Age dynamics and interrelation of biochemical blood parameters with live weight of goslings when using probiotic feed additives

A.F. Khabirov*, *E.V.* Danilova, *R.H.* Avzalov, *G.R.* Tsapalova, and *F.M.* Gafarova

Bashkir State Agrarian University, Ufa, Russia

Abstract. The article presents the results of the assessment of the effect of probiotic feed additives Bacispecin and MK on the live weight and biochemical parameters of the blood serum of goslings. It was found that at 9 weeks of age, goslings receiving Bacispecin and MK had a higher live weight than goslings receiving only the basic diet, the weight difference was 10.9% ($p<0.05$) and 0.27%, respectively. Biochemical analysis of the blood serum of goslings revealed that in the seventh week of rearing, the bilirubin content in goslings of the experimental groups was 3.9% and 9.8% higher than in the control group. The highest glucose concentration in the blood serum of goslings was established on the 63rd day of rearing. In the blood serum of goslings in the control, the glucose level was 10.0±0.14 mmol/l, which is 12.3% higher than the value of the experimental groups. At the 9th week of rearing, the urea value of -1.0±0.07 mmol/l in the blood serum of the control group of goslings exceeded the value of the experimental groups by 11.1% and 42.9% ($p<0.05$), respectively.

1 Introduction

Providing poultry with a full-fledged diet balanced in protein, fat, and carbohydrates, with the addition of biologically active substances, has a beneficial effect on the sustainable formation of the body immune status, due to the healthy balance of the intestinal flora [6, 10, 11, 12, 15, 16, 19, 20]. Adding probiotic feed additives to the poultry diet not only suppresses the vital activity of pathogenic and opportunistic bacteria in the gastrointestinal tract, but also improves the productive performance of poultry [1, 2, 4, 5, 7, 9, 13, 14].

Biochemical blood tests are performed to assess the physiological state of the bird's body, as well as for the timely diagnosis of pathological processes. Deviations from the physiological norms of individual blood components indicate a high load on internal organs [3, 8, 17, 18, 21].

The purpose is to assess the physiological state of poultry when probiotics Bacispecin and MK are included in the diet. To achieve this goal, the following **tasks** were set: to determine the age dynamics of body weight and the content of biochemical parameters of the blood serum of goslings: bilirubin, glucose, and urea; to characterize the relationship between biochemical parameters and the average daily increase in body weight.

* Corresponding author: xaifa@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

2 Materials and Methods

The study of the effect of probiotic feed additives on the body of goslings was conducted in 2024 in the Blagovarsky district of the Republic of Bashkortostan in the conditions of the scientific and production center for poultry farming Bashkir Bird LLC**.** Under identical conditions, the goslings of the three groups received a basic, nutritionally balanced diet (BR) every day for 63 days, from the age of one day. At the same time, probiotic feed additives were added daily to the basic diet of the experimental groups. The scheme of the experiment is presented in table 1. Blood sampling from the bird was carried out in the morning, on an empty stomach from the large metatarsal vein at 21 days, 49 days, 63 days of age.

Table 1. Scheme of the experiment.

Group	Number of birds	Diet	Dosage of probiotic feed additive
Control	40 (20♀+20♂)	BD	-
First experimental	40 (20♀+20♂)	BR + probiotic Bacispecin (10^8 CFU/ml)	1 ml of probiotic per 1 kg of body weight, daily
Second experimental	40 (20♀+20♂)	BR + probiotic MK (10^7 CFU/ml)	1 ml of probiotic per 1 kg of body weight, daily

3 Research results

Figure 1 shows the dynamics of live weight of goslings over 63 days of rearing.

