PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

O USO DE BIOSTIMULANTE PARA AUMENTAR O GANHO DE PESO CORPORAL DE FRANGOS

THE USE OF BIOSTIMULANT FOR INCREASING THE BODY WEIGHT GAIN OF CHICKENS

ВЛИЯНИЕ БИОСТИМУЛЯТОРА НУКЛЕОСТИМ НА ЖИВУЮ МАССУ ЦЫПЛЯТ БРОЙЛЕРОВ

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RESUMO

A avicultura ocupa um lugar especial garantindo a demanda do consumidor pelos produtos da indústria, que fornece à população produtos alimentares essenciais, tais como ovos e carne, que contêm micro e macro nutrientes vitais, proteínas, lipídios e vitaminas. Portanto, as questões da alimentação racional e economicamente viável de aves de galinheiro, como galinhas de corte, são tarefas urgentes. Também é essencial encontrar métodos eficazes de aplicação para corrigir a resistência natural e a reatividade imunológica e biológica das aves. O objetivo desta pesquisa é estudar o efeito do estimulante biológico Nucleostim no crescimento e desenvolvimento de galinhas, parâmetros hematológicos e imunológicos do sangue de aves. Na aplicação de Nucleostim, o ganho de peso vivo de frangos aumentou 9,7%. No final do experimento, a habitabilidade dos pintos do grupo experimental tratado com Nucleostim chegou a 88%, comparado com os 72% do grupo de controle. O uso de Nucleostim teve um efeito estimulante no fígado de galinhas, contribuindo para o desenvolvimento do timo no contexto da distrofia geral. Assim, Nucleostim melhora a habitabilidade dos pintinhos e aumenta o ganho de peso corporal. O estimulante biológico Nucleostim como agente adaptógeno, anabólico e imunoestimulador é promissor para encontrar novos medicamentos que melhorem a saúde e a produtividade das aves.

Palavras-chave: *Galinhas, crescimento e desenvolvimento, habitabilidade, Nucleostim, avicultura, resistência*

ABSTRACT

Poultry farming holds a special place in ensuring the products that the consumers demand, it provides the population with essential food products,such as eggs and meat,that contain vital micro and macronutrients, proteins, lipids, and vitamins. Therefore, the issues of rational, economically feasible feeding of meat poultry, namely broiler chickens, are an urgent task. It is also essential to find effective methods of their application in order to correct the natural resistance and immune and biological reactivity of birds. The purpose of this research is to study the effect of the biological stimulant-Nucleostim on the growth and development of chickens, hematological, and immunological parameters of the blood of birds.This Biostimulant is a purified bovine spleen extract containing at least 1 mg / ml of low molecular weight peptides (nucleotides and nucleosides) formed as a result of autolysis, using dry whey and diatomite as fillers. Onthe application ofNucleostim, the gain in live weight of chickens was increased by 9.7%. At the end of the experiment, the livability of the chicks of the experimental group treated with Nucleostimcame up to 88%, compared with the 72% of the control group. The use of biostimulant had a stimulating effect on the liver of chickens confirmed by the research results presented in the article, as well as contributed to the development of the thymus in the setting of general dystrophy. Thus, it improved chicklivability and increased body weight gain. The biological stimulant-Nucleostim as an adaptogenic, anabolic, and immunostimulatory agent is promising for finding new drugs that improve the health and productivity of poultry.

Keywords:Chickens, growth and development, livability, Nucleostim, poultry farming, resistance.

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АННОТАЦИЯ

Птицеводство занимает особое место, так так обеспечивает население необходимыми пищевыми продуктами, такими как яйца и мясо, которые содержат жизненно важные микро- и макроэлементы, белки, липиды и витамины. Поэтому вопросы рационального, экономически целесообразного кормления мяса птицы, а именно цыплят-бройлеров, являются актуальной задачей. Также важно найти эффективные методы их применения для коррекции естественной резистентности и иммунной и биологической реактивности птиц. Целью данного исследования является изучение влияния биологического стимулятора-Нуклеостима на рост и развитие цыплят, гематологические и иммунологические показатели крови птиц. Этот биостимулятор представляет собой очищенный экстракт бычьей селезенки, содержащий не менее 1 мг/мл. низкомолекулярных пептидов (нуклеотидов и нуклеозидов), образованных в результате автолиза, с использованием сухой сыворотки и диатомита в качестве наполнителей. При применении Нуклеостима прирост живой массы цыплят увеличился на 9,7%. В конце эксперимента выживаемость цыплят экспериментальной группы, получавших Нуклеостим, достигла 88% по сравнению с 72% контрольной группы. Применение биостимулятора оказало стимулирующее действие на печень кур, подтвержденное результатами исследований, представленными в статье, а также способствовало развитию вилочковой железы в условиях общей дистрофии. Таким образом, это улучшило жизнеспособность цыплят и увеличило прирост массы тела. Биологический стимулятор Нуклеостим как адаптогенное, анаболическое и иммуностимулирующее средство является перспективным для поиска новых лекарств, улучшающих здоровье и продуктивность домашней птицы.

Ключевые слова: цыплята, рост и развитие, живность, нуклеостим, птицеводство, устойчивость.

