Journal of Engineering and Applied Sciences 15 (6): 1341-1345, 2020
ISSN: 1816-949X

The Effect of Probiotics on the Natural Resistance and Quality of Chicken Meat

[1]Sergey Y. Smolentsev, [1]Irina I. Strelnikova, [2]Leysan F. Yakupova, [2]Nikita V. Nikolaev, [2]Ali K. Volkov, [2]Mohamed K. Dandravi, [2]Ksenia V. Muraveva, [2]Dmitry P. Hadeev, [3]Marina S. Gugkaeva, [3]Radion Kh. Gadzaonov, [3]Soslan G. Kozyrev, [3]Tatiana I. Agaeva, [3]Aza A. Urtaeva, [4]Ivan S. Ivanov and [4]Marina S. Kulikova
[1]Mari State University, Lenin Square 1, 424000 Yoshkar-Ola City, Russia
[2]Kazan State Academy of Veterinary Medicine by N.E. Bauman, Sibirsky Tract 35, 420029 Kazan City, Russia
[3]Gorsky State Agrarian University, Kirovastreet 37, 362040 Vladikavkaz City, Russia
[4]Izhevsk State Agricultural Academy, Studencheskaya Street No. 11, 426069 Izhevsk City, Russia

Abstract: The poultry industry is one of the most important components of the agroindustrial complex of Russia which was created as a comprehensive integrated system that provides all the processes from poultry reproduction to the production of finished products and its implementation. Currently, the Ministry of Agriculture of the Russian Federation has approved the program of "Development of Poultry Farming in the Russian Federation for the Period from 2018-2020". The program is aimed at facilitating the solution of Russia's strategic goal: ensuring the competitive development of Russia's agroindustrial complex, reviving the Russian countryside and ensuring the food security of the state. We have studied the effect of the Prolam and Monosporin probiotics on the body of laying hens. The studies were conducted in the conditions of the poultry farm of ZAO Mariyskoye in the Medvedevsky district of the Republic of Mari El. From the first day of life, the Prolam probiotic was added to the birdseed of the group 1 at the rate of 0.1 mL/chicken and the group 2 received Monosporin at the rate of 0.03 mL/chicken. The studies have shown that the probiotics activate the processes of erythropoiesis and leukocytosis, stimulate non-specific resistance factors. The average daily gain in live weight of young chickens on the 56, 70-day of the experiments in relation to the control was significantly higher by 3.60 and 3.07% and in the second experimental group by 4.92 and 5.92%. Organoleptic and biochemical parameters of meat of experimental groups of birds met the requirements of SanPin 2.3.2.1078-01 "Hygienic requirements for safety and nutritional value of food products". The introduction of the Prolam and Monosporin probiotics into the main diet during the rearing of young chickens, depending on age characteristics, increased the safety of young chickens by 3.1-3.4%.

Key words: Chickens, probiotics, poultry meat quality, blood counts, egg productivity, body resistance

INTRODUCTION

In modern conditions of poultry farming, much attention is paid to the maximum saving of the young chickens obtained and increase in its productivity (Khristoforovich *et al*., 2016; Smolentsev *et al*., 2018). The high concentration of the livestock in limited areas, the year-round in-cage stay of the fowl indoors leads to a violation of the microclimate, weakening of the constitution and health of the fowl (Semenov *et al*., 2018). This is accompanied by a decrease in physiological reactivity and natural resistance of the body, metabolic disorders, decreased productivity and safety, increased aggressiveness and the production of stress hormone, which have a negative effect on the body, especially, of young birds (Egorov *et al*., 2018). An urgent problem in the poultry industry is to increase the hatchability, viability, safety, productivity and resistance of young chickens to pathogens of infectious and invasive diseases using modern environmentally friendly means (Matveeva *et al*., 2015; Dmitriyevich *et al*., 2016; Ilyasovich *et al*., 2016).

World experience shows that substitution therapy aimed at restoring the intestinal biocenosis by introducing live bacteria with water or food into the gastrointestinal tract is becoming increasingly important in solving these problems (Popov *et al*., 2018; Tsaregorodtseva *et al*., 2019). Displacing pathogenic microflora from the intestine, they do not affect representatives of the normal intestinal microflora and contribute to the normalization of digestion. Preparations containing such bacteria are called probiotics (Valiullin *et al*., 2017; Samsonov *et al*., 2018). These include probiotics, created on the basis of spore-forming and lactic acid bacteria for Monosporin and Prolam made by the Biotechagro LLC.

