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## Effect of the Biosapin Probiotic and the Biolide Disinfectant on the Microclimate of Poultry Houses

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**Abstract.** Currently, in the field of poultry farming, the issue of using disinfectants for surface treatment of poultry houses, incubators and hatching eggs is particularly acute. Preparations must be both effective for the destruction of pathogenic microorganisms resistant to antibacterial substances, and safe for the environment, productive poultry and poultry goods. The purpose of this study was to test the Biosapin probiotic and the Biolide disinfectant in industrial conditions of a poultry house and incubator room. These preparations were used by aerosol spraying in the incubator and output cabinet, as well as in the poultry house in the presence of poultry. They were tested both individually and in combination, compared to the control group, where no preparations were used. The parameters of the microclimate of the premises were determined: temperature – with a weekly thermograph M-21, relative humidity – with an Augusta psychrometer and hygrograph M-16, speed of air movement – with an ASO-13 vane anemometer, illumination – with a luxmeter, concentration of carbon dioxide, ammonia, hydrogen sulphide – using gas analyser UG-2, dust pollution – according to weight method, microbial pollution – according to sedimentation method. For the first time, a production test of the use of the Biosapin probiotic and the Biolide preparation in the complex was carried out. The obtained research results indicate an improvement in the microclimate of poultry houses. It was found that when spraying a disinfectant, microbial contamination in poultry premises decreases by 48.1% ( $P<0.001$ ), and when spraying a probiotic – by 62.4% ( $P<0.001$ ), while with a complex alternating action of both drugs – by 84.1% ( $P<0.01$ ). At the same time, the bird's body is sanitised and enriched with probiotics. The positive effect of drugs on the microclimate in both the incubator room and the output hall sections has been experimentally confirmed. In particular, the concentration of ammonia decreases by 7.6% ( $P<0.01$ ), 12.3, 27.8% ( $P<0.001$ ) and hydrogen sulphide – by 16.6% ( $P<0.001$ ), 18.5 and 34% ( $P<0.001$ ). At the same time, the carbon dioxide content also decreases by 2.8, 3.3, and 5.0 times, respectively. Spraying the Biosapin probiotic and the Biolide disinfectant both separately and in combination stimulate embryogenesis, contribute to the production of more fertilised hatching eggs and the hatching of conditioned young chickens. Thus, the breeding rate of young animals increased by 5.5% ( $P<0.01$ ), by 7.0% ( $P<0.01$ ) and by 11.0% ( $P<0.01$ ). The use of the preparations under study lies in the optimisation of the microclimate in poultry premises through such indicators as relative humidity, concentration of harmful gases (ammonia, hydrogen sulphide, carbon dioxide), dust, and microbial air pollution

**Keywords:** broiler chickens, microorganisms, sanitation, incubation, hatchery, eggs, poultry house

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## Introduction

Hygiene and disinfection form an integral part of the technological process in poultry farming. Biocides protect poultry from the pathogenic effects of microorganisms and contribute to improving the safety of animal food production [1].

However, most known disinfectants, e.g., based on polymers of phenols – isothiazolinones, have toxic effects on the human body and the environment. Furthermore, most of the active substances of these drugs are of synthetic origin. Considering these factors, the demand for solutions with a biological basis is increasingly growing [2].

Conventionally, various disinfectants are used to disinfect poultry premises, which do not affect the further operation of incubation, hatching rooms, and equipment. However, it should be considered that the effectiveness of disinfection depends on such factors as exposure, temperature, concentration, pH, compatibility with detergents.

Eco-friendly alternatives to synthetic drugs are relatively safe biologics. Such preparations can include probiotics, their metabolites, organic compounds, for example, lactic acid obtained by the natural fermentation process. The use of biological preparations solves the problem with these disadvantages, which is explained by an effective combination of their natural origin, efficiency, safe handling, and environmental friendliness [3]. Since there is an urgent problem of antibiotic-resistant microorganisms in industrial animal husbandry and poultry farming [4], the search for an alternative to conventional disinfectants is relevant and important.

The effectiveness of poultry rearing substantially depends on sanitary and hygienic and zootechnical indicators, such as the method of keeping, the size of groups, the density, the microclimate of premises, as well as the regime and balance of feeding. For each hygienic parameter, there are certain ranges of normal values at which animals spend the minimum amount of energy to maintain physiological processes at an optimal level [1]. The key indicators of the microclimate for the body of adult and young poultry are the ambient air temperature, its relative humidity, air velocity, concentration of carbon dioxide, ammonia, dust and microbial pollution, and air. The use of safe disinfectants in the presence of poultry has a positive effect on the state of the air environment of poultry premises [5].

