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Effectiveness of probiotics in growing broiler chicken

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Abstract. Antibacterial preparations are used to prevent bacterial diseases in poultry when raising broilers but given the negative factor of their residual accumulation in meat and the acquisition of resistance by pathogens, it became necessary to find alternative means. The purpose of this study was to determine the effectiveness of various concentrations of *Bacillus coagulans* on the growth and development of broiler chickens. Methods employed: microbiological; physiological to determine the state of health and safety of chickens; zootechnical;

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pathological; statistical. The chickens in the experiment had a higher live weight at Day 35: in Group 1 – by 11%, in Group 2 – by 15.4%, and in Group 3 – by 18.4%, as opposed to the control. The average daily body weight gain of chickens in groups with *B. coagulans* was higher, in Group 1 – by 10.8%, in Group 2 – by 15%, and in Group 3 – by 18.3%. The preservation rate in all experimental groups, regardless of the probiotic concentration, was 100%, while in the control group – 80%. There was an increase in live weight in the following groups: Group 1 – by 11%, Group 2 – by 15.5%, Group 3 – by 19%. Feed conversion was lower in Group 1 by 5.3%, in Group 2 – by 3.4%, and in Group 3 – by 2%, compared to the control. At the end of the study, the level of *Lactobacillus sp*. in the intestines of chickens in Group 1 was 33.78% higher, in Group 2 – by 50%, in Group 3 – by 78.37%; a decrease in the content of *Enterobacteriaceae sp.* in Group 1 – by 51.48%, in Group 2 – by 65.11%, in Group 3 – by 90.67%; *Staphylococcus sp*. in Group 1 – by 15.04%, in Group 2 – by 35.44%, in Group 3 – by 51.47% ($p \leq 0.05$), in contrast to the control. The average bursal weight in Group 1 was 4.82% higher, in Group 2 – 30% higher, in Group 3 – 37.53% higher, and the bursal index was 15%, 25%, and 30% higher, respectively, compared to the control

Keywords: antibiotic resistance; *B. coagulans*; intestinal microflora; feed conversion; immunocompetent organs; live weight; preservation

INTRODUCTION

Broiler farming on an industrial scale creates a great concentration of livestock in a small area. During the cold season, poultry are kept indoors, which creates favourable conditions for infectious diseases to develop. Producers need to prevent the occurrence and spread of bacterial infections among chickens. The ban on the use of antimicrobials as growth promoters and preventive measures for bacterial infections has led to a search for alternative means of preventing them. The relevance of subject under study lies in the use of the probiotic strain *B. coagulans* ALM-86 to prevent bacterial diseases in broiler chickens.

G.R. Gibson *et al.* (2017) found that live probiotic strains of microorganisms in therapeutic doses improve the productive qualities of animals. The studies indicate that the doses of probiotic strains should be clearly defined and confirmed by toxicological studies regarding the safety of the specified strain of microorganism for animals. Therefore, the use of each probiotic must be clearly substantiated and its positive effect on animals must be proven. Furthermore, not only animal health is a vital indicator for the farm, but also production indicators such as live weight gain and feed conversion. Modern broiler crosses have a fast growth rate and accelerated metabolism, and therefore the results of using probiotic products can be clear in a shorter period of time.

A. Grant *et al.* (2018) found that probiotic strains of *Bacillus* have gained popularity for use in broiler breeding to provide safe and high-quality products. The advantages of these microorganisms are the synthesis of biocides, the formation of the microbiome, positive immunological and morphological changes in the gastrointestinal tract of chickens. However, different strains of *Bacillus* have cultural differences, and the mechanism of influence on poultry performance is not clearly defined.