Corresponding Author: Leysan F. Yakupova, Kazan State Academy of Veterinary Medicine by N.E. Bauman, Sibirsky Tract 35, 420029 Kazan City, Russia

The purpose of the research is to study the effect of the Prolam and Monosporin probiotics on the morphological, biochemical, immunological status, productive qualities and nutritional value of broiler chicken meat.

MATERIALS AND METHODS

The experimental part of the research was carried out in the period from 2017-2018 by the CJSC Mariyskoye in the Medvedevsky district of the Republic of Mari El. Further study and processing of materials was carried out in the Republican Veterinary Laboratory. The objects of research were chickens from one to 120 days old age of the Konkurent cross, obtained from different aged broodstock taken in separate phases of the period of maximum productivity. The conditions for keeping and feeding the birds were the same. The fowl was fed with complete feeds balanced in terms of the content of basic nutrients.

To identify the influence of the Monosporin and Prolam probiotics on physiological, morphological, immunological parameters, safety, growth, development and productivity of young chickens, three groups were formed on the basis of analogues (1 control and 2 experimental) of 2000 chickens each. From the first day of life, the Prolam probiotic was introduced into the diet of young chickens of the group 1 at the rate of 0.1 mL/chicken, starting from 1-14, from 22-28 and 36-42 days and in the experimental group 2 Monosporin probiotic at a dose of 0.03 mL/animal. According to a similar pattern. Young birds of the control group were not fed with these probiotics.

The number of red blood cells and white blood cells was determined with the Goryayev hemocytometer and the hemoglobin level defined with a Sahli hemoglobinometer. The lysozyme activity of blood plasma was determined using a daily agar culture of *M. Lysodeiticus*, strain ML-43-29-1, the phagocytic activity of neutrophils using a daily agar culture of *St. aureus* strain 0-55, bactericidal activity of blood serum using a daily culture of *E. coli*. The growth dynamics of birds was determined by weighing them every 10 days, the egg productivity of young birds was determined by comparative analysis of the products obtained in the experimental and control groups within the period of the experiments. Examination of meat of young chickens was carried out in accordance with GOST 7269-79 "Methods of sampling and organoleptic methods for determining freshness". The meat was evaluated by organoleptic (smell, degree of bleeding, consistency) and biochemical parameters (meat pH, reaction to peroxidase, amino-ammonia nitrogen as well as reactions with formalin and copper sulfate).

RESULTS AND DISCUSSION

On the first day of using these probiotics, the number of red blood cells and leukocytes in the blood of chickens was approximately the same in both control and experimental groups (Table 1).

At the age of fifteen days in the first and second experimental groups of chickens, compared with control analogues, a significant increase in the number of red blood cells in the blood was 2.75% ($p<0.05$) and 3.10% ($p<0.01$), hemoglobin -2.94 and 4.11% ($p<0.01$) white blood cells: 1.68 and 1.84%, however with biometric processing of digital values, the latter were statistically unreliable. Similar significant changes in the indicated blood parameters of the experimental groups chickens towards their growth, relative to the control counterparts with the use of the Prolam and Monosporin probiotics were observed on the 30th and 60th day of experiments, on average 2.08-4.36% ($p<0.05$, $p<0.01$). The maximum increase in hematological parameters was established in the blood of chickens of the second experimental group, against the background of the use of the Monosporin probiotic.

As it is known, the developmental biology of broiler chickens has its own peculiarities. The use of probiotics in different age cycles contributed to the activation of the natural resistance of young chickens throughout the entire period of experiments in chickens and experimental groups at different age periods (15, 30, 45, 60 day). The

Table 1: The effect of the Prolam and Monosporin probiotics on the morphological parameters of young chickens