1. INTRODUCTION:

Poultry farming provides the population with essential food products – eggs and meat that contain easily digestible proteins, lipids, trace elements, and vitamins. Therefore, the issues of rational, economically feasible feeding of poultry, namely broilers, appear relevant. Preliminary results of 2019 indicate that the volume of poultry meat production in Russia has grown by 1.3%: from 4.98 million tons in 2018 to 5.045 million tons. Poultry meat farming surpasses all other livestock industries in terms of feed conversion. The production of 1 kg of broiler meat requires 1.5 and 2.5 times less feed than the same amount of pork and beef. In the world ranking of poultry producing countries, Russia is among the top five countries. The main factors of production growth are the implementation of innovative processes and comprehensive modernization of poultry farming within the framework of the national project “Development of agriculture” and the State program for agricultural development (Government of the Russian Federation, 2012; Buyarovandand Buyanov, 2015; Fisinin *et al.,* 2017; Buyarov *et al.,* 2018).

World meat production is constantly increasing. In 2016, it was 259.3 million tons, and in 2019 it raised to 301 million tons. The production of meat of all animal species in the world increased sevenfold between 1950 and 2019. The maximum growth rate for the same period is in line with the production of poultry meat – 11.8-fold. In 2018, in the structure of world production, pork accounted for 37.4% of meat in the slaughter-weight; poultry – for 34.1%; beef – for 22.2% and lamb –for 4.5%. According to the FAO forecast for 2011-2025, the annual increase in meat will be 3.1% for poultry, 2.6% for pork, and 1.3% for beef. The most significant amounts of poultry meat consumption are observed in the UAE, Israel, Hong Kong, the United States, Singapore, and Brazil (Gharahveysi *et al.,* 2020).

Estimates show thatfollowing the results of 2019, poultry meat production in the world will come up to 106 million tons. Of these, 20.111 million tons are producedin the United States; 18.517 – in China; 11.500 million tons – in Brazil. The E.U. indicator will reach 12.738 million tons, with an increase of 188 thousand tons over the year. By 2020, Brazil will be among the largest exporters of poultry meat, taking the leading position, followed by the United States, China, the European Union, and Russia.

The viability of broiler chickens is an essential factor in determining the profitability of poultry farming. Chicken embryo tissues contain a high proportion of polyunsaturated fatty acids in the lipid fraction and therefore need antioxidant protection. The antioxidant system of the developing embryo and newly hatched chicken includes antioxidant enzymes, water-soluble

antioxidants, fat-soluble antioxidants, and selenium. Natural antioxidants play a pivotal role in the maternal diet affecting the development of chicken embryos and their viability in their early neonatal life (Gharahveysi *et al.,* 2020).

Upon zootechnical and economic indicators, floor-grown broilers of the cross Ross-308 were more effective than broilers of the cross Hubbard f 15. The profitability of production and sales of meat from Ross-308 cross broilers was higher than that of Hubbard f 15 cross broilers by 1.9% (Buyarov *et al.,* 2018).

The level of metabolic energy in poultry feed is one of the most critical indicators that ensure optimal growth and development of the body (Fisinin, 2013). Various feed additives, fats, and oils are used to optimize the composition of feed for broilers in terms of this indicator. They have the highest caloric content among all types of feedstock, and therefore constitute the main source of energy for poultry (Fisinin *et al.,* 2017). When choosing a food source for feeding broilers, in some cases, it is necessary to take into account not only the level of live weight gain, feed conversion, and carcass quality but also the indicators that characterize the quality of the meat itself.

Boosting the production of eggs and poultry meat is based on a significant increase in the productivity of birds with a simultaneous increase of the poultry stock with a high payment for feed by meat products and a rise in labor productivity (Nozdrin *et al.,* 2018).

However, at present, great importance is attached not only to increase the number of poultry, but also, mainly, to increasetheir viability, the resistance of the organism, productivity, improving meat qualities, and egg production (Fisinin *et al.,* 2017). The latter depends on the genetic-environmental interaction.

The use of biological stimulants is one of the most promising areas in poultry farming (Dementyev *et al.,* 2018).

Several authors cite data on studies of the nature of autarcesis of birds on increasing live weight and egg production, preserving poultry stock, viability, and its variability as affected bythe external and internal environment. Despite this, many aspects of the presented problem remain unexplored, such as improving the quality of meat, reducing the time of poultry rearing, increasing the degree of mineralization of the organic matrix of bone tissue and bone density in the process of growth and development (Buyarov *et al.*, 2012, 2018; Fisinin, 2013; Ahmadi*et al.,* 2018; Jahanian and Ashnagar, 2018; Nozdrin *et al.,* 2018; Rubio *et al.,* 2019).

Despite the available information on the use of biological stimulants, this issue remains relevant. It is also important to find effective methods of their application in order to correct the natural resistance and immune and biological reactivity of birds.

