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RESEARCH ARTICLE

Influence of the Probiotics of Lactobifadol on the Exchange Processes, Literal Microbiocenosis, Productive Indicators of Goslings

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Abstract

Inclusion of the probiotic supplement based on lactobacilli *L.acidophilus* and bifidobacterium *B. Adolescentis* to the diet of young poultry (goslings) at a rate of 0.2 g per 1 kg of body weight weekly, with subsequent weekly intervals, throughout the growing period provided: an increase in live goslings weights at 62 days of age by 3.7% compared with the intact group. The introduction of probiotic Lactobifadol to the body of goslings had a stimulating effect on protein and carbohydrate metabolism. The average total protein content from 20 days to 62 days in the control group increased by 12.6%, compared to the control group. In the blood serum of goslings, the average glucose content from 20-day to 62-day in the experimental group increased by 4% compared with intact birds. The average content of calcium and phosphorus in the blood serum of goslings of the experimental group from 20 days to 62 days of age was 14.8% less than in the control group of goslings. In the intestinal microbiocenosis, changes have occurred in the direction of an increase in the number of lactobacilli and bifidobacteria, with a significant decrease in the representation of E. coli. The use of Lactobifadol allowed to obtain a higher yield of gutted carcasses from goslings, to increase the mass of gutted carcasses by 6.64%. The use of Lactobifadol in growing of goslings allowed to receive an additional income of 23 rubles per 1 head.

Key words: *Probiotic Lactobifadol, Goslings, Live weight, Daily average growth, Morphological blood parameters, Serum biochemical parameters, Microflora, Lactobacilli, Bifidobacteria, E. coli, Meat quality, Eviscerated carcass yield, Economic efficiency.*

Introduction

Modern poultry growing technologies increasingly include the use of probiotic preparations that increase poultry productivity [1].These technologies are most in demand in countries with the high economic level of development, where there is the steady demand for environmentally friendly products, as a result of which the production of such products is profitable and promising.

The environmental friendliness of agricultural production is also largely determined by the use of rational technological processes of tillage, as well as biological treatment of crops with microbial products [2, 3].On the other hand, the tendency towards their antibiotic resistance is intensifying on the part of pathogenic bacteria, which is a new challenge for humanity.

An expanding list of pathogenic microorganisms-pathogens, the complex mutual influence of microorganisms and their toxins on the poultry organism are also traditional risk-enhancing factors. As a result, a community of animals is formed that does not lend itself to traditional effective antibiotic treatment [4, 5].

The key role of the microbiocenosis of the body is determined by its influence on the processes of digestion of the feed, metabolism and resistance of the body. Normal microflora provides immunity to birds, as a result, the safety of the bird during rearing, its resistance to technological stresses.

The most important representatives of obligate intestinal microflora are lacto- and bifidobacteria.

Their main task, as representatives of obligate microflora, is a regulatory function that prevents the colonization of intestines by foreign microorganisms and inhibits the growth of populations of opportunistic microorganisms. Bifidobacteria are one of the representative species of poultry intestinal microflora. Their role in the poultry is largely determined by association with the intestinal mucosa, to provide a protective barrier against pathogenic microbes.

They have a pronounced antagonistic activity against conditionally pathogenic microflora. Bifidobacteria are active participants in the synthesis of proteins and vitamins; they activate the absorption of iron and calcium ions. Lactobacilli, as typical representatives of obligate microflora, take an active part in intermicrobial interaction, suppressing the growth of Proteus and pathogens of intestinal infections. In the process of their life, lactobacilli secrete antibiotic substances: lysozyme and others, and they are an important link in colonization resistance. Thus, the introduction of probiotic feed additives into the body of young poultry provides stable protection against intestinal infections, normalizes metabolic processes, increases feed conversion, by including bacteria strains with high enzymatic activity in the probiotic, and promotes active growth and preservation of the bird [6, 7].

Materials and Methods

Animal Treatments and Experimental Design

All procedures for the participation of animals in this study were approved by the Committee on the care and use of animals of the Bashkir State Agrarian University. For research, we formed two groups of goslings of the Kuban breed of daily age, 30 goslings in each. The intact group of goslings received the main diet in the form of a full-feed compound taking into account the growing periods. The goslings of the experimental group, along with the main diet, were injected with the probiotic Lactobifadol at the rate of 0.2 g / kg body weight weekly with weekly breaks.