	Group of young chickens		
Age (day)/Indicator	Control	Prolam experimental 1	Monosporin experimental 2
15			
Erythrocytes (10^{12} L^{-1})	2.900±0.07	2.98±0.11*	2.99±0.09**
White blood cells (10^{9} L^{-1})	19.59±0.17	19.92±0.22	19.95±0.11
Hemoglobin (g L^{-1})	85.00±0.99	87.50±0.44**	88.50±0.69**
30			
Erythrocytes (10^{12} L^{-1})	3.050±0.04	3.16±0.02*	3.17±0.01**
White blood cells (10^{9} L^{-1})	21.13±0.03	21.57±0.16	21.73±0.28
Hemoglobin (g L^{-1})	86.80±0.88	89.90±0.19**	90.50±0.19**
60			
Erythrocytes (10^{12} L^{-1})	3.110±0.03	3.20±0.07**	3.23±0.01**
White blood cells (10^{9} L^{-1})	23.95±0,21	24.39±0.28	24.47±0.20
Hemoglobin (g L^{-1})	89.30±2.14	92.30±1.67**	93.20±1.54**

*p<0.05; **p<0.01

indicators of bactericidal activity of blood serum in the first experimental group, compared with control analogues, were significantly higher on average by 3.25-5.03% ($p<0.05$), lysozyme by 3.17-4.60% ($p<0.05$) and phagocytic blood activity by 3.8-5.02% ($p<0.05$), respectively. In the second experimental group, these indicators were: bactericidal activity of 3.52-5.46% ($p<0.05$), lysozyme activity of 3.67-4.73% ($p<0.05$) and phagocytic activity of blood of 3.96-5.82%. In the second experimental group of chickens, the indicators of non-specific resistance of blood serum when using Monosporin were slightly higher than in the first experimental group on average by 1.06, 1.8 and 2.14%.

The growth and development of young birds is considered the main indicator of the state of health and productivity. At the age of 1 day, the live weight of chickens did not have a significant difference. The average daily gain in live weight of chickens in the control and experimental groups at the age of a week had no noticeable differences and varied at the level of 3.68-3.77 g. At 2 weeks of age, the chickens of the experimental group 1 where the Prolam probiotic was added to the diet, compared with control peers, the average daily weight gain was higher on average by 1.96% and in the experimental group 2 where the Monosporin probiotic was used, this indicator was higher by 3.13%, however without any statistical significance. High, uniform and reliable gains in live weight of chickens, both in the control and in the experimental groups of young chickens were observed starting from the 56, 70 day old age cycle. In the indicated periods of their development, this indicator fluctuated at the level of 8.33-8.78 g (control group), 8.63-9.05 g (experimental group 1) and 8.74-9.3 g (experimental group 2). So, in the 56 and 70 day age cycle in the first experimental group of young chickens, against the background of the use of the Prolam probiotic, the average daily weight gain was significantly higher by 3.60 and 3.07% ($p<0,05$) compared with control analogues and in the second experimental group of birds by 4.92 and 5.92% ($p<0.01$), respectively. The most characteristic and intense growth promoting effectiveness of these probiotics was in the experimental groups in relation to the 84, 98 and 112 day old control peers. So, in the first experimental group, the reliable average daily weight gainin the indicated periods of development of the birds was characterized by an average of 3.74, 4.07 and 4.62% ($p<0.01$) and in the second experimental group it was 6.38, 6.75 and 7.25%. The introduction of the Prolam and Monosporin probiotics into the main diet of chickens had a positive effect on the egg production of laying hens.

Analysis of the data given in Table 2 indicates that the egg production of laying hens in the control and experimental groups was significantly different. So, the egg production on the initial laying hen in the control group was 133 and in the experimental groups 141 and 142 pieces, i.e., significantly higher by 6.01 and 6.76% ($p<0.01$). This indicator calculated on the average laying hen in the experimental groups with respect to the control one was significantly higher on average by 7.10 and 7.80% ($p<0.01$).

Laying hens of the control group reached 50% egg production at their age of 161 days at the same time, this indicator in the first experimental group of laying hens was 155 days and 151 days in the second one. The maximum egg productivity in the main livestock of laying hens of the experimental group 1 was observed after reaching the age of 192 days and 190 days in the experimental group 2. At the same time, in laying hens of the control group, this indicator was manifested only at the age of 202 days. The age of achievement of the highest egg productivity in birds of the experimental groups, compared with the control, was reduced by 10-12 days, respectively with the use of the Prolam and Monosporin probiotics. Physico-chemical indicators of egg quality are presented in Table 3.