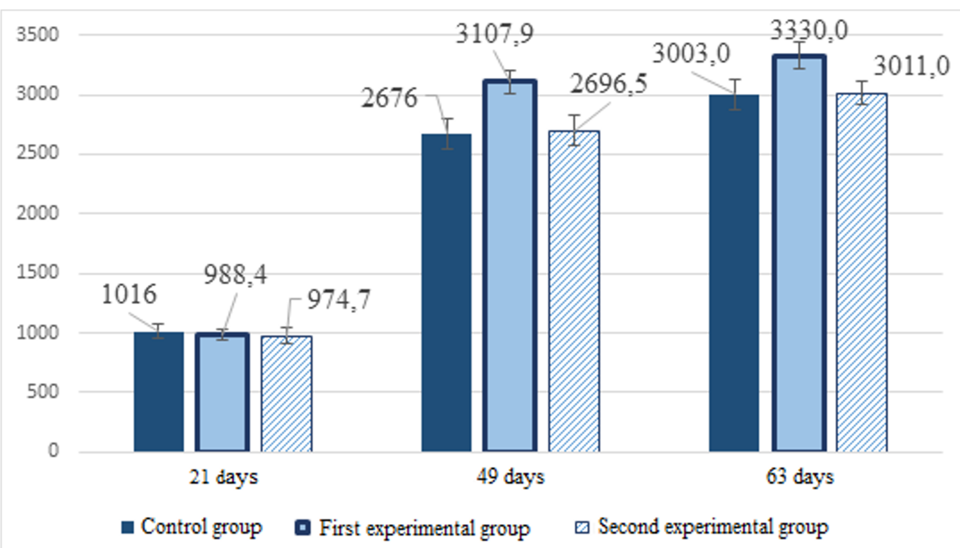

Fig. 1. The results of raising goslings in 63 days, n=40.

Analysis of the result of the inclusion of probiotics in the diet when rearing goslings indicates that on the 21st day of rearing, the live weight of goslings in the control group was 1016.0±66.53 g, which exceeded the weight of the experimental groups of goslings by 2.8% and 4.2%, respectively.

Studying the dynamics of rearing goslings on the 49th day of rearing, it was found that the weight of goslings of the first experimental group was significantly higher than the weight of the intact group by 16.1% ($p<0.01$), and the weight of the second experimental group was 0.8% higher than in the control.

Goslings of the first experimental group weighed 3330±107.53 g on the 63rd day of rearing and significantly exceeded the weight of goslings of the control sample by 10.9% ($p<0.05$). In the second experimental group, the goslings had a live weight of only 0.27% more than in the control group.

Figure 2 shows the bilirubin content in the blood serum of goslings by rearing period.

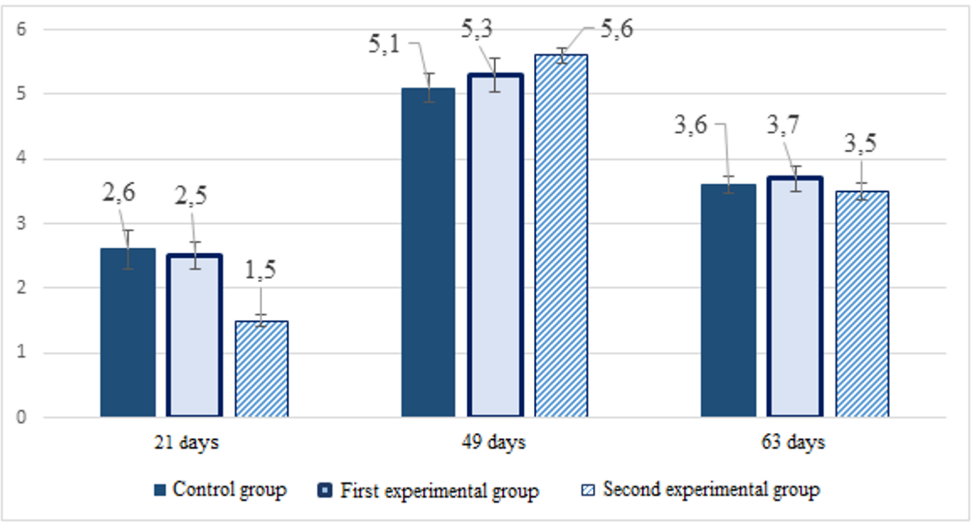

Fig. 2. Total bilirubin content in the blood serum of experimental goslings, mmol/l.