Table 1: Composition of full feed for goslings

Recipe content, %	0-21 days	22-63 days
Wheat	21.29	36.88
Corn	37	22.3
Sunflower meal	12.5	20
Extruded soy	11	
Soybean meal	13.3	
Bran		16
Monocalcium phosphate	1.22	0.13
Chalk	2.12	3.2
Common salt	0.32	0.35
Lysine	0.13	0.14
Methionine	0.12	
Premix P-5 (with enzyme)	1	
Premix P 1-2		1
Total	100	100
Content	%	
Crude fiber	5.5	6.9
Crude protein	19.5	15.9
Crude fat	6.9	4.7
Exchange energy, kcal	290	265
Methionine + cystine	0.76	0.59
Methionine	0.45	0.29
Lysine	1.0	0.65
Threonine	0.68	0.51
Calcium	1.1	1.2
Phosphorus common	0.7	0.6
Sodium	0.18	0.2

All the birds used in the experiment were clinically healthy. Weighing of all goslings and ducklings was repeated at the same time, 4 hours after feeding. Bird well-being was the most important factor. The birds were weighed on an electronic scale. The duration of the goslings growing was 63 days. The goslings were grown in houses on the floor using litter from sawdust of conifers. The first 7 days of growing, the temperature was maintained at +26 0C, air humidity 67-72%. Starting from the second week of cultivation, the temperature in the house was reduced, bringing to +22 ° C at the end of the

third week of cultivation. By the end of the fourth week of cultivation, the temperature dropped to + 18-20 ° C. The lighting regime for the first seven days of cultivation was around the clock. Later, up to 20 days of age, the lighting regime was reduced every day by 40 minutes, bringing it to 16 hours a day, from 21 days to 30 days of age, it was brought up to 14 hours and kept until the end of the goslings cultivation. The illumination was at the level of 25-30 lux.

Probiotic Lactobifadol and the Method of its Introduction into the Compound Feed

The Lactobifadol probiotic feed supplement contains live acidophilus and bifidobacteria, which were dried by a sorption method on a plant carrier. The composition of the probiotic supplement includes lactobacillus ***L. acidophilus*** with a concentration of at least 1 million / g, as well as bifidobacterium ***B. Adolescentis*** with a content of at least $8x10^6$ / g. The probiotic supplement contains no modified bacterial strains. Lactobifadol does not contain antibiotics, has a white to light brown color, is a loose powder. It is introduced into full feed by means of stepwise mixing.

Analysis of Biochemical Blood Parameters

Blood samples of 10 goslings randomly selected from each group (5 goslings from the group) were collected from a wing vein at the age of 20, 30, 40, 50 and 62 days. Heparin was used as an anticoagulant, and plasma samples were obtained by centrifugation at 2000 rpm for 10 minutes. Plasma samples were analyzed using assay kits in accordance with the manufacturer's instructions (Vital Diagnostics).

The concentration of total protein in blood serum was determined by the biuret method, in which the protein forms a colored complex with copper ions in an alkaline medium.

The glucose concentration was determined by the enzymatic colorimetric method; upon oxidation of ß-D-glucose with atmospheric oxygen under the action of glucose oxidase (GOD), an equimolar amount of hydrogen peroxide is formed. With the participation of peroxidase (POD), hydrogen peroxide oxidizes the chromogenic substrates with the subsequent formation of a colored product.

A unified colorimetric method was used to determine the concentration of calcium in serum. The principle is based on the formation by calcium of a colored complex in an alkaline medium with o-cresolphthalein complexone. The concentration of inorganic phosphorus in the blood serum was carried out by the molybdate method. The method is based on the formation of sulfuric acid in the reaction of inorganic phosphorus and ammonium molybdate phosphomolybdate complex.

Analysis of Morphological Parameters of Blood

The hemoglobin concentration was determined by the hemoglobin cyanide method: 20 µl of blood was added to 5 ml of the transforming solution, mixed thoroughly and left for 10 minutes. Then the optical density of the experimental sample was measured. The number of red blood cells (RBC) and the number of leukocytes (WBC) was determined using a hemocytometer (Campbell, 1995).

Microbiological Research

In laboratory conditions, inoculations taken from litter samples were carried out on the appropriate medium. Endo medium was used to identify and count E. coli. For the study of bifidobacteria, Blaurock's medium was used. MRS (de Man, Rogossa and Sharpe) was used to grow lactobacilli.