It is necessary to monitor hygiene and sanitation on the farm and in the incubator, since the air quality inside the poultry house is an essential factor affecting the health of chickens and the epizootic situation on the farm. Due to the violation of sanitary and hygienic requirements in production and as a result of keeping a lot of livestock in a limited area, the concentration of microorganisms in the air of poultry houses can considerably increase with the circulation of opportunistic and pathogenic microorganisms [4].

The accumulation of microorganisms in the poultry house can occur in different ways: due to poor-quality disinfection after the previous cycle of raising poultry, non-compliance with the time of biological rest of the room (the principle “everything is occupied – everything is empty”), through the personnel servicing the room, through poor-quality water or contaminated water supply system, with biofilm, contaminated feed, infected hatching eggs, with air entering the room, contaminated ventilation

system, etc. A necessary element for achieving the best disinfection results is also the correct selection of effective detergents and disinfectants [6]. Therefore, it is necessary to observe technological processes in production and perform timely sanitary measures, especially disinfection.

Probiotics are quite effectively used in veterinary medicine for the prevention of various diseases, in namely dysbacteriosis with digestive disorders and deterioration of the assimilation of feed nutrients, as well as in the form of means that increase the immune status and effectiveness of vaccination. Interest in probiotic drugs is growing every year, as they can be used as an alternative to antibiotics in poultry farming, including in organic production [7].

Probiotics contain live microorganisms and components of normal intestinal microflora, which normalise the qualitative and quantitative composition and biological activity of avian digestive canal automicoflora [8].

The advantage of products based on lactic, supra-molecular acids and hydrogen peroxide is environmental friendliness, biodegradability and safety, since the main components of the product decompose into water, oxygen and lactic acid at the time of disinfection. The latter is a product of the vital activity of living organisms and is absolutely safe for the environment [9].

Especially important is the use of ecological, biological, effective, and safe disinfectants in organic production. Their use is strictly controlled by the certification authority, and any violation may lead to the loss of the certificate by the organic market operator [2; 3]. There is a close interrelation between the state of the microflora of hatching incubators and the formation of the own intestinal microflora of chickens. The formation of a stable microbiocenosis of the digestive canal takes several weeks [9].

By their mechanism of action, probiotics can actively colonise the gastrointestinal tract of animals with microorganisms that produce biologically active metabolites and have a detrimental effect on pathogens [10]. Symbiotic microflora uses its enzymatic ability to process organic substances, synthesises proteins, amino acids, polypeptides, vitamins and other metabolites that are useful for the macroorganism [6; 11]. Microorganisms affect the absorption of calcium, iron, vitamins, as well as the synthesis of amino acids and other biologically active compounds [12; 13].

The mechanism of biological action of bacteriocins produced by lactobacilli and other microorganisms is based on the destruction of the cytoplasmic membranes of pathogenic bacteria sensitive to them. Bacteriocins act selectively and affect antibiotic-resistant microorganisms, followed by their splitting and final removal from the body [14]. The microflora of incubator and hatching rooms also depends on high-quality disinfection and maintaining an appropriate microclimate [15].

Complex use of disinfectants and rotation in production is an essential link of well-being and ensuring productivity in poultry farming [16]. The use of preparations based on lactic and supra-molecular acids, hydrogen peroxide, in combination with a probiotic, allows reducing the microbial background in the room in the presence of poultry and improve its microclimate, partially modifying the gas composition of the air [17; 18].

*The purpose of this study* was to investigate the effectiveness of the complex and separate use of the Biosapin

probiotic and the Biolide disinfectant to improve the microclimate by aerosol spraying in the incubator and hatching cabinet, as well as in the poultry room in the presence of poultry.

### Materials and Methods

The study was conducted in one of the farms of the Lviv region on broiler chickens of the Ross-308 Cross, starting from the 1-day age in February 2022. The experiment consisted of three stages. On the first stage, the main parameters of the indoor microclimate were investigated: temperature – with a weekly thermograph M-21, relative humidity – with an Augusta psychrometer and hygograph M-16, air speed – with an ASO-13 vane anemometer, illumination – with a luxmeter, concentration of carbon dioxide, ammonia, hydrogen sulphide – using the UG-2 gas analyser, dust pollution – according to the weight method, microbial pollution – according to the sedimentation method against the background of irrigation with the Biosapin probiotic, as well as separately with the Biolide disinfectant and together with a disinfectant [19]. These drugs were developed by employees of the State Research Institute for Laboratory Diagnostics and Veterinary and Sanitary Expertise (city of Kyiv, SRILDVSE).

