle tissue and is recommended during the recovery period after surgical operations and injuries. The use of Nitamin increases the content of isoleucine and leucine by 1.6%.

Lysine is responsible for the absorption of calcium; participates in the formation of collagen; takes an active part in the production of antibodies, hormones, and enzymes. Lysine reduces the level of triglycerides in the blood serum. Lysine in combination with proline and vitamin C prevents the formation of lipoproteins that cause blockage of the arteries. The use of Nitamin increases the lysine content by 1.2%. This is important, because the lack of the claimed amino acid causes the development of immunodeficiency conditions, fatigue, inability to concentrate, damage to eye vessels, anemia, and the occurrence of problems in the reproductive sphere [19].

Threonine is an important component in the synthesis of purines. It is a component of collagen, elastin, adjusts the work of the digestive and intestinal tracts; participates in the processes of metabolism and absorption. The use of Nitamin increases the threonine content by 0.6%, which is undoubtedly promising, for the possibility of transformation into other amino acids, in particular into glycine and serine, necessary for the construction of muscle tissue, collagen, and elastin.

Tryptophane determines the physiological activity of digestive tract enzymes, oxidative enzymes in cells and a number of hormones, participates in the renewal of plasma proteins. The introduction of the preparation under our study into the diet of broiler chickens contributed to an increase in this amino acid by 0.18% relative to the control.

Aspartic acid plays an important role in metabolism in the body. Transferring amino groups to ketoacids, forming a number of other amino acids, turning into oxalic acid, aspartic acid binds nitrogenous compounds. Forming asparagine, aspartic acid neutralizes ammonia in tissues. It has an immunomodulatory effect, increases physical endurance, normalizes the balance of excitation and inhibition in the central nervous system, and has a protective effect against radiation exposure. Aspartic acid also improves blood circulation conditions and increases oxygen consumption in the myocardium. The use of the Nitamin preparation increases the level of this amino acid in the muscle tissue of broiler chickens by 6.9% relative to the control group.

Trace elements are part of proteins, enzymes, vitamins, and hormones and take an active part in many biochemical processes of the body. With their help, all physiological processes are carried out, namely, growth, development, reproduction, respiration, etc.

Our studies aimed at determining the amount of trace elements in the meat of broiler chickens are presented in Table 3. The selenium content in the meat of experimental chickens increased by 0.031 mg/kg in comparison with the control.

Table 3. The content of trace elements in the muscle tissue of broiler chickens

Studied groups	Name of indicators	Amount, mg/kg
Experiment	Selenium	0.094 ± 0.008
	Iron	10.0 ± 1.7
Control	Selenium	0.063 ± 0.017
	Iron	Not found

Iron is a widespread element in nature, previously it was attributed to macronutrients due to its relatively high content in the body. This trace element is necessary for the synthesis of hemoglobin, cytochromes, in which more than half of its reserves in the body are concentrated. As an oxygen carrier, iron helps to enhance the metabolism of nutrients inside the cell. It is part of a number of enzymes: cytochromes, catalase, peroxidase, etc. Lack of iron in the diet leads to the development of anemia. The iron content in the meat of experimental chickens turned out to be 10.0 mg/kg, no iron was found in the meat of chickens of the control group. The need of poultry for iron, as a rule, is met from feed components, and with a large excess. The synergists of iron during its absorption are vitamins B6, B12, E.

In biochemical processes, selenium, like vitamin E, plays the role of an antioxidant. The lack of selenium in the diet of poultry causes a disease similar to vitamin deficiency in it. In natural compounds, it is able to replace sulfur. Selenium has an immunostimulating property, it has a positive effect on the reproductive functions of laying hens and roosters, promotes the removal of heavy metals from the body. Selenium intake is necessary to maintain cellular and humoral immunity. Large doses can enhance the immune response and protect the body from certain viral infections. Selenium deficiency in chickens and

turkeys causes a decrease in egg productivity. Chickens with a lack of selenium have exudative diathesis [13].

The selenium content in the meat of experimental chickens increased by 0.031 mg/kg in comparison with the control.

4 Conclusion

The presented fortified preparation Nitamin when it is fed to broiler chickens from 2 days of age to 5 days of age and from 15 days of age to 18 days of age at the rate of 1 ml of the preparation per 1 liter of water makes it possible to obtain meat more enriched in amino acid composition, according to the data obtained, the content of essential amino acids increases by 14.38%, nonessential - by 10.9%. The content of selenium and iron in muscle tissue increased in relation to the control by 0.031 mg/kg and 10.0 mg/kg, respectively. Drawing a conclusion from the data obtained by us, the use of the preparation Nitamin for broiler chickens has a positive effect on the biological and nutritional value of the meat obtained.

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