Anatomical Cutting of Carcasses of Birds

The evaluation of meat qualities was carried out according to the results of anatomical cutting. The considered indicators were: pre-slaughter mass of poultry and mass of gutted carcass. The mass of gutted carcasses did not take into account the mass of blood, feather, legs, head, and digestive tract.

Statistical Analysis

The statistical analysis was performed using the program Statistica 10 (company Statsoft). The quantitative data are presented as arithmetic mean and its standard error (M ± m). The reliability of intergroup differences was judged using the value of Student's t criterion. The differences in the compared groups were considered statistically significant when the error level of the first level (p) is less than 0.05.

Research Results

Goslings Growth Dynamics when using Lactobifadol

The results of measuring body weight of goslings who received a probiotic supplement Lactobifadol and intact goslings with full-feed compound by age of studies are presented in Table 2.

The weighing results show that the use of the probiotic supplement Lactobifadol had a definite effect on the dynamics of the increase in live weight.

If at the beginning of the study there were practically no differences in the live weight of goslings, then at 62 days of age, there were certain differences.

Table 2: Dynamics of body weight and stock of goslings when using the probiotic Lactobifadol, X ± Sx, n = 30

Age	Group	Live mass, g	Average day increase, g
1 day	Control	94.6±2.77	
	Experimental	95.9±2.19	
10 days	Control	413.4±12.6	31.8
	Experimental	437.1±12.2	34.1
20 days	Control	835.2±32.7	42.2
	Experimental	847.2±29.7	43.7
30 days	Control	1526.4±55.7	69.1
	Experimental	1659.1±37.9*	81.2
40 days	Control	2120.5±61.4	44.3
	Experimental	2301.4±68.4*	64.2
50 days	Control	2415.6±81.3	29.5
	Experimental	2632.3±68.4*	33.1
62 days	Control	2803.2±71.3	38.8
	Experimental	2906.6±92.6	27.4

Over the entire period of research, the safety of birds in the experimental group was 100%, while in the control group - 97%. At the age of 62 days, goslings treated with the probiotic Lactobifadol tended to increase body weight by 3.7% more than goslings of the control group. A certain effect from the use of Lactobifadol manifested itself on the tenth day of studies, when the weight of the goslings of the experimental group was higher than in the control group by 5.7%.

During the research period, when the age of the experimental bird reached 30 days, the goslings of the experimental group weighed 8.7% ($P < 0.05$) more than the goslings of the intact group. At 40 days of age, the trend of more active increase in live weight in the experimental bird by 8.5% ($P < 0.05$) continued. At 50 days of age, the weight of the experimental bird was 8.9% more ($P < 0.05$), and at 62 days of age, it was 3.7%. In the period from the 1 day to the age of 50 days, the average daily gains in goslings of the experimental group always exceeded the values of the control group. However, during the period from 51 to 62 days of growing, the daily gain in live weight in goslings of the control group was higher, averaging 38.8 g / day, compared to 27.4 g / day in the experimental group. Thus, the use of the probiotic feed supplement Lactobifadol allows to obtain 3.7% of the additional increase in live weight of goslings.

Dynamics of Morphological Parameters of Goslings

The vital activity and products of the synthesis of the components of the probiotic feed supplement Lactobifadol have a definite effect on the state of the body, including the effect on the blood picture. We carried out a morphological analysis of goslings, the results of which are presented in Table 3.

Table 3: Dynamics of changes in morphological blood parameters of goslings with the introduction of Lactobifadol (X ± Sx, n = 5)

Age	Group	RBC, 10^{12}/l	WBC, 10^{9}/l	Hemoglobin, g/l
20 days	Control	1.76±0.10	28.3±1.63	143.3±9.6
	Experimental	1.73±0.13	26.4±1.72	144.5±11.03
30 days	Control	2.24±0.02	26.8±1.68	174.6±14.96
	Experimental	2.28±0.04	25.32±0.84	180.1±2.06
40 days	Control	2.14±0.03	24.0±0.57	176.4±5.42
	Experimental	2.10±0.06	21.7±0.69	180.6±5.51
50 days	Control	2.15±0.10	19.0±0.76	170.2±0.94
	Experimental	2.11±0.09	19.2±0.92	171.6±1.09
62 days	Control	2.13±0.08	22.5±0.66	179.2±5.45
	Experimental	1.74±0.09	21.8±0.30	177.4±2.46

In goslings of the control group at the age of 20 days, a trend of an increase in the number of red blood cells by 1.7% was established, when compared with the experimental group. A comparative analysis of the erythrocyte content at the age of 30 days and 20 days shows that with age there is a general increase in the number of red blood cells in the blood by 27.3% in the goslings of the control group and by 31.8% in the goslings of the experimental group.