J.M. Ngunjiri *et al.* (2019) found a direct correlation between beneficial and pathogenic microflora in the gut and lungs at all production stages of chicken rearing. Scientists believe that advances in this research could lead to the development of an effective method based on intervention in the microbiome to improve productivity and control disease in poultry. Multidrug-resistant bacterial pathogens, which become resistant due to the use of antibiotics, are one of the most arduous challenges in poultry production. T.J. Johnson *et al.* (2018) investigated over two thousand samples from different broiler farms. The basic bacterial microflora, *Lactobacillus*, was identified by sequencing the 16S rRNA gene. The researchers believe that it is necessary to continue experiments towards maintaining the isolated microbiota using probiotic strains of microorganisms.

Y. Wu *et al.* (2018) found that the use of *Bacillus coagulans* in poultry affected by necrotising enteritis reduced the level of *C. perfringens*. The use of the broiler probiotic had a positive effect on productive performance and increased alkaline phosphatase activity. The experiment was limited to the use of a single pathogenic microorganism, *Clostridium perfringens*, and therefpre there is a need to expand the range of possible antimicrobial activity of *B. coagulans*. K. Sasaki *et al.* (2020) concluded that *B. coagulans* restores the beneficial microflora in the human gut and reduces the number of *Enterobacteriaceae* in the colon. However, the effect of *B. coagulans* on the small intestinal microbiome and possible morphological changes is uncertain. C. Liu *et al.* (2022) indicated that *B. coagulans* in the poultry diet had a positive effect on the metabolism of protein and other metabolites. No studies have been conducted on the effect of probiotics on the immunocompetent organs of poultry.

The findings of W. Zheng *et al.* (2023) suggest that *B. coagulans* has prominent qualities as a probiotic. The researchers propose to use it for livestock production as a substitute for growth promoters and feed antibiotics. Furthermore, *B. coagulans* showed low levels of acute and chronic toxicity. There is a need to conduct research

in this area to determine the effectiveness of the introduction of *B. coagulans* in livestock. That is why the *purpose of this study* was to determine the effectiveness of *B. coagulans ALM 86* in preventing bacterial diseases and the productive performance of broiler chickens.

MATERIALS AND METHODS

The study was conducted in the vivarium of the Faculty of Veterinary Medicine of Sumy National Agrarian University in October 23. Broiler chickens (Cobb-500 cross) were selected as the object of study, of which 4 experimental groups and one control group of 25 birds each were formed. From the first to 36 days, the birds were kept on the floor on deep litter and fed with compound feed according to the standard indicators. Poultry in the experimental groups were supplemented with the probiotic *Bacillus coagulans* ALM-86 in various concentrations (Table 1).

Table 1. *Research design*

Groups	Concentration of Bacillus coagulans ALM-86
Experimental No. 1	1×10^5, CFU/g
Experimental No. 2	1×10^7, CFU/g
Experimental No. 3	1×10^9, CFU/g
Control	water

Notes*: CFU is a colony forming unit*
Source*: compiled by the authors of this study based on personal findings*

Study of the properties of Bacillus coagulans. The adhesive properties of *Bacillus coagulans* ALM-86 were determined according to the Brilis method (Brilis *et al.*, 1986) using the mean adhesion index (MAI), erythrocyte participation rate (EPR), and erythrocyte adhesion index (EAI).

Study of physiological parameters of chickens. The weight of the chickens was determined by weighing them on the second, third, fourth, and fifth week of the experiment. Feed conversion and chicken survival were also measured.

Research on the microbiome in chickens. The composition of the bacterial microflora of the intestine of chickens was determined after slaughter of five birds from each group at the age of 2 and 5 weeks. Average samples weighing 1 g were taken from the contents of the small intestine (duodenum), transferred to a phosphate-buffered solution of 9 cm^3, diluted from 10^{-1} to 10^{-10} and inoculated onto MPA (meat-peptone agar), Endo, Sabouraud, and vegetable media. They were incubated in a thermostat with an exposure time of 24-48 hours at 37°C, followed by counting the faecal CFU.