On the 21st day of rearing, the bilirubin level in the blood serum of goslings of the control group was 2.6±0.29 mmol/l, which exceeded the values of the experimental groups by 4.0% and 73.3%, respectively ($p<0.01$).

A significant increase in the bilirubin content in the blood serum of goslings can be traced on the 49th day of rearing compared with the age of 21 days, so in the blood serum of the intact group of goslings, the bilirubin level increased by 96.2% and in the experimental groups by 2.1 and 3.7 times, respectively.

By the end of the scientific and economic experiment, the highest bilirubin content was found in the first experimental group of 3.7 ±0.11 mmol/l, which exceeded the analog values of the control group by 2.8% and the second experimental group by 5.7%.

Thus, the dynamics of bilirubin content in the blood serum of experimental goslings has its own age characteristics, which were pronounced and manifested by a maximum level at the age of 49 days, followed by a decrease by the age of 63 days, while remaining at a level higher than at the age of 21 days.

Figure 3 shows the dynamics of glucose content in the blood serum of goslings by rearing period.

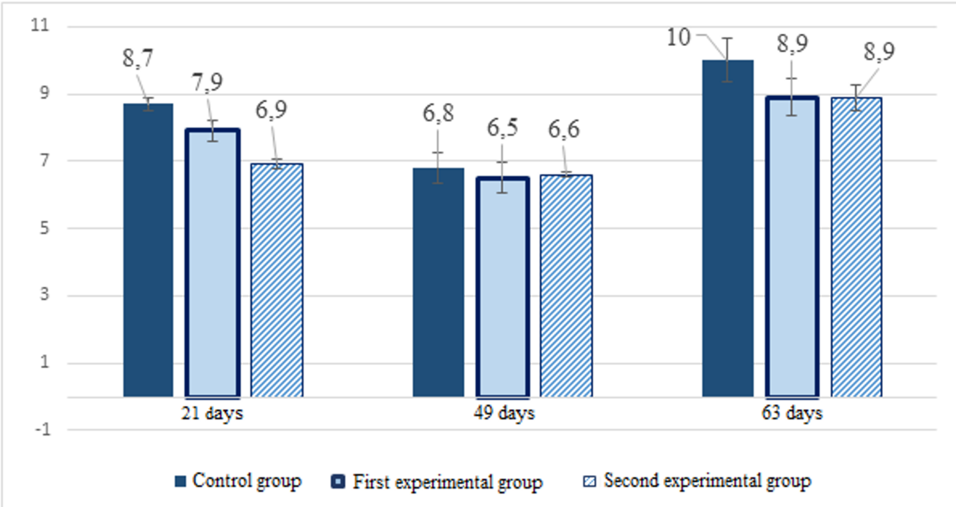

Fig. 3. Glucose content in blood serum of experimental goslings, mmol/l.

As can be seen from the data in Figure 3, at three weeks of age, the glucose content was highest in the control group of goslings - 8.7±0.19 mmol/l, which exceeded the same indicator of the group in which the probiotic Bacispecin was used by 10.1% and 26.1% ($p<0.05$) more than in the second experimental group of goslings with probiotic MK.

By the age of 49 days, the glucose in the blood serum of the goslings of the intact group reached the level of 6.8±0.29 mmol/l, which is higher than the experimental groups by 4.6% and 3.0%, respectively.

The results of a biochemical study of blood serum allow to conclude that in all experimental groups the highest concentration of glucose in the blood serum was found on the 63rd day of rearing goslings. At the same time, the goslings of the intact group had 12.3% more glucose compared with the experimental groups of goslings.

The indicators of age-related variability of the urea content in blood serum are shown in Figure 4.