At the age of 40 days, we observe a steady tendency toward a decrease in the number of red blood cells in the blood of goslings of experimental groups. Moreover, these differences, compared with the 30-day-old age, account for 4.5% for goslings of the control group, and 7.9% for goslings of the experimental group. Blood tests at the age of 62 days showed that in the goslings of the control group their content was 22.5% higher than in the experimental group. The average erythrocyte count for the entire study period was $2.08x10^{12}$ / l in the control group, versus $1.99x10^{12}$/ l in the experimental group, which is 4.6% less.

The research results indicate that in this case, the use of Lactobifadol did not have a pronounced erythropoietic effect. The results of the studies found that the quantitative indicators of leukocytes were within the physiological norm according to studies of all ages of the bird. The most significant differences in the content of leukocytes were found by us at the age of 20 days.

The white blood cell count in the control group of goslings was 7.2% more. Over the next period of research, up to 50 days of age, a steady tendency to a decrease in the content of leukocytes is recorded. At the age of 50 days, we found a 1.1% excess of the white blood cell count in the blood of the goslings of the experimental group. At the final stage of poultry growing at the age of 62 days, the leukocyte content in the blood of goslings of the control group was 3.1% higher than in the blood of goslings of the experimental group. In general, when comparing data at 50 days and 62 days, we observe a tendency to increase the number of leukocytes in both groups of goslings by 13.6-18.5% at 62 days of age of the bird.

The research results show that at the age of 20 days, the concentration of hemoglobin was higher in goslings of the experimental group by 1.2 g / l, or 0.9%. As the analysis shows, at 20 days of age, the concentration of hemoglobin in goslings of the control group was 143.3 g / l, in the experimental group-144.5 g / l. Subsequently, from 20 days to 40 days of age, hemoglobin concentration increases and reaches 174.6 ± 14.96 g / l in the control group and 180.6 ± 5.51 g / l.

The data obtained exceed the same indicators of goslings at the age of 20 days by 23.1% and 25.0%, respectively. For the age of 50 days, a decrease in hemoglobin concentration to a level of 170.2 ± 0.94 g / l in the control group and 171.6 ± 1.09 g / l in the experimental group relative to the 40-day-old age of the bird is characteristic. Intergroup differences at this age are 0.9%. The average hemoglobin concentration for the entire study period was 170.8 g / l in the experimental group of goslings, which is 1.3% more than that of goslings-analogues from the intact group. Thus, the use of the probiotic Lactobifadol in growing of goslings provides a tendency to increase the hemoglobin concentration by 1.3%, compared with the basic version of feeding the bird.

Dynamics of Biochemical Indicators of Goslings Blood Serum

The introduction of the probiotic supplement Lactobifadol into the feed composition had a definite effect on the dynamics of goose blood biochemical parameters. The results of the studies found that at the age of 20 days the total protein content in the blood serum of goslings of the experimental group was at the level of 59.33 g / l, which is 27.9% higher than the corresponding indicator of the control group of goslings.

The research results show that at the age of 30 days the total protein content remains higher in the serum of goslings of the experimental group by 17.1% ($P < 0.05$), characterizing a higher level of protein metabolism in the body of goslings. For 40-day-old goslings, the lowest total protein values for the entire period of studies are characteristic; they were 39.08 g / l in the control and 40.7 g / l in the experimental group of goslings. At the age of 50 days, we note a tendency to exceed the total protein content in the blood serum of goslings of the experimental group by 1.6% and at 62 days of age by 9.7%, respectively.

The average value of the total protein content over the entire period of research in the blood serum of goslings of the experimental group was 48.8 g / l, which is 12.6% more than that of the goslings of the control group. Thus, the above research results give us reason to believe that the use of Lactobifadol provides the activation of protein metabolism in the body of the bird, which is reflected in the increase in its content in the blood serum of goslings. The research results show that at the age of 20 days a higher level of glucose concentration was found in goslings of the control group - 6.95 mmol / l.