At the second stage, the effectiveness of treatment with the studied preparations of the incubator and the extraction cabinet was determined. Three experimental and one control groups of 200 hatching eggs each were formed. The third stage of research was a production experiment on broiler chickens of the ROSS-308 cross. Three experimental and one control groups of 100 heads each were formed.

Aerosol treatment of premises with Biolide was carried out using a cold mist generator. The Biolide disinfection preparation (TU U 24.2-00699690-001:2022), which includes lactic acid, perlactic acid, hydrogen peroxide, water, and according to preliminary laboratory studies, exhibits bactericidal and virulicidal activity with a prolonged effect.

The Biosapin probiotic preparation (TU U 24.2-00699690-004:2022) includes: mixtures of probiotic bacteria *Bacillus sybtilis*, *Bacillus amyloliquefaciens* and aluminium silicate. Treatment with Biosapin was performed with a dry aerosol generator at the rate of 10-30 g/m<sup>2</sup>, once every two weeks.

For the second stage of the experiment, eggs were taken from 180-day-old, 260-, 350-day-old chickens, which met the basic requirements of the standard for hatching eggs: in terms of weight, size, shell hardness, etc. During the incubation process, constant monitoring was carried out, and after incubation was completed, the survival rate of chickens, their viability on the first day and the corresponding care were visually determined.

In the first group, to establish the effect of the Biosapin probiotic preparation on the microclimate of the hatchery and hatching rooms, a dry aerosol generator was used, which was evenly sprayed at the rate of 10-30 g/m<sup>3</sup>, twice a week for exposure of 120 minutes for 19 days, with 200 hatching eggs.

In the second experimental group, the incubator and hatching rooms were disinfected with a 0.1% solution of Biolide disinfectant once a week, for 19 days, where there were 200 pieces of hatching eggs.

In the third experimental group, a complex of the Biosapin probiotic and the Biolide disinfectant was sprayed using the same method as in the first two groups. There-with, a disinfectant was used on the first day, and a probiotic was used on the next day. This procedure was not performed in the control rooms. After completing the studies, the percentage of hatchability of chickens was calculated.

Production experiment (the third stage of this study) on chickens was carried out as follows: the farm carried out preliminary disinfection of premises without poultry with Biolide disinfectant. According to the principle of analogues, four groups (100 heads each) of broiler chickens of the ROSS-308 cross, equal in weight, were formed – control and three experimental. Standard mixed feed was used in the control. The term of rearing chickens was 41 days.

After placing one-day-old chicks, a thorough inspection of the entire flock was conducted. The state of feeding and care of a healthy number of chickens was monitored, eliminating adverse factors. Temperature, humidity, air movement speed were measured with an aspiration psychrometer MV-41-L, weekly thermograph, hygrometer M-16 and hygograph M-21, vane anemometer ASO-13, layer catathermometer, concentration of harmful gases – with universal gas analyser UG-2, dioxide level carbon – according to the Hess method, illumination – with a Yu-16 luxmeter [20].

Once a week, the premises were disinfected in the presence of poultry with Biolide disinfectant. Then, for effective use of the method of increasing productivity and preserving the poultry population, the complex Biosapin preparation was evenly sprayed in the room at the rate of 10-30 g/m<sup>2</sup>. The preparation was used once in two weeks. Chickens of the control group were fed standard mixed feed according to the current feeding standards from the manufacturer of ROSS-308 cross (Aviagen), and no preventive preparations were used [21].

Chickens of the first experimental group were fed standard mixed feed, evenly sprayed with the complex Biosapin preparation in the room at the rate of 10-30 g/m<sup>2</sup>, once every two weeks. Chickens of the second experimental group were fed standard mixed feed, according to the manufacturer's instructions and recommendations for growing this cross. Once a week, the premises were disinfected in the presence of poultry with 0.1% solution of the Biolide disinfectant. Chickens of the third experimental group were fed standard mixed feed. Once a week, the premises were disinfected in the presence of poultry with a Biolide disinfectant, after two days, once in two weeks, the complex Biosapin preparation was evenly sprayed in the room at the rate of 10-30 g/m<sup>2</sup>.

Digital data was processed using the biometric method of variational non-parametric analysis using the Microsoft Excel software of the Microsoft Office Professional XP table editor package and the Origin 6.1 programme. The difference between the values of indicators was considered statistically probable:  $P < 0.05$ ,  $P < 0.01$ , and  $P < 0.001$ .

