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The influence of probiotic on the biochemical status of young pigs

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ABSTRACT

Nowadays the fact of positive effects of new environmentally friendly and at the same time highly effective probiotic, antibacterial drugs on the body of young pigs attract particular attention of scientists. One of such drugs is sporobacterin. The aim of this study is to determine the influence of this drug on the physiological, morphological, and biochemical status of young pigs. The research was carried out on a pig farm «Ozerny» in the Republic of Tatarstan, Russia. The objects of the research were 75 one-day-old large white piglets, each weighing 1.1–1.2 kg. The young pigs were divided into three groups. Every day for 30 days the piglets of the first experimental group were given sporobacterin liquid at a dose of 0.2 ml/h, and a dose of 0.5 ml/h was administered to the second experimental group. The animals of the control group were on a basic diet. The study has shown that the administration of sporobacterin liquid at a dose of 0.2 and 0.5 ml/h induced high physiological activity. Morphological and biochemical blood composition in piglets of the experimental groups had improved by the age of 60 days. The total protein level in the serum of piglets increased by 8.95% and 8.98%; albumin, 6.13% and 7.37%; globulin, 10.79% and 11.43%; and gamma globulin, 27.74%, and 28.05%. The dose of 0.5 ml/h was more effective on average by 0.75%.

Keywords: probiotic, sporobacterin, morphological and biochemical status, blood parameters and blood serum of piglets
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INTRODUCTION

At present, various feed antibiotics and hormones are widely used in large pig farms. They adversely affect the resistance of animals and the quality of products. In this regard, scientists have been studying the positive effects of new environmentally friendly and highly effective probiotic, antibacterial drugs on the body of young pigs. One of these drugs which have been developed in scientific association «Bakoren» (Orenburg, Russia) is sporobacterin liquid.

The aim of the study is to define zootechnical and veterinary benefits from the use of sporobacterin in growing pigs. The task to study the influence of this drug on the physiological, morphological, and biochemical status of young pigs was given by the governing body of «Bakoren».

MATERIALS AND METHODS

The research on the impact of sporobacterin on the physiological, morphological, and biochemical indicators of blood and blood serum of animals was conducted in winter, spring, and summer on a large pig farm «Ozerny» in the Republic of Tatarstan, Russia. It lasted 90 days.

The objects of the research were 75 healthy, well-developed one-day-old large white piglets, each weighing 1.1–1.2 kg. The animals were divided into three groups (a control and two experimental ones). There were 25 pigs in each group. Animals of the experimental and control groups were kept in the same zoohygienic conditions and fed in accordance with existing standards.[2,5,6] For 30 days, the piglets of the first experimental group were given sporobacterin liquid at a dose of 0.2 ml/h, and the animals of the second experimental group were given a dose of 0.5 ml/h. The animals of the control group were on a basic diet. The experiment lasted until the young pigs reached the age of 90 days.

To carry out the research, the following methods were used:[4,10]

- clinical and physiological methods—to define physiological parameters (body temperature, pulse rate, and respiration rate) in the control and experimental groups with methods generally accepted and approved in veterinary medicine;
- zoohygienic method—to define the temperature and relative humidity in the pigsties with a modern multipurpose device "TKA-PKM" (model 42), the air velocity was measured with thermo-anemometer "TKA-PKM" (model 50), the concentration of carbon dioxide was measured according to Subbotin, the amount of ammonia was measured with a universal gas analyzer UG-2;

- hematological method—to count blood cells: the number of red blood cells and white blood cells was counted in the Goryaev counting chamber as well as the level of hemoglobin with a blood cell count;
- biochemical method—to examine blood serum of animals: the total protein with Refractometer IRF-454B2M, and individual proteins with turbidimetry.