In the goslings of the experimental group, the glucose concentration was 3.3% lower. The age of 30 days is characterized by a decrease in glucose concentration in goslings of both groups, relative to the 20-day-old age of the bird. Moreover, the obtained values are the lowest for the entire period of research. Intergroup differences make up 12.3% in favor of the goslings of the experimental group.

Throughout the remaining periods of research, a steady increase in the concentration of glucose in goslings of both experimental groups was noted. In this case, the average glucose content for the entire period of research in the experimental group amounted to 6.51 mmol / L, which is 4.0% more than the corresponding indicator for goslings of the control group. The data obtained allow us to conclude that the inclusion of the probiotic supplement Lactobifadol in the main diet provides activation of carbohydrate metabolism in the body of an experimental bird.

The research results show that the serum calcium content is quite unstable and varies significantly by age of research. The lowest values of calcium were found by us at the age of 20 and 40 days. An important circumstance is the fact that only at the age of 20 days the calcium content in the blood serum of goslings of the experimental group was higher than in the control by 51.9%.

In other periods of the study, the concentration of calcium in the blood serum of goslings of the control group was always higher. These differences ranged from 2.5% at the age of 30 days to 173% at the age of 62 days. The average value of the content of calcium in the blood serum of goslings for the entire period of research in the control group was 4.36 mmol / l, which is 14.8% more than that of analogues from the experimental group of birds.

The study of the content of inorganic phosphorus shows a similar age-related nature of changes in its concentration in the blood serum of goslings in both experimental groups. It is obvious that at the age of 30 and 62 days, the maximum peaks of phosphorus content in the blood serum of goslings are observed. The research results show that at the age of 20 days, no significant differences in the phosphorus content were found.

At the age of 30 days, we observe both a general increase in the level of phosphorus in the blood serum, and an increase of 1.5% relative to the experimental group, and the phosphorus content of the goslings of the control group. At the age of 40 days, a significant decrease in the phosphorus content in the blood serum of goslings of both experimental groups was noted, while in the goslings of the control group its content was 11.5% higher.

Further studies at the age of 50 and 62 days showed that the concentration of phosphorus in the blood serum of goslings of the control group remains significantly higher. So, at the age of 50 days this excess was 37.6%, at 62 days of age - 38.5%. The average phosphorus content in the blood serum of goslings for the study period amounted to 3.26 mmol / l in the control group, which is 15.3% more than that of the analogues of the experimental group.

The Composition and Dynamics of Microflora of Goslings Litter

The research results of the microbiocenosis of litter of goslings of the studied groups are presented in Table 4.

Table 4: Intestinal microbiocenosis goslings, log, CFU / g (X ± Sx, n = 5)

Age	Group	E. coli	Lactobacilli	Bifidobacteria
20 days	Control	6.2±1.19	3.7±1.16	1.9±0.18
	Experimental	6.1±1.05	5.1±0.14	2.8±1.20
40 days	Control	1.7±0.48	3.4±0.33	3.7±1.62
	Experimental	1.3±0.26	5.8±1.63	4.8±2.10

The research results show that the use of probiotic feed supplements for growing goslings significantly changes the quantitative composition of intestinal microorganisms at different age stages of poultry research. The analysis of age-related changes in the number of Escherichia coli clearly indicates its significant decrease in the intestine of the bird with age. So, at the adjacent stages of research, we found a decrease in the number of Escherichia coli in the litter of goslings at the age of 40 days in the control group - 3.65 times, in the experimental group - 4.7 times.

At the same time, when comparing the groups with each other, we see that in the goslings of the control group, the content of Escherichia coli was 1.7% (20 days) and 30.8% (40 days) higher respectively. The content of lactobacilli in the litter of goslings of the studied groups was multidirectional. So, if in the control group their content decreased by 8.9% with age, then in the experimental group it tended to increase with age by 13.8%, compared with the 20-day-old age of the bird.

At the same time, the average number of lactobacilli in the experimental group exceeded the control analogues by 53.6%. Summarizing the obtained data, we conclude that the use of a probiotic preparation, which includes living forms of lacto- and bifidobacteria, leads to a significant increase in their quantitative content in the intestines and droppings of birds. At the same time, a significant decrease in the number of Escherichia coli is obvious.