### Results and Discussion

The conducted studies have established the effect of the Biosapin probiotic and the Biolide disinfectant on the parameters of the microclimate in the incubator room. Air temperature, relative humidity, air velocity, concentration

of ammonia, hydrogen sulphide, carbon dioxide, dust content, and microbial contamination were monitored.

The results presented in Table 1 show that the spraying of the Biosapin probiotic and the Biolide preparation had a positive effect on the optimisation of the main parameters of the microclimate in the premises of the incubator. Thus, the relative humidity of the air decreased improbably in the experimental section of the incubation

hall, where the probiotic was sprayed without the use of a disinfectant, in comparison with the control group. At the same time, in another section where the Biolide preparation was sprayed, this indicator decreased by 6.09% ( $P < 0.01$ ), and in the group where complex treatment with the Biosapin probiotic and the Biolide preparation was used – by 8.32% ( $P < 0.001$ ), respectively, compared to the control group.

**Table 1.** Microclimate of industrial premises against the background of the use of the Biosapin probiotic and the Biolide preparation,  $M \pm m$ ,  $n = 5$

| Indicator  | Group        |  |   |   |
|--|--------------|--|---|---|
|  | Control      | 1 <sup>st</sup> experimental, Biosapin preparation | 2 <sup>nd</sup> experimental, Biolide preparation | 3 <sup>rd</sup> experimental, preparations Biosapin + Biolide |
| <i>Incubator room</i>                              |              |  |   |   |
| Air temperature, 0 °C                              | 21.10 ± 0.11 | 21.13 ± 0.03                                       | 22.02 ± 0.08                                      | 22.15 ± 0.15  |
| Relative humidity, %                               | 72.42 ± 0.21 | 69.12 ± 0.23                                       | 66.33 ± 0.33*                                     | 64.10 ± 0.12**  |
| Air velocity, m/s                                  | 0.21 ± 0.02  | 0.22 ± 0.03  | 0.21 ± 0.05                                       | 0.24 ± 0.02   |
| Ammonia concentration, mg/m <sup>3</sup>           | 7.85 ± 0.02  | 7.31 ± 0.03*                                       | 6.32 ± 0.04*                                      | 6.12 ± 0.05**   |
| Hydrogen sulphide concentration, mg/m <sup>3</sup> | 3.31 ± 0.05  | 2.61 ± 0.09**                                      | 2.49 ± 0.04**                                     | 2.31 ± 0.03**   |
| Carbon dioxide concentration, %                    | 0.17 ± 0.01  | 0.11 ± 0.01  | 0.10 ± 0.03                                       | 0.09 ± 0.03**   |
| Dust concentration, mg/m <sup>3</sup>              | 8.42 ± 0.13  | 6.08 ± 0.10*                                       | 4.85 ± 0.11*                                      | 4.07 ± 0.12**   |
| Microbial contamination, thous. t/m <sup>3</sup>   | 71.35 ± 0.54 | 41.32 ± 0.34**                                     | 31.56 ± 0.14**                                    | 9.89 ± 0.44**   |
| <i>Hatching room</i>                               |              |  |   |   |
| Air temperature, °C                                | 22.10 ± 0.14 | 22.12 ± 0.02                                       | 22.45 ± 0.14                                      | 22.40 ± 0.09  |
| Relative humidity, %                               | 73.60 ± 0.24 | 68.95 ± 0.17*                                      | 67.17 ± 0.22*                                     | 63.41 ± 0.21*   |
| Air velocity, m/s                                  | 0.24 ± 0.04  | 0.26 ± 0.02  | 0.29 ± 0.03                                       | 0.29 ± 0.05   |
| Ammonia concentration, mg/m <sup>3</sup>           | 6.98 ± 0.12  | 6.45 ± 0.10*                                       | 6.12 ± 0.11**                                     | 5.04 ± 0.11**   |
| Hydrogen sulphide concentration, mg/m <sup>3</sup> | 3.08 ± 0.02  | 2.57 ± 0.02**                                      | 2.51 ± 0.11**                                     | 2.03 ± 0.01**   |
| Carbon dioxide concentration, %                    | 0.6 ± 0.01   | 0.21 ± 0.03  | 0.18 ± 0.02*                                      | 0.12 ± 0.04**   |
| Dust concentration, mg/m <sup>3</sup>              | 8.80 ± 0.12  | 5.12 ± 0.13**                                      | 4.01 ± 0.11**                                     | 3.45 ± 0.02**   |
| Microbial contamination, thous. t/m <sup>3</sup>   | 73.60 ± 0.22 | 42.08 ± 0.11**                                     | 35.62 ± 0.02**                                    | 12.06 ± 0.12**  |