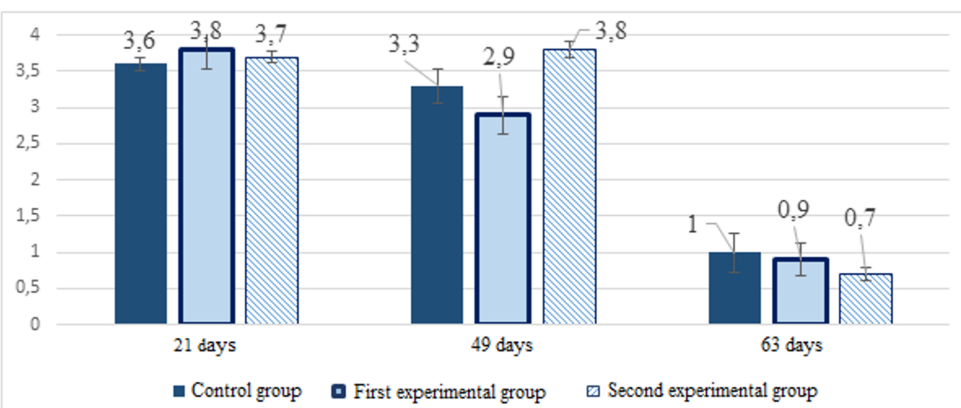

Fig. 4. Age-related variability of urea content, mmol/l.

The analysis of the age-related variability of urea content demonstrates a tendency to decrease its concentration from the age of 21 to 63 days. At the same time, the most significant decrease was observed in the period from the 49th to the 63rd day of cultivation, when the urea content decreased in all the studied groups by more than three times.

The analysis of intergroup differences at 21 days of age is insignificant, with a slight predominance of content in the experimental groups by 5.6% and 2.8%, respectively.

At 49 days of age, the highest urea content was found in the group of goslings treated with MK - 3.8 mmol/l, which is 15.1% more than in the control group and 31.0% more than in the first experimental group.

For the entire period of scientific and economic experiment, the lowest concentration of urea in the blood serum of goslings of experimental groups was established on the 63rd day. In the blood serum of goslings of the control group, the urea level was 1.0±0.07 mmol/l, in the first experimental group the urea content was 0.9±0.11 mmol/l, which is 11.1% less; in the second experimental group, the urea level was 42.9% less ($p<0.05$) in the intact group.

Table 2. Correlation coefficients between indicators.

Indicator	Group		
	control	first experimental	second experimental
Urea - Average daily increase	0.39	0.94***	0.44
Bilirubin - Average daily increase	-0.91**	-0.53	-0.88**
Glucose - Urea	-0.74	-0.60	-0.99***
Bilirubin - Glucose	-0.68	-0.65	-0.13
Bilirubin - Urea	0.01	-0.22	0.04
Glucose - Average daily increase	0.33	-0.30	-0.35

*Note: statistical reliability of the correlation coefficient at ** $p < 0.05$; *** $p < 0.001$.*

The results of the correlation analysis give an understanding that goslings of all the studied groups are characterized by a positive correlation between the average daily increase and the content of urea in the blood serum. At the same time, in the group of goslings treated with the probiotic Bacispecin, this relationship was strongly positive (0.94) ($p<0.001$), whereas in the control and second experimental groups it was moderate (0.39–0.44).

In all experimental groups, the correlation between the average daily increase and the bilirubin content is negative, in the first experimental group this power is average (-0.53), and in the control (-0.91) ($p<0.001$) and the second experimental (-0.88) ($p<0.001$) it is strong.

The nature of the correlation between glucose and urea levels in all experimental groups is negative, from average power (-0.60) in the first experimental group, strong in the control group (-0.74), to close to functional (-0.99) ($p<0.001$) in the second experimental group of goslings.