Sporobacterin liquid is a suspension of Bacillus subtilis 534. This is one of the first representatives of a new group of probiotic antibacterial drugs. Its development became possible after the discovery of a previously unknown defense mechanism of warm-blooded animals against infections. The manufacturing methods and the composition of drugs are protected by the patents of the Russian Federation. This drug is approved for use in medical and veterinary practice to prevent and treat enteritis, dysbacteriosis, and other diseases of the gastrointestinal tract of young animals.

In animals, spore-forming bacteria of Bacillus subtilis 534 isolate antimicrobial substance of protein nature that prevents the development of pathogenic and opportunistic pathogenic bacteria and fungi: Staphylococcus, Streptococcus, Escherichia, Proteus, Klebsiella, Salmonella, Shigella, Candida fungi, non-clostridial anaerobes, clostridia, yeasts, actinomycetes, and so on. These bacteria also produce proteolytic enzymes improving protein digestibility on average by 4%, fat by 6%, and fiber by 10.7%. Moreover, the absorption of minerals is improved by 7.3%, and nitrogen absorption was improved by 9.3%. Bacteria secrete an immunomodulator which provides anti-allergic effects and synthesizes essential amino acids. The shelf life of the drug is 2 years.[8]

Table 1 **Basic physiological parameters of young pigs when using sporobacterin**

Indicators	Age, days	Control group (BD)	First experimental group (BD + sporobacterin, 0.2 ml)	Second experimental group (BD + sporobacterin, 0.5 ml)
Body temperature, °C	1	39.6 ± 0.05	39.4 ± 0.05	39.5 ± 0.06
	15	39.5 ± 0.05	39.8 ± 0.04*	39.9 ± 0.06*
	30	39.4 ± 0.03	39.6 ± 0.03*	39.7 ± 0.06*
	60	39.5 ± 0.06	39.9 ± 0.03*	39.9 ± 0.05*
Pulse rate, Bpm	1	228.0 ± 1.50	230.0 ± 1.50	229.0 ± 1.44
	15	111.0 ± 1.50	120.0 ± 1.26*	121.0 ± 1.67*
	30	74.0 ± 3.50	93.0 ± 2.93	95.0 ± 3.53
	60	71.0 ± 0.63	76.0 ± 1.26	78.0 ± 1.6
Respiration rate, Bpm	1	84.0 ± 1.67	82.0 ± 1.67	85.0 ± 1.96
	15	65.0 ± 1.67	72.0 ± 2.30	74.0 ± 2.02
	30	52.0 ± 0.57	56.0 ± 2.02	59.0 ± 2.45
	60	47.0 ± 0.75	45.0 ± 0.57	46.0 ± 0.75

Note: BD = basic diet; *$p < 0.05$.

RESULTS

The research has shown that the main parameters of the microclimate in pigsties for growing pigs met the zoohygienic requirements. The air temperature was 20.15 ± 0.42–21.86 ± 0.54°C, relative humidity was 70.44 ± 1.19–73.38±1.22%, and speed of air movement was 0.19 ± 0.01–0.21 ± 0.02 m/s. The concentration of harmful gasses (ammonia, carbon dioxide, hydrogen sulfide), dust, and microorganisms in the indoor air also met the zoohygienic norms.[1,3,7]

The research data show that the tested drug has had an effect on the physiological state of experimental animals (Table 1).

On the 15th day of the experiment, there was a significant increase in the body temperature of the experimental animals in the first group on average by 0.3°C ($p < 0.05$) and in the second group by 0.4°C ($p < 0.05$) in comparison with the control group. Such fluctuation in the body temperature was observed in the experimental animals aged 30 and 60 days.

On the 15th day of the research, a similar pattern was observed in the dynamics of respiratory movements. These indicators in experimental animals of the first group were higher by 7 breaths per min ($p < 0.05$) or by 10.77%, and for the second group, it was higher by 9 breaths per min ($p < 0.05$) or by 13.8% than in the control group.