Poultry farming plays a significant role in providing the population with high-quality food. Interest in this industry is constant both in large specialized enterprises and on small farms. At the same time, the species range of captive birds, from ostriches to quails, is expanding, although industrial production of meat and eggs of chickens is more traditional for agriculture (Buyarov *et al.,* 2018). Also, to achieve that technological capacities have been established, conditions for keeping and feeding poultry have been brought about. Low feed consumption, a short period of reproduction, the plasticity of an organism of hens and chicks are the advantages of breeding poultry (Fisinin, 2013).

However, the genetic potential of the birds' organism for meat production is not enough. One of the keys to an extensive increase in poultry production capacity is to find opportunities for the use of biologically-active preparations, i.e., medicinal substances with bioactive properties and a regulating effect on the growth and development of birds, the intensity of exchange processes;enhancing the functional activity of organs and body systems; increasingautarcesisof the organism of birds and at the same time safe for own body and its products to humans and the environment (Julean *et al.,* 2013).

In connection with the above, the research objective was to study the effect of the biological stimulant biostimulator on the growth and development of chickens, hematological, and immunological parameters of the blood of birds.

Biostimulant is a purified bovine spleen extract containing at least 1 mg/ml of low molecular weight peptides (nucleotides and nucleosides) formed as a result of autolysis, using dry whey and diatomite as fillers.

2. MATERIALAND METHODS:

One hundred broiler chickens of the crosses ROSS 308and Rodonit were used for the research. The conditions for conducting

experiments were identical for the control and experimental groups, and they meet the requirements of “Sanitary rules for the construction, equipment, and maintenance of experimental and biological clinics (vivariums)”No. 1045-73 as well as of GOST (All-Union State Standard) R 53434-2009 “Principles of good practice” corresponding to international GLP standards. The diet of the young birds consisted of a balanced complete feed PC-2 produced by the Bogdanovich feed mill (Table 1).Water was supplied *ad libitum*.

Biopreparation was used in the study – a water-soluble premix for poultry containing natural growth stimulants represented by low molecular weight biologically active peptides–nucleosides and nucleotides. Bioadditive was introduced into the diet of birds in the right concentrations and fed with the feeding stuff according to the instructions for use – broiler chickens: 10 g/kg of feed every other day for ten days. The optimal dose of biopreparation was 10 g/kg of feed. The investigational product mixed with feed was given daily for ten days.

The live weight was determined by individual weighing using laboratory electronic scales AND GF-600. The broiler stock was weighed from the first to the ninth week of research (Figure 1). The chick livability was determined by taking into account the mortality rate.

The development of internal organs was determined by necropsy from the $30^{th}$to 38^{th}days of chickens’ life at the Department of morphology, pathology, pharmacy, and non-infectious diseases of Bashkir state agrarian university (Russia)with further evaluation of the weight and size of internal organs.

Anatomical and morphological methods were used to measure the size, weight, and topography of internal organs (Skovorodin*et al.,* 2019). The central organs of the bird's immune system (thymus, spleen, Bursa), heart, and liver were used as research materials. The investigational organs were weighed by analytical laboratory scales AND GF-600.

Based on the data obtained, the relative weight of the organ was calculated.

Modern clinical assessment of general condition, thermometry, assessment of mucous membranes, pulse rate and breathing, assessment of feather cover,hematological(erythrocytes, hemoglobin, color index, leucocytes) and biochemical research methods (total protein, protein fractions, total bilirubin, AST, ALT) were used in the work.

Hematological studies of whole blood were performed using an automatic hematological analyzer Abacus Junior 5Vet (Diatron Messtechnik GmbH),which determines 22 hematological parameters: leucocytes, 10^9/l, lymphocytes, %, lymphocytes, 10^9/l, monocytes %, monocytes, 10^9/l, neutrophils, %, neutrophils, 10^9/l, eosinophils %, eosinophils, 10^9/l, basophils, %, basophils, 10^9/l, erythrocytes, 10^{12}/l, hemoglobin, g/l, hematocrit, %, mean corpuscular volume, fl, mean contents of hb in er., pg, mean hb conc. in er, g/l, the distribution range of erythrocytes population,%, platelets, 10^9/l, platelet count,%, average platelet volume, fl, distribution range of platelets population,%).

Verification and calibration of the hematological analyzer were carried out within the framework of in-laboratory control with the formulation of studies of standardized whole blood samples with normative and pathological values of indicators issued by DiatronMesstechnik GmbH. Biochemical blood tests were performed using a semi-automatic biochemical blood analyzer StatFax 1904+ (Awareness Technology Inc.,) using standardized reagents Vital Diagnostics Spb.

Statistical analyses

The obtained data were statistically processed using Microsoft Excel.

Ethical issues

The experiments are approved by the Commission on Bioethics of Bashkir state agrarian University established to monitor and evaluate the policy of working with laboratory animals, methodological and experimental base for the humane treatment of animals and their rational use, guided by the legislation of the Russian Federation, the provisions of the “European Convention for the protection of vertebrates used for experimental and other scientific purposes”, as well as the provisions of the Guide for the Care and Use of Laboratory animals and other rules of international law which regulate the maintenance and use of laboratory (experimental) animals (Protocol No. 18-2020 of January 14, 2020).