Note: \* $P < 0.01$ ; \*\* $P < 0.001$ , probable compared to the control group

Therewith, spraying the Bioapin probiotic both alone and in combination with the specified disinfectant did not have a noticeable effect on the air temperature, which in all experimental sections of the incubation room was at the level of 21-22 °C and its movement speed, which varied from 0.21 to 0.24 m/s, i.e., within the limits of permissible physical fluctuations without a probable difference between the indicators of the control and experimental sections of the incubation hall.

Under the influence of these measures, a decrease in the concentration of harmful gases was noted in all experimental sections of the incubation room. Thus, a probable decrease in the concentration of ammonia by 6.9% ( $P < 0.01$ ), respectively, occurred in the air of the room of the first experimental section, where a separate spray of disinfectant was used, and in the second (spray with probiotic) – by 6.8% ( $P < 0.01$ ), in the third section (spray with disinfectant and probiotic – by 22.0% ( $P < 0.001$ ), respectively, compared to the control group.

A probable decrease in the concentration of hydrogen sulphide by 21.1% ( $P < 0.001$ ) occurred in the air of the first experimental section, where Biolide disinfectant was used, and in the second (probiotic spraying) – by 24.8%

( $P < 0.001$ ), in the third section (disinfectant and probiotic spraying) – by 30.2% ( $P < 0.001$ ), respectively, compared to the control group.

In the air of the room of the third experimental section, where the complex spraying of the Biosapin probiotic and the Biolide disinfectant was carried out, a probable decrease in the concentration of carbon dioxide was observed by 1.9 times or by 0.08% ( $P < 0.01$ ) compared to the control group. A slight decrease in the value of this indicator in the first and second experimental sections of the room turned out to be statically improbable.

As a result of using the Biosapin probiotic, the dust content in the air of the first experimental section decreased by 1.4 times or by 2.34 mg/m<sup>3</sup> ( $P < 0.001$ ) compared to the control group. In other experimental sections, the decrease in dust concentration in the air occurred to a greater extent – by 1.7 times or by 3.57 mg/m<sup>3</sup> ( $P < 0.01$ ) and with the combined use of spraying, this indicator was 2.07 times higher or 4.35 mg/m<sup>3</sup> ( $P < 0.001$ ) compared to the control group.

The use of spray preparations had a positive effect on reducing microbial contamination of the air in the incubation room. In the first experimental section, as a result of

spraying with the Biosapin probiotic, the value of microbial contamination decreased by 42.0% ( $P<0.001$ ) compared to the control group. In other sections of this room, with the combined use of preparations spraying, the level of microbial contamination of the air decreased to a greater extent than in the control section. Thus, this indicator decreased in the second experimental section by 56.0% ( $P<0.001$ ), in the third – by 86.0% ( $P<0.001$ ) compared to the control group.

Similar changes in the microclimate were recorded in the sections of the hatching hall. Thus, the probable decrease in the concentration of ammonia in the first, second, and third groups compared to the control group occurred, respectively, by 7.6% ( $P<0.01$ ), 12.3 and 27.8% ( $P<0.001$ ).

A probable decrease in the concentration of hydrogen sulphide in the first, second, and third groups compared to the control group occurred by 16.6% ( $P<0.001$ ), 18.5%, and 34.0% ( $P<0.001$ ), respectively. The content of carbon dioxide in the air of the experimental groups also decreased: the first – by 2.8 times (by 0.39%), the second – by 3.3 times (by 0.42%), the third – by 5.0 times (by 0.48%) compared to the control.

According to the indicators presented in Table 2, of the eggs laid for incubation, 191 birds of the control group were fertilised, which is 95.5%, and in the three experimental groups this indicator was 97.5%, 96.5%, and 97%, respectively.