By the age of 15 days, pulse rate had increased by 9 beats per min ($p < 0.05$) or 8.11% in the animals of the first experimental group and by 10 beats per min ($p < 0.05$) or 9.0% in the animals of the second experimental group.

The results of the study of the animals' blood are presented in Table 2.

As can be seen from Table 2, there was a gradual increase in the morphological and biochemical blood indicators in the animals of the control and experimental groups. Their increase in both experimental groups depended on the amount of probiotic drug. So, on the 15th day of the experiment the increase in the number of erythrocytes in the blood of piglets of the first experimental group which were given probiotic sporobacterin at a dose of 0.2 ml/h was by 4.01% ($p < 0.05$); hemoglobin, 5.11% ($p < 0.05$); and leukocyte, 2.52% ($p < 0.05$). In the second experimental group of animals which were given the drug at a dose of 0.5 ml/h,

Table 2 Dynamics of morphological and biochemical parameters of the piglets' blood when using sporobacterin

Indicators	Age, days	Groups		
		Control group (BD)	First experimental group (BD + sporobacterin, 0.2 ml)	Second experimental group (BD + sporobacterin, 0.5 ml)
Erythrocytes, $10^{12/l}$	15	4.73 ± 0.04	4.92 ± 0.01*	4.96 ± 0.01*
Leukocytes, $10^{9/l}$		12.28 ± 0.31	12.59 ± 0.05	12.61 ± 0.22
Hemoglobin, g/l		91.14 ± 0.59	95.80 ± 0.74*	96.69 ± 0.81*
Total protein, g/l		62.10 ± 0.32	66.53 ± 0.18**	67.18 ± 0.26**
Albumin, g/l		25.78 ± 0.13	27.54 ± 0.10**	27.55 ± 0.09**
Globulins, g/l		36.32 ± 0.08	38.99 ± 0.24**	39.53 ± 0.24**
Including alpha globulins, g/l		11.14 ± 0.16	11.55 ± 0.05	12.01 ± 0.36
beta globulins, g/l		10.12 ± 0.11	10.32 ± 0.08	10.38 ± 0.12
gamma globulins, g/l		15.06 ± 0.04	17.12 ± 0.20 ***	17.24 ± 0.05 ***
Erythrocytes, $10^{12/l}$	30	5.90 ± 0.05	6.15 ± 0.12*	6.14 ± 0.01*
Leukocytes, $10^{9/l}$		11.87 ± 0.29	12.15 ± 0.20	12.22 ± 0.22
Hemoglobin, g/l		94.98 ± 0.55	99.12 ± 0.30*	100.03 ± 0.50*
Total protein, g/l		63.75 ± 0.19	69.04 ± 0.37**	69.32 ± 0.42**
Albumin, g/l		26.12 ± 0.12	28.16 ± 0.21**	28.66 ± 0.18**
Globulins, g/l		37.63 ± 0.34	42.17 ± 0.16**	42.79 ± 0.26**
Including alpha globulins, g/l		11.22 ± 0.06	11.46 ± 0.11	11.65 ± 0.21
beta globulins, g/l		10.54 ± 0.07	10.59 ± 0.09	10.60 ± 0.09
gamma globulins, g/l		15.87 ± 0.04	20.12 ± 0.07***	20.54 ± 0.14***
Erythrocytes, $10^{12/l}$	60	5.72 ± 0.04	5.96 ± 0.04*	6.00 ± 0.05*
Leukocytes, $10^{9/l}$		11.83 ± 0.26	12.17 ± 0.23	12.18 ± 0.24
Hemoglobin, g/l		93.96 ± 0.59	98.70 ± 0.77*	99.51 ± 0.86*
Total protein, g/l		65.45 ± 0.55	71.31 ± 0.14**	71.88 ± 0.07**
Albumin, g/l		25.91 ± 0.11	27.50 ± 0.09**	27.82 ± 0.11**
Globulins, g/l		39.54 ± 0.30	43.81 ± 0.29**	44.06 ± 0.29**
including alpha globulins, g/l		12.20 ± 0.05	11.93 ± 0.10	12.00 ± 0.18
beta globulins, g/l		11.23 ± 0.08	11.30 ± 0.08	11.43 ± 0.09
gamma globulins, g/l		16.11 ± 0.06	20.58 ± 0.04***	20.63 ± 0.07***