3. RESULTS AND DISCUSSION:

The immunobiology of the animal organism during fetal development is characterized by certain features. First of all, during this period of ontogenesis, germinal organs are formed and function – the placenta, gall bladder, allantois, and amnion, which perform metabolic and fetus-protecting functions. Protection of the fetus by temporary germinal organs involves maintaining the immunological balance of the mother and the fetus and preventing infection of the latter. The chicken organism is also able to transmit its own antibodies transovarially. Poor supply of the fetus with maternal antibodies in itself implies the autoreproduction of antimicrobial factors by the fetus. The antimicrobial activity of autarcesis plays an important role in the life of chickens.

As known, many biological stimulants have an anabolic effect due to the increased formation of nucleic acids and protein in the liver and muscles. Therefore, the live weight of broiler chickens was one of the main indicators in the study of the properties of biopreparation. The values of the live weight of birds when compared with the norm and control, the average daily gain, as well as the livability of the broiler stock for the entire time of the experiment, were paid attention to (Julean *et al.,* 2013).

The experiment conducted involved addingthe biological product Nucleostimat a dose of 10 g/kg of feed into the diet of broiler chickens of the cross ROSS-308 in order to stimulate growth as well as protect them from diseases during rearing.

Day-old chickens were divided into 2 groups. The first group totaling 50 birds was fed standard feed with the addition of vitamins, trace elements, and biopreparation at a dose of 10 g/kg. The second group consisting of 50 chickens,was fed standard feed and served as the control.

It is known that in the postnatal period, the growth of chickens depends on the initial weight of biologically active tissue. The live weight of the crossROSS 308 chickens was 40.5 ±0.4 g in the experimental group and 39.9 ±0.3 g in the control group.

Chickens are markedly affected by an indoor microclimate. Constant temperature (in the first days up to 32℃), light regime, humidity, and air exchange were maintained in the poultry house (Dementyev *et al.,* 2018).

The development of chickens is affected by compound poultry feed (crumb) with the correct calorie-protein ratio and their enrichment with vitamins, trace elements, and antibiotics, which increases the biological usefulness of the feed (Salem *et al.,* 2018).

It is known that getting weighty chickens in the first week of fattening can affect the degree of increase in body weight in the following weeks (Table 2).

The table shows that during the first week of life, the increase in live weight of chickens fed biopreparation increased by 9.7% compared with the control. After three weeks, chickens treated with bioadditive overweighed the control by 87.4 g, and in 5 weeks, the average live weight of broiler chickens exposed to biopreparation was 1060.0±15.0 g and of control chickens – 848.5±15.0 g. The chickens of the experimental group overweighed the control ones by 211.5 g.

At the end of the study, that is, at the age of 9 weeks, the average live body weight of one chick fed biostimulator was 2180.0±50.0 g, and of the control – 1850.5±48.5 g.

Thus, the chickens exposed to bioadditive overweighed the chickens of the control group by 290.5 g.

At the end of the experiment, the livability of the experimental group of chickens was 88%, and of the control group – 72%.

As a result of the use of bioadditive ata dose of 10 g/kg of feed, there has been an overallsurvival growth of chickens and an increase in the live weight gain.

The second set of experiments was performed for therapeutic purposes with 36 64-day-old chickens of the cross Rodonit which were rejected due to general dystrophy (failure in growth, weight, development) and divided into three following groups of 12 birds each:

1. Control

2. bioadditive at a dose of 10 g/kg of feed

3. bioadditive at a dose of 5 g/kg of feed.

The chickens were weighedat the age of 64, 74, 84, and 94 days. The data obtained are shown in Table 3.

Analyzing the obtained data, it can be observed that the chickens of the experimental group had a significantly high average daily increase compared to the chickens of the control group. The highest results were observed in the group of chickens fed biopreparation at a dose of 10 g/kg of feed. So, throughout theresearch, the increase in live weight of chickens in that group was 104.4%, in the group of chickens exposed to biological stimulator at a dose of 5 g/kg of feed –

93.3% compared to chickens in the control group.

The chick livability in the experimental and control groups was similar. In the control group, ninechickens lived through the experiment, and the mortality rate was 20%; in the second group, 11 chickens survived, or 91.6%, and in the third group – 90%.

The impact of bioadditive on on the development of internal organs was studied on 30-38 days old chickens. Fourgroups of 10 birds each were formed. The test stock was fed standard mixed feed. In addition, to feed,the biostimulantunder investigation was given daily for tendays. Group 1 – biological stimulator (10 g/kg of feed). Group 2 – biological stimulator (5 g/kg of feed). Group 3 – biological stimulator (15 g/kg of feed). Group 4 –control.

The effect of the biopreparation was evaluated by the condition of the digestive organs (liver, glandular stomach) and the immune system (thymus, Bursa). Special attention was paid to the central immune organs of birds since they all grow rapidly in the first months of life and reach maximum development: the thymus by 3.5-4 months, and the Bursa by 4-4. Fivemonths. Then thymus gradually mummifies upon reaching puberty.

Autopsies were performed from the 30thto 38th day of the life of chickens at the Department of morphology, pathology, pharmacy, and non-infectious diseases of Bashkir state agrarian university. No pathological changes were found in the organs. The weight and size of internal organs were evaluated. The study data are shown in Table 4.