**Table 2.** Incubation of chicken eggs during the use of Biosapin and Biolide preparations

| Indicator                      | Group   |  |   |   |
|--------------------------------|---------|--|---|---|
|                                | Control | 1 <sup>st</sup> experimental, Biosapin preparation | 2 <sup>nd</sup> experimental, Biolide preparation | 3 <sup>rd</sup> experimental, preparations Biosapin + Biolide |
| Laid eggs, pcs.                | 200     | 200  | 200   | 200   |
| including fertilised eggs, pcs | 191     | 195  | 193   | 194   |
| Moved to output, pcs           | 185     | 191  | 192   | 193   |
| Received chickens, heads       | 162     | 173  | 176   | 184   |
| Breeding of young animals, %   | 81      | 86.5   | 88  | 92  |
| Egg hatching, %                | 84.5    | 88.7   | 91.2  | 94.8  |

Table 2 shows that a larger number of chickens were obtained in the experimental poultry groups. Thus, in the first experimental group, more chickens were obtained by 6.79%, in the second – by 8.64% and in the third – by 13.6% compared to the control group.

In the first experimental group, the rate of hatching eggs was higher by 5.5% ( $P<0.01$ ), in the second – by 6.7% ( $P<0.01$ ), and in the third – by 10.3% ( $P<0.01$ ) compared to the control group.

Hatching of chickens was characterised by the number of healthy chickens bred, expressed as a percentage of the number of eggs laid in the incubator. Thus, the rate of hatching of young in the first experimental group

increased by 5.5% ( $P<0.01$ ), in the second – by 7.0% ( $P<0.01$ ), and in the third – by 11% ( $P<0.01$ ) compared to the control group.

Thus, the conducted studies showed that spraying the Biosapin probiotic and the Biolide disinfectant both individually and in combination stimulate embryogenesis, contribute to obtaining a larger number of fertilised hatching eggs and the hatching of conditioned young chickens.

According to the indicators presented in Tables 1 and 3, the optimisation of the main parameters of the microclimate in the hatching hall and in the workshop of raising young chickens under the influence of complex use of drugs occurred similarly.

**Table 3.** Microclimate indicators in poultry rearing shops,  $M\pm m$ ,  $n=5$

| Indicator  | Research day | Group        |  |   |   |
|--|--------------|--------------|--|---|---|
|  |              | Control      | 1 <sup>st</sup> experimental, Biosapin preparation | 2 <sup>nd</sup> experimental, preparation Biolide | 3 <sup>rd</sup> experimental, preparations Biosapin + Biolide |
| Temperature (20-25 cm above floor), °C             | 1-5          | 33.20 ± 0.12 | 33.60 ± 0.13                                       | 34.10 ± 0.11                                      | 34.20 ± 0.12  |
| Temperature (20-25 cm above floor), °C             | 6-10         | 32.54 ± 0.33 | 32.12 ± 0.13                                       | 32.56 ± 0.12                                      | 32.45 ± 0.11  |
| Temperature (20-25 cm above floor), °C             | 11-20        | 30.10 ± 0.3  | 30.20 ± 0.12                                       | 30.12 ± 0.13                                      | 30.34 ± 0.13  |
| Temperature (20-25 cm above floor), °C             | 21-30        | 25.13 ± 0.19 | 25.50 ± 0.18                                       | 24.90 ± 0.11                                      | 24.89 ± 0.13  |
| Temperature (20-25 cm above floor), °C             | 31-40        | 22.40 ± 0.19 | 22.78 ± 0.14                                       | 22.56 ± 0.12                                      | 22.89 ± 0.13  |
| Indoor air temperature, °C                         | 41-60        | 20.01 ± 0.01 | 19.87 ± 0.11                                       | 20.24 ± 0.14                                      | 19.58 ± 0.11  |
| Indoor air temperature, °C                         | >60          | 18.31 ± 0.12 | 18.60 ± 0.12                                       | 18.14 ± 0.13                                      | 18.34 ± 0.11  |
| Relative humidity, %                               | 1-110        | 71.85 ± 0.12 | 66.80 ± 0.12**                                     | 65.56 ± 0.11***                                   | 64.34 ± 0.11***   |
| Air velocity, m/s                                  | 1-110        | 0.23 ± 0.01  | 0.22 ± 0.02  | 0.23 ± 0.02                                       | 0.21 ± 0.05   |
| Ammonia concentration, mg/m <sup>3</sup>           | 1-110        | 7.34 ± 0.12  | 6.45 ± 0.11*                                       | 6.08 ± 0.11**                                     | 5.90 ± 0.12***  |
| Hydrogen sulphide concentration, mg/m <sup>3</sup> | 1-110        | 5.02 ± 0.11  | 4.24 ± 0.12*                                       | 3.64 ± 0.10***                                    | 2.90 ± 0.11***  |