Determination of the effect of probiotic on the immunocompetent organs of broiler chickens. At the age of 5 weeks after slaughter, five poultry heads were examined for the mass of immunocompetent organs (bursa, thymus). The bursal index was also determined using the following formula:

$$BI = m / M \times 1000, \quad (1)$$

where BI is the bursal index, m is the mass of the immunocompetent organ, M is the mass of the chicken.

Statistical analysis. Statistical calculations of the data obtained were carried out using the Fisher-Student method (Fisher & Mosteller, 1948) when comparing the digital data of the control and experimental groups. The study considered the statistical significance of indicators ($p<0.05$) over 95%. Animal studies were conducted according to the methodology of DSTU EN ISO/IEC 17025:2019 (2021), the requirements and rules of bioethics and humane treatment of vertebrates 2010/63/EU (Hartung, 2010). The animals were kept, and all manipulations were conducted following the provisions of the Procedure for conducting tests and experiments on animals by scientific institutions (Law of Ukraine No. 249, 2012) and the European Convention (1986).

RESULTS AND DISCUSSION

Results of the study of Bacillus coagulans and its properties. At the first stage, the culture of Bacillus coagulans ALM-86 was *prepared* by growing it on vegetable medium, preparing smears and examining it under a microscope (Fig. 1).

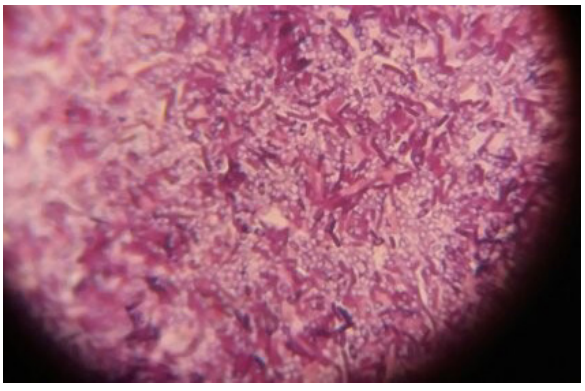

Figure 1. *Light microscopy of B. coagulans ALM-86 (magnification ×4000)*
Source*: compiled by the authors*

The degree of adhesion to rooster erythrocytes was also determined to establish the virulence of the strain (Fig. 2).

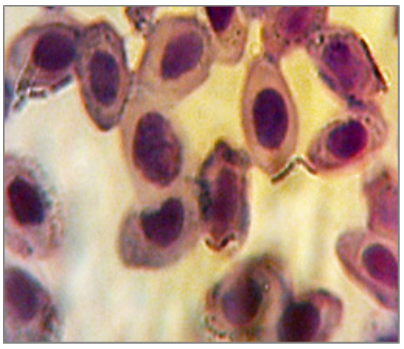

Figure 2. *The result of adhesion of B. coagulans ALM-86 on rooster erythrocytes (×1000)*
Source*: compiled by the authors*

When investigating the adhesiveness index of *B. coagulans* ALM-86 erythrocytes, it was found that it was 2.35±0.12. This is the average indicator according to the Brilis method (Fig. 2), the adhesion index – 1.80±0.05, and the adhesion coefficient – 85.34±1.12.

Results of determining the productive performance of chickens. At the beginning of the experiment, the body weight of broiler chickens, their preservation and feed conversion were found (Table 2).

Table 2. *Physiological and productive parameters of broiler chickens using Bacillus coagulans ALM-86, n=25*