Table 4 shows that in three experimental groups, the weight of the internal organs of broiler chickens is greater than in the control group. The most significant increase in organs was observed in chickens exposed to bioadditive at, a dose of10 g/kg of feed.

When conducting research for therapeutic purposes on 64-day-old cross Rodonitchickens with clinical signs of general dystrophy, deficiency in live weight, and failure in growth and development were found. According to domestic and foreign sources, there is a correlation between the condition of some internal organs and the overall condition of the body of chickens. So, when the depletion increases, the thymus lobes grow less, and when the feed ration of birds improves,the gland regeneration begins in parallel (Skovorodin*et al.,* 2013).

Studies have shown that throughout the experiment, the development of the thymus was registered in all groups of chickens. Apparently, this was due to improved feeding during the study period.

The absolute weight of the thymus in the control group of chickens was 0.8±0.07 g, and in chickens fed biopreparation at a dose of 10 g/kg of feed – 1.006±0.03 g which was 0.206 g more.

Thus, the use of biostimulator contributed to the development of the thymus in chickens in the setting of general dystrophy.

The absolute weight of the liver of Rodonit cross chickens that were treated with biopreparation at doses of 10, and 5 g/kg of feed at the age of 64-days was 12.25±0.35 and 10.85±0.18 g, respectively, which was 2.05 and 0.65 g more than the liver weight of the control chickens.

In such a way, bioadditive has a stimulating effect on the liver of chicks of experimental and control groups. At the same time, the relative weight of the organ is less than in control, which implies physiological hepatomegaly.

The blood system is directly involved in specific and non-specific reactions of the body affecting its resistance and reactivity. Blood readily responds to anyexposure and serves as an important criterion for the physiological condition of the animal body and the metabolic rate.

The study of morphological and immunological parameters of chicken blood was carried out by many researchers. However, there are splits over the dynamics of blood indicators of young chickens. It was found that they changed depending on the age and physiological state of chickens, which indicated a different intensity of metabolic processes in each period of their life, which was confirmed by our research.

The stimulatoryaction of various biostimulants on hematopoiesis, and especially on leukopoiesis, has been mentioned by many scientists.

Morphological studies have shown that the use of biostimulator did not have any significant impact on the dynamics of indicators of red and white blood of birds. During the experiment, they were within the physiologicallynormal state for that age and type of production.

The minimum content of red blood cells and hemoglobin was registered at the age of 30 days (Table 5), which was consistent with the data of domestic and foreign scientists. By the 40thday of the life of chickens (in the first set of

experiments), the indicators increased on average by 14.8%. After the treatment with biopreparation, the content of red blood cells in the second experimental group (Nucleostim 10 g/kg of feed) increased by 16% compared to the control.

At the age of 40 days, the difference in the content of red blood cells in the experimental and control groups raised up to 10.5-31.6% and of hemoglobin – to 10.8-24.6% (Table 5).

In the blood of experimental and control groups of chickens, the content of white blood cells was found to be quite high, which was typical for that age. The leukogram of the chickens of experimental and control groupshowed the ratio of individual white blood cells within the physiological range, but some specific features were observed. For example, the percentage of eosinophils and basophils in the control group was 20% higher than in the experimental group, which indicated a more pronounced sensitization of chickens in that group (by 30 days of age, the chickens were challenged with five different vaccines). At the same time, a slight increase in the number of lymphocytes (by 3-8%) in the blood of chickens of the experimental groups compared to the control indicates the mobilization of the immune system in response to exposure, including the use of the compounds under investigation (Table 6).

An increase in the level of lymphocytes in the blood indicates an enhancement in the specific immunity of birds since these cells are the main executive element in the manifestation of cellular and humoral protection of the body.

It is known that many biological stimulants can increase the phagocytic activity of white blood cells. This increases both the number of phagocytic cells and the number of microbes they absorb (Tang *et al.,* 2007).

To characterize the system of non-specific immunity in birds when exposed to the investigational product bioadditive the functional activity of pseudo-eosinophils, monocytes and platelets of the whole blood of chicks in phagocytic reactions (for phagocytic number and phagocytic index) and the reduction reaction of nitro blue tetrazolium (spontaneous and latex-induced NBT-test) and the level of complement in blood serum have been studied.

The results of the research are shown in Table 7, analyzing which one can see that before the experiment, the phagocytosis indicators and the level of complement in the blood of chickens were within the physiological range. When re-analyzing the blood of animals after the use of the compounds under investigation, there were significant deviations in the indicators of the experimental groups compared to the control (Table 7).

In groups using biostimulator, there was an increase in the absorption activity of white blood cells, and in the level of complement compared to the control group. The complementary activity of the blood serum of chickens in those groups increased by 24.6 and 25.6% compared to the control group. The average number of latex particles absorbed by a single cell (PHI) was 23% higher than in the control group. The activity index of pseudo-eosinophils in the “spontaneous” test increased by 50% compared to the control, and by 6.7% when induced by latex, respectively. The optimal effect was observed at a dose of 10 g/kg of feed. Reducing the dose to 5 g/kg of feed led to a slight decrease in the functional activity of phagocytes.