Table 3, Continued

|  |       |              |                 |                 |                |
|--|-------|--------------|-----------------|-----------------|----------------|
| Carbon dioxide concentration, %                  | 1-110 | 0.25 ± 0.02  | 0.24 ± 0.01     | 0.23 ± 0.01     | 0.22 ± 0.04    |
| Dust concentration, mg/m <sup>3</sup>            | 1-110 | 9.04         | 6.40 ± 0.15**   | 5.50 ± 0.14***  | 4.06 ± 0.14*** |
| Microbial contamination, thous. t/m <sup>3</sup> | 1-110 | 81.46 ± 1.56 | 42.31 ± 0.36*** | 30.61 ± 0.34*** | 12.99 ± 0.18** |

Note: \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ , probable compared to the control group

This procedure did not affect the temperature and speed of indoor air movement. In the hatching hall, these indicators varied within acceptable values. As the age of the chickens increased, the temperature in these rooms gradually decreased, according to the technology of their rearing. By the 40-day age of young animals, it was reduced to 19°C. At the same time, under the influence of the measures taken, a gradual decrease in air humidity was observed, which was recorded in all experimental sections of these premises: the first – by 5.05%, the second – by 6.29%, the third – by 7.50%.

The concentration of ammonia in the air of the workshop for growing young chickens of the first experimental group decreased by 12.13% ( $P < 0.05$ ), of the second – by 17.16% ( $P < 0.01$ ), and of the third – by 19.62% ( $P < 0.001$ ) compared to the control group. The concentration of hydrogen sulphide in the air of the shop for growing young chickens of the first experimental group decreased by 16.0% ( $P < 0.05$ ), the second – by 27.0% ( $P < 0.001$ ), and the third – by 42.2% ( $P < 0.001$ ) compared to the control group. The concentration of carbon dioxide in the air of these rooms under the influence of procedures decreased by 0.01-0.03%, but these values turned out to be statically incorrect.

During the spraying of the preparations, the content of solid aerosols (dust) in the air of the premises of the removal hall and the workshop for growing young chickens of experimental groups of poultry decreased in comparison with the control group. Thus, in the indoor air of the first experimental group, a probable decrease in dust concentration was established by 29.2% ( $P < 0.01$ ), the second – by 39.2%, and the third – by 55.1% ( $P < 0.001$ ) compared to the control group.

Spraying of the Biosapin probiotic both separately and in combination with the Biolide preparation had a certain positive effect on reducing microbial contamination in the air of the hatching hall and the workshop for rearing young poultry. Thus, the number of microorganisms in the air of the workshops where poultry of the first experimental group was kept decreased by 48.1% ( $P < 0.001$ ), the second – by 62.4% ( $P < 0.001$ ), and the third – by 84.1% ( $P < 0.01$ ) compared to the control.

Evidently, the main indicators of the microclimate, such as humidity, temperature, dust, and microbial air pollution, depend on the number of birds kept in the room. Recommendations for the use of probiotic as a spray in the room and for changes in ventilation, air exchange multiplicity, and temperature regime of poultry rearing are still absent [20; 21].

The effectiveness of complex use of drugs was higher in this indicator than with their separate use in the first two experimental groups. The obtained data are consistent with the results of other scientists regarding the improvement of air quality in poultry houses by carrying out disinfection in the presence of birds. According to Boleli

et al. [14], ongoing disinfection in incubators increases and optimises the hatchability of healthy young chickens.

In the technological process of rearing poultry, it is impossible to completely abandon preventive vaccinations, disinfection, the use of antibiotics, anthelmintics, and other preparations. After their use, or together with pro- and prebiotics, there is a need to restore the normal intestinal microflora of the chicken, which is necessary to increase the assimilation of feed nutrients. And this, in turn, as is known from [4; 10], affects the improvement of the nutritional and biological value of poultry slaughter products and contributes to a more rational use of feed.

Thus, the use of the Biosapin probiotic in the incubator premises helped optimise the microclimate in them in terms of such indicators as relative humidity, the concentration of harmful gases (ammonia, hydrogen sulphide, hydrogen dioxide), dust and microbial air pollution. The use of the Biosapin probiotic and the Biolide preparation in the spray complex increased the effectiveness of the procedure in the incubator rooms, where the best microclimatic indicators were obtained.

## Conclusions

The use of modern eco-friendly and safe disinfectants for poultry and service personnel in industrial poultry farming is a promising solution to the issues of normalising the microclimate of poultry premises, namely microbial air pollution.

1. The complex use of spraying Biosapin probiotic and Biolide disinfectant based on lactic acid, hydrogen peroxide, and supramolecular acid in working concentrations increases the efficiency of the procedure in the incubator, hatching hall and poultry room, helps optimise the microclimate, especially in terms of relative humidity, concentration of harmful gases, dust and microbial air pollution.