The average negative relationship between glucose and bilirubin levels in the control (-0.68) and the first experimental (-0.65) groups of goslings should also be noted. As well as a moderate negative relationship in the first experimental (-0.30) and the second experimental (-0.35) groups of goslings between the glucose content and the average daily gain.

4 Conclusions

Based on the results of our scientific and economic experimente, the importance of using feed additives based on live cells and spores of the Paenibacillus ehimensis strain IB 739 and the probiotic MK has been shown. This thesis is supported by a significant difference in the live weight of goslings at the end of the scientific and economic experiment. Goslings receiving the probiotic feed additive Bacispecin with the basic diet weighed 3330±107.53 by the 63rd day of rearing and significantly exceeded the weight of goslings of the control group by 10.9% ($p<0.05$). The introduction of a probiotic based on lactic acid bacteria into the main diet of the goslings of the second experimental group made it possible to trace the growth trend, as the weight of the goslings was higher by 0.27% compared to the intact group. The results of biochemical analysis of the blood serum of goslings allowed to establish the highest concentration of bilirubin on the 49th day of rearing, while in the experimental groups of goslings the bilirubin content was higher than in the control group by 3.9% and 9.8%, respectively. By the 63rd day of rearing, glucose in the blood serum of goslings of the control group was 10.0±0.14 mmol/l, which is 12.3% higher than the value of the experimental groups. During the same period, a significant difference in urea content was noted, so in the control group, the urea level was 1.0±0.07 mmol/l, which is 11.1% and 42.9% higher than the same value in the experimental groups ($p<0.05$), respectively. The goslings of the experimental groups are characterized by a positive correlation between the average daily increase and the content of urea in the blood serum, so in the group of goslings treated with the probiotic Bacispecin, this relationship is strongly positive (0.94) ($p<0.001$). On the contrary, the nature of the correlation between the average daily increase and the bilirubin content, and between the glucose and urea content in all experimental groups is negative. Thus, in the control and in the second experimental group, a strong power was established, which is (-0.91) ($p<0.001$) and (-0.88) ($p<0.001$), respectively.

References

1. I.N. Rozhkova, K.O. Kopytina, O.A. Manzhurina, et al., *The effect of the preparation Profort on the morphological and biochemical parameters of the blood of turkeys of the Hybrid converter cross*, Veterinary Pharmacological bulletin, **3(12),** 89-97 (2020) (in Russ).
2. S.V. Mezentseva, M.V. Lazareva, L.N. Statsevich, *The effect of the feed additive Biocalcium on the biochemical status of quail blood,* Bulletin of NGAU, **4(65),** 153-159 (2022) (in Russ).
3. V.E. Podolnikov, M.V. Podolnikov, L.N. Gamko, et al., *Productive qualities and morpho-biochemical composition of blood in young birds when Humic substances are used in their diets*, Bulletin of the Bryansk State Agricultural Academy, **3(103),** 31-36 (2024) (in Russ).
4. R.A. Tuzikov, S.V. Lebedev, A.E. Arinzhanov, et al., *Studying the effect of probiotics on the productive and hematological parameters of the blood of broiler chickens*, Animal husbandry and feed production, **105(4),** 195-207 (2024) (in Russ).
5. R. Fairushin, S. Shakirova, R. Ganieva, et al., *Effectiveness of bacillus subtilis (vitafort) probiotic used for raising broiler chickens*, Medycyna Weterynaryjna, **78(2),** 1-5 (2022).
6. A. Khabirov, R. Avzalov, G. Tsapalova, et al., *Effect of a probiotic containing lactobacilli and bifidobacteria on the metabolic processes, litter microbiocenosis, and production indicators of broiler pekin ducklings*, Veterinary World, **15(4),** 998-1005 (2022).
7. G.R. Tsapalova, A.F. Khabirov, R.Kh. Avzalov, et al., *Physiological basis of probiotics use for growing gees*, American Journal of Animal and Veterinary Sciences, **17(4),** 258-266 (2022).
8. E. Kochkina, A. Andreeva, A. Torshkov, et al., *Metabolic response of broiler chickens to different doses of Enterococcus faecium ICIS 96 in the diet,* Canadian Journal of Veterinary Research, **88(1)** 19-23 (2024).