Thus, the use of bioadditive had a stimulating effect on the phagocytic activity of pseudo-eosinophils, monocytes, and platelets of the blood of birds and on the complement system – a non-specific factor of humoral immunity. The new biological stimulant Nucleostim is recommended for use in veterinary medicine as an adaptogenic, anabolic, and immunostimulating agent and is promising for finding new drugs that improve the health and productivity of poultry.

Many biological stimulants have an anabolic effect due to the increased formation of nucleic acids and protein in the liver and muscles. Therefore, the live weight of broiler chickens was one of the main indicators in the study of the properties of biopreparation. Attention was drawn to the values of the live weight of birds when compared with the norm and control, the average daily gains as well as the livability of the broiler stockthroughout the experiment (Julean *et al.,* 2013; Khaziev *et al.,* 2018; Santos *et al.,* 2019).

The development of chickens is affected by compoundpoultryfeed (crumb) with the correct calorie-protein ratio, their enrichment with vitamins, trace elements, and antibiotics, which increases the biological usefulness of the feed (Sharipovaand Khaziev, 2015; Salem *et al.,* 2018).

It is known that getting weighty chickens in the first week of fattening can affect the degree of increase in body weight in subsequent weeks (Buyarov *et al.,* 2018). In the first week of life, the live weight gain of chickens treated with bioadditive increased by 9.7% compared withthe control chickens. After threeweeks, the chickens exposed to biostimulator overweighed the control

ones by 87.4 g, and after fiveweeks– by 211.5 g.

At the end of the study, that is, at the age of 9 weeks, the average live body weight of one chick treated with biostimulator was 2180.0±50.0 g and of the control – 1850.5±48.5 g. The chickens exposed to biostimulator overweighed the control chicks by 290.5 g. At the end of the experiment, the livability of the experimental group of chickens was 88%, and of the control group – 72%.

As a result of the use of bioadditive at, a dose of 10 g/kg of feed, there is an increase in the livability of chickens and an increase in their live weight gain. The livability of chickens in the experimental and control groups was similar. In the control group, ninechickens lived through the experiment, and the mortality rate was 20%; in the second group, 11 chickens stayed alive or 91.6%, and in the third group – 90%.

The effect of the biopreparation on internal organs was assessed by the state of the digestive organs (liver, glandular stomach) and the immune system (thymus, Bursa). Special attention was paid to the central organs of immunity in birds since they all grow rapidly in the first months of life and reach maximum development: the thymus by 3.5-4 months and the Bursa by 4-4.5 months. Then the thymus gradually mummifies upon reaching puberty (Nasrin *et al.,* 2012; Skovorodin *et al.,* 2013).

No pathological changes were found in the organs. The weight and size of internal organs were estimated (Tange*t al.,* 2007; Skovorodin *et al.,* 2019).

When conducting research for therapeutic purposes on 64-day-old Rodonit cross chickens with clinical signs of general dystrophy deficiency in live weight and failure in growth and development were found. According to domestic and foreign sources, there is a correlation between the state of some internal organs and the general state of the body of chickens. Thus, when the depletion increases, the thymus lobes grow less and when the feeding diet of birds improves, the gland regeneration begins in parallel (Aluwong *et al.,* 2013; Skovorodin*et al.,* 2013; Fisinin *et al.,* 2017; Jahanian and Ashnagar, 2018; Rubio *et al.,* 2019).

Studies have shown that throughout the experiment, the development of the thymus was registered in all groups of chickens. Apparently, this was due to improved feeding during the study period. BiostimulantNucleostim has a stimulating effect on the liver of chicks of experimental and control groups. At the same time, the relative weight of the organ is less than in control, which indicates physiological hepatomegaly.

The study of morphological and immunological parameters of the blood of broiler chickens was carried out by many researchers. However, there are splits over the dynamics of blood indicators of young chickens. It was found that they changed depending on the age and physiological state of chickens, which pointed to a different intensity of metabolic processes in each period of their life, which was confirmed by our research. The stimulating effect of various biostimulants on hematopoiesis, and especially leukopoiesis, has been noted by many scientists (Julean *et al.,* 2013; Sharipova and Khaziev, 2015; Salem *et al.,* 2018; Khaziev *et al.,* 2020).

Morphological studies have shown that the use of biopreparation did not have a significant impact on the dynamics of indicators of red and white blood of birds. During the experiment, they were within the physiological range for that age and type of productivity. The minimum content of red blood cells and hemoglobin was registered at the age of 30 days, which was consistent with the data of domestic and foreign scientists. After application of biopreparation, the content of red blood cells in the second experimental group (biostimulator 10 g/kg of feed) increased by 16% compared to the control group (Buyarov *et al.,* 2012; Fisinin, 2013; Ahmadi *et al.,* 2018; Buyarov *et al.*, 2018; Jahanian and Ashnagar, 2018; Nozdrin *et al.,* 2018; Rubio *et al.,* 2019).