Indicators	Experimental groups of chickens			
	1 Experimental B. coagulans 1×10^5, CFU/g	2 Experimental B. coagulans 1×10^7, CFU/g	3 Experimental B. coagulans 1×10^9, CFU/g	control
Body weight per 1 head Day 1, g	50.20± 0.61	50.12±0.37	49.80±0.24	49.91±0.36
Day 7, % to control	178.21±1.50 101.10	180.21±1.15 102.30	179.12±1.34 101.70	176.30±1.22 100.00
Day 14, g % to control	474.64±2.25 97.90	498.68±1.41 101.60	496.35±1.28 101.20	490.04±1.45 100.00
Day 21, g % to control	997.10±1.57 105.90	1,014.30±3.69* 107.70	1,020.5±2.99* 108.40	941.10±2.18 100.00
Day 28, % to control	1,631.92±28.78 101.60	1,679.30±37.51 104.60	1,751.20±42.67* 109.20	1,605.31±39.70 100.00
Day 35, g % to control	2,472.41±8.83* 111.00	2,569.30±17.53* 115.40	2,642.92±25.34* 118.40	2,226.92±30.30 100.0
Average daily live weight gain, g % to control	72.07±0.66* 110.80	74.84±0.54* 115.00	76.93±0.60* 118.30	65.05±0.23 100.00
Poultry mortality (heads) preservation, %	0 100.00	0 100.00	0 100.00	5 80.10
Live weight gain, kg	60.55±0.65* 111.00	62.98±0.86* 115.50	64.92±0.72* 119.00	54.50±0.63 100.00
Feed consumption, kg	128.20±0.65 94.68	130.82±0.45 96.60	132.61±0.86 97.90	135.42±0.33 100.00
Feed consumption per 1 kg of live weight gain, kg % to control	2.11 85.10	2.07 83.50	2.04 82.20	2.48 100.00

Notes*: *P<0.05 – relative to the control*
Source*: compiled by the authors of this study based on the data obtained*

The results show that different concentrations of the probiotic had distinct effects on weight gain and feed conversion during broiler chicken rearing. The body weight of day-old chickens in the experimental and control groups was the same. At one to two weeks of age, chickens had analogous body weights in all groups. Body weight increased (p≤0.05) in the groups of chickens on Day 21 of the experiment: in Group 1 – by 5.9%, in Group 2 – by 7.7%, in Group 3 – by 8.4%, in contrast to the control. On Day 28 of the study, a significant increase in weight was obtained in the broiler groups: in Group 1 – by 1.6%,

in Group 2 – by 4.6%, and in Group 3 – by 9.2%. The use of *Bacillus coagulans*ALM-86 has a positive effect on the productive qualities of poultry. At the end of the experiment on Day 35, the weight of chickens in Group 1 increased significantly by 11%, in Group 2 – by 15.4%, and in Group 3 – by 18.4%. Furthermore, the average daily weight gain of broilers in the groups where the poultry took the probiotic was significantly higher: in Group 1 – by 10.8%, in Group 2 – by 15.0%, and in Group 3 – by 18.3%, in contrast to the control. Therewith, the preservation rate in all experimental groups, where different concentrations of the probiotic were used as an additive, was 100%. In the control group of 25 chickens, 5 chickens died from a bacterial infection. Chickens in the control group showed a decrease in weight on Day 35. It was found that the main cause of death of the chickens was catarrhal inflammation of the small intestine (Fig. 3). During the bacteriological examination of the pathological material, the causative agent of escherichiosis was isolated.