The activity of hydrogen ions (pH) of eggs makes it possible to determine the reaction of egg white and yolk which is important for the course of biological processes. The yolk of an egg having ionic properties, usually has a slightly acidic (normal pH 5.7-6.3) reaction of the medium and an egg white, slightly alkaline (normal pH 8.0-9.0). In our studies, the activity of hydrogen ions of the yolk and protein did not go beyond the normative indicators. An important indicator of the degree of lipid breakdown in a fresh egg is an acidic number, normally it should not exceed 5 mg per 1 g of yolk and 8 mg per 1 g of egg-white. The data obtained in our studies show that the introduction of probiotics did not adversely affect the processes occurring in the yolk and egg-white. The solids content in the egg was determined by the readings of the

Table 2: Indicators of egg production of laying hens when using the Prolam and Monosporin probiotics

	Group of laying hens				
Indicator	Control	Experimental 1	Control (%)	Experimental 2	Control (%)
The number of laying hens in the experiment, heads	500	500	100	500	100
Gross production of eggs for the experiment period (90 days), pcs.	70500	75500	107.09	76000	107.80
Egg production per initial laying hen, pcs.	133	141	106.01	142	106.76
Egg production per average laying hen, pcs.	141	151	107.10	152	107.80
Egg production intensity (%)	78.3	83.8	—	84.4	—
Age of laying hens which have reached 50% of egg production, a day	161	155	96.27	151	93.78
Age of laying hens which have reached the peak of egg production a day	202	192	95.04	190	94.06

Table 3: Physico-chemical indicators of egg quality with the use of Prolam and Monosporin probiotics

	Indicator		
Group	pH	Refractive index	Acid number (mg) KOH
Control			
Egg-white	8.76±0.22	1.350±0.01	7.20±0.11
Yolk	5.88±0.30	1.416±0.02	5.00±0.08
Experimental 1			
Egg-white	8.68±0.22	1.365±0.01	7.18±0.12
Yolk	6.14±0.16	1.414±0.04	4.89±0.15
Experimental 2			
Egg-white	8.84±0.16	1.360±0.03	7.27±0.22
Yolk	6.22±0.18	1.419±0.04	4.77±0.18

Table 4: Biochemical parameters of young chickens meat

	Group		
Indicator	Control	Experimental 1	Experimental 2
Peroxidase response	Positive	Positive	Positive
Primary protein breakdown products	Negative	Negative	Negative
Meat pH	5.73±0.15	5.82±0.18	5.84±0.18
Amino ammonia nitrogen (mg)	0.78±0.06	0.88±0.04	0.86±0.06
The reaction with copper sulfate	Negative	Negative	Negative
Formalin probe	Negative	Negative	Negative

refractive index of the egg-white and yolk. The average values of the refractive index of the egg-white are 1.350-1360, yolk 1.416-1.414. The data we received are in line with the norm. The effect on the quality of meat and egg productivity is an important indicator when biologically active substances are introduced into the main diet of birds. In this regard, we carried out a veterinary sanitary examination of meat and eggs of experimental chickens. Veterinary and sanitary inspection of the young chickens carcasses in the control and experimental groups showed that they were well bloodless without any residues of fluff and feather. The appearance and color of the surface of the carcasses had a drying crust, the muscles in the section were moist did not leave spots on the filter paper. The cut meat samples of the experimental and control groups of birds were of dense consistency, elastic when pressed with a finger, the dimple leveled quickly. During cooking, the broth was fragrant, transparent. On the surface, there was an accumulation of fat droplets. Foreign odors were absent. Our studies suggest the suitability of all meat samples for food purposes. For the most detailed study of the poultry meat quality, we conducted biochemical studies which are presented in Table 4.

The reaction to peroxidase in the samples of the control and experimental groups was positive which indicates the activity of the enzyme muscle tissue peroxidase and characterizes the meat as benign. Negative reactions with copper sulfate, the formalin reaction and meat pH of 5.73±0.15 -5.84±0.18 of all samples confirm the absence of primary protein breakdown products in the broth and its high nutritional value. The dry matter content in the meat samples of the experimental groups, compared with the control analogues was significantly higher by 1.72% ($p<0.05$) and 1.98% ($p<0.01$) in the experimental group 2. The calculation per 100 g of dry matter indicates that a higher protein content was observed in the experimental group 1 by 1.35% ($p<0.05$) and by 2.63% ($p<0.01$) in the experimental group 2.