In the blood of experimental and control groups of chickens, the content of white blood cells was found to be quite high, which was typical for that age. The leukogram of experimental and control groups of chickens showed the ratio of individual white blood cells to fall within the physiological range, but some specific features were observed. An increase in the level of lymphocytes in the blood indicates an increase in the specific immunity of birds since these cells are the main executive element in the manifestation of cellular and humoral protection of the body (Buzala *et al.,* 2017).

Many biological stimulants can increase the phagocytic activity of white blood cells. This increases both the number of phagocytic cells and the number of microbes absorbed by them (Buyarov *et al.,* 2012, 2018; Fisinin, 2013; Ahmadi *et al.,* 2018; Jahanian and Ashnagar, 2018; Nozdrin *et al.,* 2018; Rubio *et al.*, 2019).

To characterize the system of non-specific immunity in birds when exposed to the investigational product Nucleostim, the functional

activity of pseudo-eosinophils, monocytes, and platelets of whole blood of chicks in phagocytic reactions (for phagocyte number and phagocytic index) and the reduction reaction of nitro blue tetrazolium (spontaneous and latex-induced NBT-test) and the level of complement in blood serum were studied (Cuetos *et al.,* 2017; Abdulameer, 2018).

Thus, the use of biopreparation had a stimulating effect on the phagocytic activity of pseudo-eosinophils, monocytes, and platelets of birds' blood and on the complement system – a non-specific factor of humoral immunity. The new biological stimulantNucleostim is recommended for use in veterinary medicine as an adaptogenic, anabolic, and immunostimulatory agent and is promising for finding new drugs that improve the health and productivity of poultry.

The new biological stimulant is recommended for use in veterinary medicine as an adaptogenic, anabolic, and immunostimulating agent and is promising for finding new drugs that improve the health and productivity of poultry

4. CONCLUSION:

The body weight gain of chickens exposed to bioadditive increases by 9.7%; after threeweeks, chickens treated with biopreparation overweighed the control group by 87.4 g, after fiveweeks– by 211.5 g. The livability of the experimental group of chickens was 88%, and of the control group – 72%. As a result of the use of biopreparation at a dose of 10 g/kg of feed, there is an increase in chick livability and an increase in their live weight gain.

The use of the biostimulant contributed to the development of the thymus in chickens against the background of general dystrophy. It had a stimulating effect on the liver of chicks of the experimental and control groups. At the same time, the relative weight of the organ is less than in control, which indicates physiological hepatomegaly. The use of biostimulator had a stimulating effect on the phagocytic activity of pseudo-eosinophils, monocytes, and platelets in the blood of birds and on the complement system – a non-specific factor of humoral immunity.

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Table 1. *PC-2 complete feed composition for broiler chickens produced at the Bogdanovich feed mill (Bogdanovich town, Sverdlovsk region, 64, Stepan Razin street).*

The composition of the feed PC-2 in %	
Wheat	43.72

Corn	30.41
Soybean meal	11.15
Sunflower cake	8,0
Fish flour	1.80
Lysine	0.45
Feed methionine	0.2
Table salt	0.24
Monocalcium phosphate	1.33
Limestone	1.61
Premix (P5 - 1)	1.00

Table 2.*Effect of the biostimulant Nucleostim on the average daily body weight gain of ROSS 308 cross broiler chickens*

Weeks	Number of chicks in the group	biological stimulator, at a dose of 10g/kg of feed		Control	
		live weight, g	average daily gain, g	live weight, g	average daily gain, g
Day	50	40.5±0.4		39.9±0.3	
1	50	135.3±8.5	11.9	123.4±8.0	10.5
2	50	379.1±10.0	29.5	300.0±12.0	19.6
3	50	520.3±20.0	35.2	432.9±15.9	22.9
4	50	830.8±21.0	34.5	700.9±20.0	25.4
5	50	1060.0±15.0	36.30	848.5±35.0	29.5
6	50	1095.5±17.0	70.4	996.2±26.8	49.6
7	50	1290.9±20.0	89.3	1040.7±15.8	85.3
8	50	1510.5±30.0	55.5	1269.1±19.9	38.6
9	50	2093.0±50.0	70.1	1799.5±27.5	61.1

Table 3. *Effect of the BiostimulantNucleostim on the live weight of Rodonit cross chickens*

Item	Dose g/kg of feed	Live weight, g	Daily live weight gain, g	Relative gain, %	Gain-norm relation, %
			64 days old		
Control	-	420.0±3.08	-	-	-
biostimulator	10.0	435.0±4.92	-	-	-
biostimulator	5.0	425.0±9.84	-	-	-
			74 days old		
Control	-	539.0±9.05	14.9	24.8	62.0
biostimulator	10.0	629.0±7.99	24.3	36.5	101.0
biostimulator	5.0	595.0±7.03	21.3	33.3	88.5
			84 days old		
Control	-	635.0±13.18	12.0	16.4	100.0

biostimulator	10.0	731.0±7.03	12.4	15.0	106.3
biostimulator	5.0	694.0±6.67	12.4	15.4	103.2
			94 days old		
Control	-	666.0±20.58	6.2	4.8	62.0
biostimulator	10.0	784.0±9.24	10.6	7.0	106.0
biostimulator	5.0	738.0±7.98	8.8	6.2	88.0