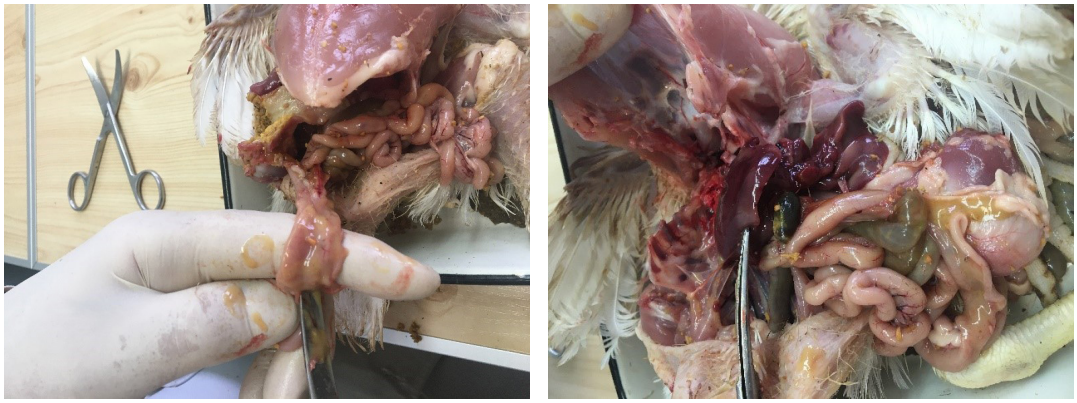

Figure 3. *Catarrhal inflammation of the small intestine in chickens of the control group*
Source*: compiled by the authors of this study based on the data obtained*

As a result of the experiment, there was an increase in body weight gain by group: in Group 1 – by 11%, in Group 2 – by 15.5%, and in Group 3 – by 19.0%. Feed consumption for the entire study period was 5.3% less in Group 1, 3.4% less in Group 2, and 2% less in Group 3, which is also a plus to economic profit compared to broiler chicken rearing without probiotics. This fact is also confirmed by the indicator of feed consumption per 1 kg of live weight gain, which was 14.9% lower in Group 1, 16.5% lower in Group 2, and 17.8% lower in Group 3 than in the control group.

Results of determining the composition of gastrointestinal microflora in chickens. The health and productivity of poultry depend on the state of the intestinal bacteriocenosis. The next significant variation is in the content of microorganisms in the small intestine of broiler chickens of different groups at the beginning of poultry rearing. During this period, the bacterial content in the intestines of chickens in Groups 1 and 2 was approximately 1.5-2.0 times higher than in the control group.

Table 3 presents quantitative changes in the intestinal microflora of chickens at 2 and 5 weeks of age. By Week 2 of the study, the colonisation of the beneficial intestinal microflora with *Lactobacillus sp.* increased in Group 1 by 1.48%, in Group 2 – by 31.94%, and Group 3 – by 64.78%. By Week 5 of the study in broiler chickens, the amount of *Lactobacillus sp.* in the intestinal contents was 33.78% higher in Group 1, 50.0% higher in Group 2, and 78.37% higher in Group 3 than in the control. Furthermore, a potential increase in *Lactobacillus sp.* in chickens of the experimental groups should be noted compared to Week 2 of the study. The family *Enterobacteriaceae sp.* includes bacteria that include well-known pathogens such as *Escherichia coli*. Therefore, the decrease in the level of pathogenic bacteria in the intestine of chickens was a sign of the competitiveness of *Bacillus coagulans* ALM-86 as a probiotic. By Week 2 of the study, a significant decrease in the content of *Enterobacteriaceae sp.* bacteria was found in Group 1 by 34.5.9%, in Group 2 – by 37.27%, and in Group 3 – by 53.16%. By Week 5 of the experiment, the number of *Enterobacteriaceae sp.* in the duodenum in Group 1 decreased by 51.48%, in Group 2 – by 65.11%, in Group 3 – by 90.67% compared to the control.

Table 3. *Composition of the microflora of the small intestine (duodenum) of chickens on Weeks 2 and 5 of rearing, n=5*

Groups	*Lactobacillus sp.*		*Enterobacteriaceae sp.*		*Staphylococcus sp.*		Associated microflora	
	Week 2	Week 5	Week 2	Week 5	Week 2	Week 2	Week 2	Week 5
1st Experimental B. coagulans 1×10^5, CFU/g	(10.27±0.28) $\times10^4$	(19.83±0.32)* $\times10^7$	(13.02±0.34)* $\times10^4$	(14.73±0.24)* $\times10^7$	(8.64±0.42)* $\times10^4$	(6.04±0.30) $\times10^7$	(13.18±0.42)* $\times10^5$	(14.91±0.41)* $\times10^8$