9. E.O. Alonge, D. Eruvbetine, O.M.O. Idowu, et al., *Comparing the effect of supplementary antibiotic, probiotic, and prebiotic on carcas composition, Salmonella counts and serotypes in dropping and intestine of broiler chicken,* Poultry Science Journal, **5(1),** 41-50 (2017).
10. G.M. Nava, L.R. Bielke, T.R. Callaway, *Probiotic alternatives to reduce gastrointestinal infections: the poultry experience*, Animal Health Research Reviews, **6,** 105-118 (2005).
11. Z. Zduńczyk, J. Jankowski, S. Kaczmarek, *Determinants and effects of postileal fermentation in broilers and turkeys part 1: gut microbiota composition and its modulation by feed additives*, World's Poultry Science Journal, **71,** 37-48 (2015).
12. J. Hu, H. Chen, H-W. Cheng, *Effect of Direct-fed Microbials Bacillus subtilis, on Production Performance, Serotonin Concentrations and Behavioral Parameters in a Selected Dominant Strain of White Leghorn Hens*, International Journal of Poultry Science, **17(3),** 106-115 (2018).
13. A. Mujnisa, L. Gustina, A.N. Dosage, et al., *Effects of Lactococcus lactis ssp. lactis 2 as a Probiotic on the Percentage of Carcass, Abdominal Fat Content and Cholesterol Level in Broilers,* International Journal of Poultry Science, **17(2),** 100-105 (2018).
14. S. Heon Chung, J. Lee, Ch. Kong, *Effects of Multi Strain Probiotics on Egg Production and Quality in Laying Hens Fed Diets Containing Food Waste Product,* International Journal of Poultry Science, **14(1),** 19-22 (2015).
15. A.K. Molnár, B. Podmaniczky, P. Kürti, et al., *Effect of different concentrations of Bacillus subtilis on growth performance, carcase quality, gut microflora and immune response of broiler chickens*, British Poultry Science, **52(6),** 658-665 (2011).
16. A.L. Wealleans, M. Sirukhi, I.A. Egorov, *Performance, gut morphology and microbiology effects of a Bacillus probiotic, avilamycin and their combination in mixed grain broiler diets*, British Poultry Science, **58(5),** 523-529 (2017).
17. A.A. Alaqil, A.O. Abbas, H.S. El-Beltagi, et al., *Dietary supplementation of probiotic Lactobacillus acidophilus modulates cholesterol levels, immune response, and productive performance of laying hens,* Animals, **10(9),** 1-12 (2020).
18. A. Alkhalf, M. Alhaj, I. Al-Homidan, *Influence of probiotic supplementation on blood parameters and growth performance in broiler chickens*, Saudi journal of biological sciences, **17(3),** 219-225 (2010).
19. S.P. Bai, A.M. Wu, X.M. Ding, et al., *Effects of probiotic-supplemented diets on growth performance and intestinal immune characteristics of broiler chickens*, Poultry science, **92(3),** 663-670 (2013) doi: 10.3382/ps.2012-02813
20. G.T. Cao, X.F. Zeng, A.G. Chen, et al., *Effects of a probiotic, Enterococcus faecium, on growth performance, intestinal morphology, immune response, and cecal microflora in broiler chickens challenged with Escherichia coli K88,* Poultry science, **92(11),** 2949-2955 (2013) doi:10.3382/ps.2013-03366
21. A.A. El-Sawah, S.M. Aboelhadid, E.N. El-Nahass, et al., *Efficacy of probiotic Enterococcus faecium in combination with diclazuril against coccidiosis in experimentally infected broilers,* Journal of applied microbiology, **129(4),** 1020-1028 (2020) doi:10.1111/jam.14691.