CONCLUSION

The results obtained indicate that the Prolam and Monosporin probiotics have a positive effect on the development processes of young birds. The revealed complex of physiological, morphological, biochemical and immunological changes in the body of young chickens expands knowledge in the field of veterinary science and practice, allows to improve the technology of growing young poultry, to more fully realize the potential for the use of nutrients of feed and to improve the quality of meat and egg products. To activate nonspecific resistance, to increase the rate of gain in live weight, preserve young chickens, to increase meat and egg productivity, we recommend introducing the Prolam probiotics into the main diet from day 1-42 with a week break of 0.1 mL/chicken per day and Monosporin according to the same scheme at a dose of 0.03 mL/ chicken.

REFERENCES

Dmitriyevich, C.E., O.A. Vladimirovich, R.A. Leonidovich, H.L. Valeryevna and N.C. Sergeevna *et al*., 2016. The Russian heavy draft milk type mares characteristics. Res. J. Pharm. Biol. Chem. Sci., 7: 1930-1933.

Egorov, V.I., S.Y. Smolentsev, L.R. Valiullin, V.V. Biryulya and A.A. Nabatov *et al*., 2018. Toxicity indices of uracil derivatives on lung epithelial cells. Indian Vet. J., 95: 33-36.

Ilyasovich, S.E., T.A. Mikhailovna, S.V. Rasimovich, S.S. Yurievich, S.F. Akhmadullovich, P.K. Khristoforovich and T.M. Yakovlevich, 2016. Efficiency of application of a polysaccharide enterosorbent of «Fitosorb» for prevention of the combined mycotoxicosis. Res. J. Pharm. Biol. Chem. Sci., 7: 2229-2237.

Khristoforovich, P.K., K.I. Ravilevich, S.V. Rasimovich, T.M. Yakovlevich and T.A. Mikhailovna *et al*., 2016. Cytomorphological changes hepatorenal system combined with fever poisoning xenobiotics. Res. J. Pharm. Biol. Chem. Sci., 7: 2214-2221.

Matveeva, E.L., V.P. Korosteleva, E.K. Papynidi, G.R. Yusupova and S.Y. Smolentsev, 2015. Electron microscopic evaluation of the impact on microorganisms of quaternary ammonium compounds. Res. J. Pharm. Biol. Chem. Sci., 6: 207-209.

Popov, S.V., I.I. Kalyuzhny, S.Y. Smolentsev, D.H. Gataullin and V.I. Stepanov *et al*., 2018. Acid-base homeostasis indices upon electric neurostimulation therapy of calves with acute pulmonary pathologies. Res. J. Pharm. Biol. Chem. Sci., 9: 553-556.

Samsonov, A.I., E.I. Semenov, E.M. Plotnikova, S.Y. Smolentsev, A.I. Nikitin, K.K. Papunidi and M.Y. Tremasov, 2018. Mink farming and my cotoxicosis. Indian Vet. J., 95: 52-55.

Semenov, E.I., N.N. Mishina, S.A. Tanaseva, I.R. Kadikov and A.M. Tremasova *et al*., 2018. Systemic anaphylaxis due to combined mycotoxicosis in Wister rats. Indian Vet. J., 95: 16-19.

Smolentsev, S.Y., E.N. Poltaev, L.E. Matrosova, E.L. Matveeva and A.E. Ivanova *et al*., 2018. Stimulation of Rumen Microflora in cattle by using Probiotic concentrate. Res. J. Pharm. Biol. Chem. Sci., 9: 948-950.

Tsaregorodtseva, E.V., S.Y. Smolentsev, T.V. Kabanova, S.I. Okhotnikov and E.G. Shuvalova *et al*., 2019. Sheep breeding for dairy herd, composition and technological properties of raw milk. Res. J. Pharm. Biol. Chem. Sci., 10: 1772-1780.

Valiullin, L.R., I.I. Idiyatov, V.I. Egorov, V.R. Saitov and K.K. Papunidi *et al*., 2017. A study into the safety of novel bioresorbable matrices for repairing bone tissue defects. Bali Med. J., 6: 327-330.1