Table 3. Continued

Groups	*Lactobacillus sp.*		*Enterobacteriaceae sp.*		*Staphylococcus sp.*		Associated microflora	
	Week 2	Week 5	Week 2	Week 5	Week 2	Week 2	Week 2	Week 5
2nd Experimental *B. coagulans* 1×10^7, CFU/g	(13.4±0.35)* $\times10^4$	(22.25±0.39)* $\times10^7$	(12.47±0.28)* $\times10^4$	(10.59±0.36)* $\times10^7$	(6.28±0.32)* $\times10^4$	(4.59±0.43)* $\times10^7$	(13.90±0.40)* $\times10^5$	(12.77±0.52)* $\times10^8$
3rd Experimental *B. coagulans* 1×10^9, CFU/g	(16.64±0.29)* $\times10^4$	(26.41±0.35)* $\times10^7$	(9.31±0.35)* $\times10^4$	(2.83±0.18)* $\times10^7$	(4.85±0.29)* $\times10^4$	(3.45±0.29) c $\times10^7$	(12.98±0.58)* $\times10^5$	(11.99±0.50)* $\times10^8$
control	(10.08±0.26) $\times10^4$	(14.87±0.28) $\times10^7$	(19.88±0.25) $\times10^4$	(30.36±0.55) $\times10^7$	(14.56±0.24) $\times10^4$	(7.11±0.38) $\times10^7$	16.71±0.37 $\times10^5$	16.23±0.36 $\times10^8$

***Notes**: *P<0.05 – relative to the control*
***Source**: compiled by the authors of this study based on the data obtained*

By Week 2 of the test, the growth of *Staphylococcus sp*. was inhibited in Group 1 by 40.65%, in Group 2 – by 56.86%, in Group 3 – by 66.68%, compared to the control. In Group 1, the level of *Staphylococcus sp*. at the end of the tests was significantly lower than in the control group by 15.04%, in Group 2 – by 35.44%, and in Group 3 – by 51.47%. The associated microflora included unidentified microorganisms that affect the overall level of bacteria in the duodenum of broiler chickens. The content of associated microflora on Week 2 of the experiment was lower in Group 1 by 21.12%, in Group 2 – by 16.81%, and in Group 3 – by 22.32% compared to the control. At Week 5 of the study, the level of associated microflora in Group 1 was 8.13% lower, in Group 2 – 21.31% lower, and in Group 3 – 26.12% lower.

The results of determining the effect** of **probiotic on the immunocompetent organs of chickens. To establish the possible toxic effects on the chickens' body and immune system, necropsies and studies of immunocompetent organs were performed (Table 4). The average thymus weight of broiler chickens in the groups was almost identical, and therefore the thymus index was not calculated. The conducted studies found that the average weight of the bursa in Group 1 and the control group was lower than in the other groups. The average weight of the organ in Group 1 was 4.82% higher, in Group 2 – by 30.0%, and in Group 3 – by 37.53%.

***Table 4.** Weight of immunocompetent organs of chickens at the age of 5 weeks, n=5*

Groups	Average thymus weight, g	Average weight of the bursa, g	Bursal index
1st Experimental B. coagulans 1×10^5, CFU/g	7.81±0.20	3.91±0.27	2.30±0.12
2st Experimental B. coagulans 1×10^7, CFU/g	8.31±0.34	4.85±0.41*	2.50±0.21
3st Experimental B. coagulans 1×10^9, CFU/g	8.15±0.28	5.13±0.45*	2.60±0.12
control	8.03±0.45	3.73±0.21	2.10±0.14

***Notes:** *P<0.05 – relative to the control*
***Source:** compiled by the authors of this study based on the data obtained*

According to the results, the bursal index was 15% higher in Group 1, in Group 2 – 25% higher, and in Group 3 – 30% higher compared to the control group. The experiment suggests that chickens in the experimental groups where *Bacillus coagulans* ALM-86 was used as a dietary supplement had greater body weight, safety, and immune status compared to the control group.