2. Spraying the Biosapin probiotic and the Biolide disinfectant both separately and in combination stimulates embryogenesis, contributes to the production of more fertilised hatching eggs and the hatching of conditioned young chickens by 5.5-10.0%.

3. To reduce microbial air pollution in poultry premises, it is appropriate to use the Biosapin probiotic at the rate of 10-30 g/m<sup>2</sup>, once every two weeks. Thus, the number of microorganisms in the air of the workshops where the birds of the first research group were kept decreased by 48.1% ( $P < 0.001$ ), the second – by 62.4% ( $P < 0.001$ ), and the third – by 84.1% ( $P < 0.01$ ) compared to the control group.

4. To disinfect poultry houses in the presence of poultry, it is advisable to use a 0.1% solution of the Biolide preparation using a cold mist generator. Therewith, the consumption of the working solution of the disinfectant is 30 ml/m<sup>3</sup> of the room.

Prospects for further research: development of modes and schemes for the use of the Biosapin probiotic and the Biolide disinfectant in production conditions.

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## Вплив пробіотики «Біозапін» і дезінфікуючого препарату «Біолайд» на мікроклімат птахівничих приміщень

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**Анотація.** Нині у сфері птахівництва особливо гостро постає питання застосування дезінфікуючих засобів для обробки поверхонь пташників, інкубаторів та інкубаційних яєць. Препарати мають бути одночасно ефективними для знищення патогенних мікроорганізмів, резистентних до антибактеріальних речовин, і безпечними для довкілля, продуктивної птиці та продукції птахівництва. Мета роботи полягала у випробуванні пробіотики «Біозапін» і дезінфікуючого препарату «Біолайд» у промислових умовах пташнику та інкубаторного приміщення. Вказані препарати застосовували методом аерозольного розпилення у приміщенні інкубаторію та вивідної шафи, а також у птахівничому приміщенні в присутності птиці. Їх випробовували як окремо, так і в комплексі, порівняно з контрольною групою, де не застосовувалися жодні препарати. Визначали параметри мікроклімату приміщень: температуру – тижневим термографом М-21, відносну вологість – психрометром Августа і гігрографом М-16, швидкість руху повітря – анемометром крильчатим АСО-13, освітленість – за допомогою люксметру, концентрацію вуглекислого газу, аміаку, сірководню – з використанням газоаналізатору УГ-2, пилову забрудненість – ваговим методом, мікробну забрудненість – седиментаційним методом. Уперше було здійснено виробниче випробування застосування в комплексі пробіотики «Біозапін» і препарату «Біолайд». Отримані результати досліджень свідчать про покращення мікроклімату птахівничих приміщень. Встановлено, що за розпилення дезінфектанту зменшується мікробна забрудненість у птахівничих приміщеннях на 48,1 % ( $P < 0,001$ ), а за розпилення пробіотики – на 62,4 % ( $P < 0,001$ ) і за комплексної почергової дії обох препаратів – на 84,1 % ( $P < 0,01$ ). Водночас санується і збагачується пробіотиками організм птиці. Експериментально підтверджено позитивний вплив препаратів на мікроклімат як у секціях інкубаторного приміщення, так і вивідної зали. Зокрема, знижується концентрація аміаку на 7,6 % ( $P < 0,01$ ), 12,3, 27,8 % ( $P < 0,001$ ) і сірководню – на 16,6 % ( $P < 0,001$ ), 18,5 і 34 % ( $P < 0,001$ ). Водночас зменшується і вміст діоксиду вуглецю у 2,8 раза, 3,3 і 5,0 разів. Розпилення пробіотики «Біозапін» і дезінфектанту «Біолайд» як окремо, так і в поєднанні стимулюють ембріогенез, сприяють отриманню більшої кількості запліднених інкубаційних яєць та виведенню кондиційного молодняку курей. Так, показник виведення молодняку підвищився на 5,5 % ( $P < 0,01$ ), на 7,0 % ( $P < 0,01$ ) і на 11,0 % ( $P < 0,01$ ). Застосування досліджуваних препаратів полягає в оптимізації мікроклімату в птахівничих приміщеннях за такими показниками, як відносна вологість, концентрація шкідливих газів (аміак, сірководень, діоксид вуглецю), пилова та мікробна забрудненість повітря

**Ключові слова:** курчата-бройлери, мікроорганізми, санація, інкубація, вивідне відділення, яйця, пташник