Note: BD - basic diet; * P<0.05; ** P<0.01; *** P<0.001.

these indicators increased by 4.86% ($p < 0.05$), 6.08% ($p < 0.05$), and 2.68%, respectively. On the 30th and 60th days of the research the number of erythrocytes grew by 4.27% and 4.89% ($p < 0.05$); hemoglobin, by 4.35% and 5.91% ($p < 0.05$); leukocyte, by 2.35% and 2.95%, respectively. However, the increase in the number of leucocytes in the blood of experimental animals in all cases was not statistically significant.

The nature of changes in biochemical parameters of blood serum of experimental animals during the whole period of the experiment was different. On the 15th day of the experiment the total protein level in the serum of piglets of the first and second experimental groups significantly increased on average by 7.13% to 18% ($p < 0.01$) and on the 30th and 60th days of the experiment, by 8.29%, 8.73%, and 8.95%, 8.98% ($p < 0.01$), respectively, for the first and second experimental groups. The increase in this indicator in the blood serum of experimental animals was mainly due to albumin and globulins.

The concentration of alpha and beta globulins in the blood serum of tested piglets was insignificant; it was 2.32–2.66% higher than in the control group being not statistically significant. As is well known, gamma globulins are special proteins, most of which are immunoglobulins possessing the protective properties of antibodies which participate in the formation of certain immunity in animals.[7] When using the drug, there was a

significant increase in this indicator in the blood serum of the tested animals in comparison with the control group throughout the experiment. So, when using sporobacterin, depending on the dose and the period of the experiment, the level of gamma globulin in the blood serum of tested animals of the first group grew on average by 1.96 g/l or by 13.01% ($p < 0.01$) on the 15th day, by 4.25 g/l and 4.47 g/l or by 26.78% and 27.74% ($p < 0.001$) on the 30th and 60th days of the experiment, and in the second experimental group by 2.18 g/l, 4.67 g/l, 4.82 g/l or by 14.47%, 29.42%, 29.91% ($p < 0.001$), respectively.

At present, the fact that probiotics have positive physiological and biological effects in animal husbandry and veterinary medicine is undeniable.[7,8,9] Positive research results confirm this assertion. As mentioned in "Materials and Methods," while multiplying in the intestine Bacillus subtilis bacteria strain synthesizes proteolytic enzymes and other biologically active substances which activate the process of digestion and the activity of the digestive system and normalize intestinal microflora and metabolic processes in the body. After their absorption into the blood, they stimulate the function of red bone marrow, liver, heart, organs of the immune system contributing to the activation of physiological processes in the body, protein metabolism, and the increase in morphological and biochemical parameters in the blood and serum of experimental animals.

CONCLUSION

Probiotic, antibiotic sporobacterin liquid at doses of 0.2 and 0.5 ml/h induces quite high physiological activity:

- morphological and biochemical blood composition in 60-day-old piglets of the experimental group has improved: the number of erythrocytes has increased by 4.19% and 4.89% ($p < 0.05$) and hemoglobin by 5.04% and 5.90% ($p < 0.05$);
- the level of total protein in blood serum of piglets has increased by 8.95% and 8.98% ($p < 0.01$), albumin by 6.13% and 7,37% ($p < 0.01$), globulins by 10.79% and 11.43% ($p < 0.01$), gamma globulin by 27.74% and 28.05%;
- the dose of 0.5 ml/h was more effective than the dose of 0.2 ml/h by 0.75%.

The obtained results allow us to recommend using the sporobacterin liquid at certain doses in growing young pigs.

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