The determination of the properties of *B. coagulans* ALM-86 showed that the strain has an average adhesion index, which indicates the avirulence of the bacterium to the organism. O. Shkromada *et al*. (2022) proved the positive effect of the *Bacillus* probiotic on the gastrointestinal tract microflora and milk production in cows. According to the results of body weight determination, an increase in broiler chicken weight was found in the experiment on Days 21-35 of rearing, where the probiotic was used. The best results were obtained in Group 3, where *B. coagulans* was fed at a dilution of 1×10^9 CFU/g. The findings of Y. Zhou *et al*. (2020) also reported an improvement in the performance of broiler chickens upon using *B. coagulans*. R. Jäger *et al*. (2018) and Z. Liu *et al*. (2022) confirm that *B. coagulans* promotes protein metabolism in animals.

During the research, it was found that the safety of chickens in all experimental groups, where different concentrations of the probiotic were used as an additive, was 100%. In the control group, chickens died due to intoxication caused by a bacterial infection. C. Liu *et al*. (2022) proved that one of the bacterial pathogens for poultry is *S. pullorum*, which leads to a high mortality rate caused by acute enteritis. Thus,

B. coagulans inhibits the growth and reproduction of opportunistic microflora in the intestine, which is confirmed by the study of the composition of the duodenal microbiome in chickens of two and five weeks of age. The test results are confirmed by K. Amoah *et al.* (2019) and S.S. Xing *et al.* (2019), who found that *B. coagulans* reduced intestine damage and restored the microbiome.

The number of beneficial microflora *Lactobacillus sp.* was significantly greater in chickens of the experimental groups, while *Enterobacteriaceae sp.* and *Staphylococcus sp.* were lower. S. Xie *et al.* (2022) and W. Zhen *et al.* (2018) confirmed that *B. coagulans* helps to form the intestinal microbiome, increase the body's resistance, and contribute to protection against pathogens such as *S. enteritidis* in chickens. Thus, *B. coagulans* can be added to the poultry diet as a growth stimulant and biocide, especially for young poultry, due to the inhibition of pathogenic microflora. Furthermore, studies have established the presence of a stimulating effect of *B. coagulans* ALM-86 on immunocompetent organs – the bursa, which gives grounds for its use as an immunomodulator. T.V. Bomko *et al.* (2017) and Z. Wang *et al.* (2022) found that in mice with streptomycin-induced colitis, the introduction of *B. coagulans* led to the cessation of diarrhoea, normalisation of gastrointestinal motility, and complete restoration of immunity merely using the probiotic.

In addition, due to the improved feed digestibility in chickens of the experimental groups, there was a decrease in feed conversion, which reflects the economic feasibility of using *B. coagulans* as an additive to broiler chickens. The high intensity of growth and metabolic processes in broiler chickens makes it necessary to search for safe growth and immunity stimulants. As an alternative, the *B. coagulans* ALM-86 probiotic for industrial use proved to be a desirable choice in the study.

CONCLUSIONS

Studies have shown that chickens treated with probiotics had a higher body weight on Day 21: in Group 1 – by 5.9%, in Group 2 – by 7.7%, in Group 3 – by 8.4%; on Day 28: in Group 1 – by 1.6%, in Group 2 – by 4.6%, in Group 3 – by 9.2%; on Day 35: in Group 1 – by 11%, in Group 2 – by 15.4%, in Group 3 – by 18.4%, compared to the control. When using *B. coagulans* in chickens, the average daily body weight gain was higher in Group 1 by 10.8%, in Group 2 – by 15.0%, and in Group 3 – by 18.3%, with an increase in body weight gain by 11%, 15%, and 19%, respectively, compared to the control. The survival rate of the chickens in the experiment was 100%, as opposed to 80% in the control group. Feed consumption per 1 kg of live weight gain was 14.9% lower in Group 1, 16.5% lower in Group 2, and 17.8% lower in Group 3; feed conversion was 5.3%, 3.4%, and 2% lower, respectively.