Goose Meat Productivity Indicators

By the meat productivity of birds, we first of all understand the ability to achieve slaughter mass as early as possible with the corresponding feed costs per unit of increase. The results of the slaughter of goslings are shown in Table 5.

Table 5: The results of the control slaughter of goslings (X ± Sx, n = 5)

Indicator	Group	
	control	experimental
Pre-slaughter body mass, g	3892.8±106.14	4038.2±68.89
Gutted carcass weight, g	2260.4±79.3	2410.5±67.9
Slaughter yield, %	58.1	59.7

The results of the control slaughter of goslings show that the use of the probiotic feed supplement Lactobifadol ensures the formation of a larger experimental live bird before slaughter. The excess for this indicator in the experimental bird was 3.8%. The gutted carcass weight of the goslings of the experimental group was similarly higher, which was 6.7% higher than the goslings of the control group. The value of slaughter yield was also higher in the experimental group of goslings - 59.7%, which is 1.6 percentage points higher than in control. The economic calculations show that when using Lactobifadol, you can get an additional income of 23 rubles per 1 head.

Discussion

The research results showed that the introduction into the body of goslings the probiotic feed supplement Lactobifadol, which includes lactobacillus ***L. acidophilus*** and bifidobacteria ***B. Adolescentis***, had a positive effect on the productivity of young waterfowl. According to the results of weighing the studied birds, it was found that the inclusion in the diet of goslings the probiotic Lactobifadol ensured an additional increase in live weight by 3.7% at 62 days of age. The similar effect of probiotic feed supplement was noted in studies [8] when a probiotic based on Bacillus subtilis was included in the diet; in studies [9] using a probiotic supplement based on Bacillus amyloliquefaciens; the work [10] noted the positive effect of the use of the "Livesac" probiotic on white Peking ducks; in studies [11] using the probiotic Propul with a strain of Lactobacillus fermentum.

The inclusion of the probiotic feed supplement Lactobifadol in the composition of the feed had a stimulating effect on the metabolic processes in the poultry organism; protein metabolism was activated in goslings. It was found that the average total protein content over the entire period of research in the experimental group was 12.6% higher than in the control group. In studies [12], it was shown that, when feeding broiler ducklings with a probiotic based on Saccharomyces cerevisiae, significant ($P < 0.05$) differences in the content of serum albumin and globulin are noted.

In the blood serum of goslings, the average group glucose content from 20-day to 62-day was 4% more in the experimental group than in the intact group of the birds.

The similar results are shown in studies [13] using a probiotic supplement (Bacillus subtilis). In the blood serum of ducks, an increase in glucose and alkaline phosphatase activity was found. At the same time, according to [14, 15], when Bacillus subtilis natto was added to duck diets, the concentration of total cholesterol and glucose decreased. However, the above results did not have significant differences between the groups. The average content of calcium in serum over the entire period of research in the experimental group of goslings was 14.8% less than that of the control analogues. However, studies [16] present the results of an increase in serum calcium concentration and the absence of a significant effect on grouse body weight gain when using a prebiotic.

According to the phosphorus content in the blood serum, the goslings have a picture similar to the calcium content. From 20 days to 62 days in the experimental group of goslings, the phosphorus content was 15.3% lower than in the control. The effect of the probiotic feed additive Lactobifadol was manifested in a significantly higher quantitative content of lactobacilli and bifidobacteria, while at the same time a significant decrease in the content of representatives of Escherichia coli. The similar data were obtained in studies [17]. They found an increase ($P < 0.05$) in the Lactobacillus population and a decrease ($P < 0.05$) in the small and large intestine Escherichia coli when using probiotic feed additives based on Bacillus subtilis var.

According to [9], a similar result was obtained when broilers were fed with a probiotic supplement based on Bacillus amyloliquefaciens. According to the analysis of meat qualities, it is evident that the use of Lactobifadol allowed increasing the gutted carcass weight by 6.64% and the gutted carcass yield from goslings of the experimental group. The similar results were shown in studies [19] conducted on broiler ducklings with the addition of the probiotic preparation Propoul with a strain of Lactobacillus fermentum. Thus, the probiotic supplement Lactobifadol is an effective growth promoter for young waterfowl. The probiotic Lactobifadol has excellent potential in improving the production of poultry meat and its environmental safety.

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