Table 4.*Effect of the BiostimulantNucleostim on the development of internal organs of ROSS 308 cross broiler chickens*

Test organs	Weight, g			
	Groups			
	Control	biostimulator 10 g/kg of feed	biostimulator 5 g/kg of feed	biostimulator 15 g /kg of feed
Thymus	0.8±0.07	1.006±0.03	0.84±0.045	0.84±0.02
Liver	10.2±0.16	12.25±0.35	10.85±0.18	10.70±0.46
Stomach	2.2±0.19	2.68±0.13	2.33±0.03	2.35±0.05

Table 5.*Effect of Nucleostim on the morphological parameters of chicken blood*

Material under investigation	Dose g/kg	Erythrocytes million/mm^3	Hemoglobin g %	Color indicator	Leucocytes thousand/mm^3
age 30 days					
Before experiment	-	1.8±0.08	8.8±0.72	1.5±0.15	58.4±1.50
age 40 days					
Control	-	1.7±0.04	10.3±0.21	1.8±0.06	56.2±3.65
biostimulator	10.0	2.1±0.15	10.4±0.21	1.7±0.15	58.1±3.43
biostimulator	5.0	1.8±0.09	10.3±0.21	1.8±0.06	58.3±3.22
Normal	-	1.5–4	8–12	1–3	20–40

Table 6.*Effect of Nucleostim on the percentage of different groups of leucocytes in chicken blood*

Groups	Dose g/kg	Basophils	Eosinophils	Pseudoeosino-phils	Lymphocytes	Monocytes
age 30 days						
Before experiment		5.8±0.43	7.5±0.43	23.3±0.48	57.2±4.49	5.8±0.23
age 40 days						
Control	-	6.2±0.60	7.0±0.64	26.6±1.72	52.8±1.50	5.0±0.43
biostimulator	10.0	6.0±0.60	7.4±0.43	25.4±1.72	55.0±1.07	6.4±0.64

biostimulator	5.0	5.0±0.43	6.6±0.64	26.2±2.58	59.0±2.15	5.2±0.43
Normal		2–5	2–20	15–35	40–70	2–11

Table 7.*Effect of Nucleostim on the intensity of phagocytosis and the complement level in chicken blood*

Item		Phagocytosis		NBT-test		Level of complement
	Dose g/kg	Phagocytic number, %,	Phagocytic index %	spontaneous	induced	
age 30 days						
Before experiment		3.49±0.20	0.39±0.01	0.18±0.01	0.50±0.04	34.50±0.30
age 40 days						
Control		3.3±0.12	0.35±0.01	0.16±0.02	0.45±0.04	30.1±1.35
bioadditive	10.0	3.9±0.09	0.43±0.011	0.24±0.01	0.48±0.02	38.8±0.4
bioadditive	5.0	3.7±0.09	0.43±0.011	0.21±0.01	0.47±0.01#	37.5±0.50

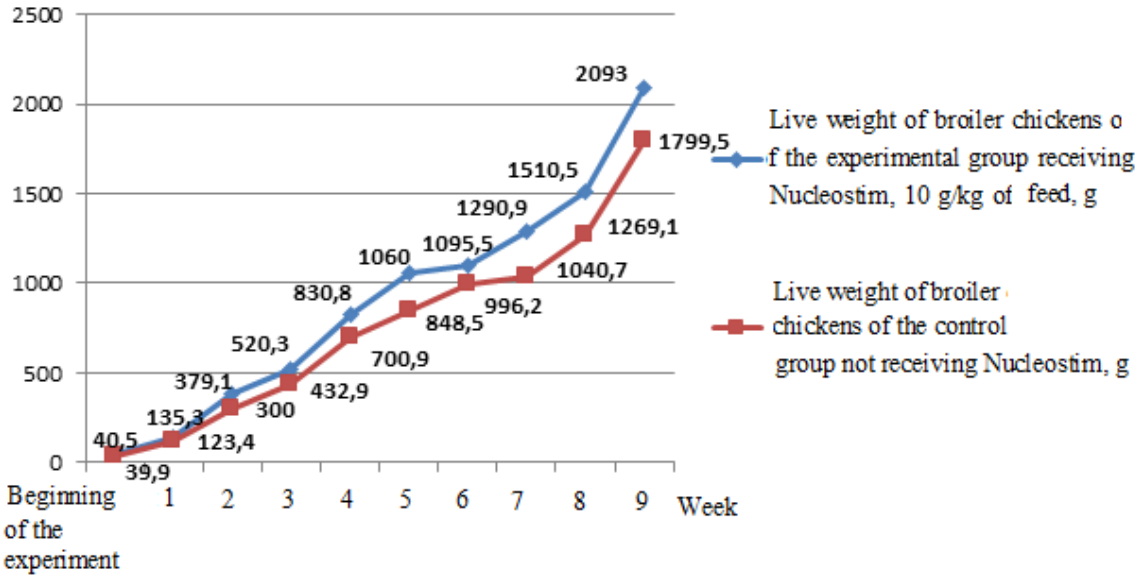

Figure 1.*Influence of the biostimulant Nucleostim on the live weight of ROSS 308 cross broiler chickens during the period of intensive growth*