At Week 2 of the study, the content of *Lactobacillus sp.* in the intestines of poultry in Group 1 was 1.48% higher, in Group 2 – 31.94%, and Group 3 – 64.78%; at Week 5 of the study: Group 1 – 33.78%, Group 2 – 50.0%, Group 3 – 78.37%. At Week 2 of the study, a decrease in the content of *Enterobacteriaceae sp.* was found in Group 1 by 34.5.9%, in Group 2 – by 37.27%, in Group 3 – by 53.16%; at Week 5: in Group 1 – by 51.48%, in Group 2– by 65.11%, in Group 3 – by 90.67%, significantly compared to the control. By Week 2, the study found an inhibition of *Staphylococcus sp.* growth in the groups as follows: in Group 1 – by 40.65%, in Group 2 – by 56.86%, in Group 3 – by 66.68%; by Week 5, in Group1 – by 15.04%, in Group 2 – by 35.44%, and in Group 3 – by 51.47%. The study of the effect of *B. coagulans* on immunocompetent organs showed that the average bursa weight in Group 1 was 4.82% higher, in Group 2 – 30.0% higher, in Group 3 – 37.53% higher. Further prospects of the research are to investigate the effect of *B. coagulans* ALM-86 on the intestinal morphology of broiler chickens.

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None.

CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

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Ефективність застосування пробіотиків при вирощуванні курчат-бройлерів

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Анотація. При вирощування бройлерів з метою профілактики бактеріальних хвороб птиці застосовують антибактеріальні препарати, але, враховуючи негативний фактор накопичення їх залишкової кількості у м'ясі, та набуття збудниками заразних хвороб резистентності виникла необхідність пошуку альтернативних засобів. Метою дослідження було визначити ефективність різних концентрацій *Bacillus coagulans* на ріст та розвиток курчат-бройлерів. Використані методи: мікробіологічний; фізіологічний для визначення стану здоров'я та збереженості курчат; зоотехнічний; патологоанатомічний; статистичний. Курчата в експерименті мали більшу живу масу на 35 добу: в групі № 1 на 11 %, в групі № 2 – на 15,4 %, в групі № 3 – на 18,4 %, на відміну від контролю. Середньодобовий приріст маси тіла курчат у групах з *B. coagulans* був вище, в групі № 1 на 10,8 %, в групі № 2 – на 15 % та в групі № 3 – на 18,3 %. Збереженість у всіх дослідних групах не залежно від концентрації пробіотику, склала 100 %, в контрольній – 80 %. Відбувалось збільшення живої ваги в групах: групі № 1 – на 11 %, групі № 2 – на 15,5 %, групі № 3 – на 19 %. Конверсія корму була нижча у групі № 1 на 5,3 %, у групі № 2 – на 3,4 %, у групі № 3 – на 2 %, на відміну від контролю. По завершенню дослідження рівень *Lactobacillus sp.* у кишечнику курчат групі № 1 групи був вище на 33,78 %, групі № 2 – на 50 %, групі № 3 – на 78,37 %; *зниження вмісту Enterobacteriaceae sp.* у групі № 1 на 51,48 %, групі № 2 – на 65,11 %, у групі № 3 – на 90,67 %; *Staphylococcus sp.* у групі № 1 групі на 15,04 %, в групі № 2 – на 35,44 %, в групі № 3 – на 51,47 % ($p \leqslant 0,05$), на відміну від контролю. Середня маса бурси в групі № 1 була більша на 4,82 %, в групі № 2 – на 30 %, в групі № 3 – на 37,53 %, відповідно бурсальний індекс на 15 %, 25 %, та 30 %, порівняно з контролем

Ключові слова: антибіотикорезистентність; *B. coagulans*; мікрофлора кишечника; конверсія корму; імунокомпетентні органи; жива маса; збереженість