Efficiency of the use of probiotics in comparison with antibiotics in pig breeding

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Abstract. The article presents materials on the study of effect of complex of biologically active substances "Lactumin" and "Lactusil" based on lactulose as an alternative to antibiotics in diets of young pigs on state of microflora of gastrointestinal tract and the formation of productive qualities of animals. The scientific research was carried out on basis of farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region. The level of humoral immunity was assessed according to results of bactericidal activity of blood serum obtained from results of zootechnical studies. The assessment of dynamics of live weight was carried out on the basis of control weighings and the calculation of absolute and average daily gains. Control slaughter of 5 animals from each studied group was carried out according to methodology generally of All-Russian Institute of Animal Husbandry accepted in Russia. It was found that the use of studied probiotic supplements in diets of pigs promoted a higher level of metabolic processes in their bodies, improved biochemical, morphological indicators and the level of natural resistance, and also influenced in live weight and slaughter indicators.

1. Introduction
At present, one of the pressing task in many countries of the world is introduction of technologies for production of livestock products without the use of feed antibiotics. This is especially important when conducting pig and poultry farming. In pig breeding industry one of the innovative solutions to this problem is the search for effective means as an alternative to antibiotics. As it is known, countries of the European Union abandoned the use of feed antibiotics in cultivation of farm animals and poultry, replacing them with feed additives aimed at maintaining, first of all, optimal functioning of intestine and reducing level of pathogenic microflora in it. In this case, an alternative can be: probiotics, prebiotics, symbiotics, phytobiotics, various enzymes, organic acids and their salts, as well as all kinds of extracts of plant materials, essential oils, various spices and herbs. At present, scientists from many countries of the world, on the basis of fundamental knowledge of processes of realizing genetic potential of animals and poultry, are conducting research to find effective means that can replace antibacterial drugs [1-9].

Thus, solution of this problem can be considered a global challenge for modern zooveterinary science, solution of which provides development and implementation of new methods for raising young animals without the use of antibiotics. Certain experience has already been accumulated in realizing genetic potential of pigs through the use of new feed products, biologically active feed additives as an alternative to antibiotics, ensuring completeness and balance of feed nutrients, their digestibility, as well
as an increase in productivity and normalization of physiological parameters of animals [10-14]. However, searches in this direction continue, patterns of influence of various biologically active additives in pigs rations on the growth of microflora of the gastrointestinal tract in comparison with the effect of antibiotics are being established, which is one of the promising directions in modern animal husbandry [15-18].

The research aim is to study effect of prebiotic feed additives based on lactulose as an alternative to antibiotics in the diets of young pigs on state of microflora of gastrointestinal tract and formation of productive qualities of animals.

2. Materials and methods
The base for scientific experiments was farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region in 2019. Two experiments were carried out.

2.1. First experiment
Experimental studies were carried out on 3 experimental groups of young pigs of large white breed at the age of 2 months, 30 heads each.

Animals of control group received a farm standard diet (SD), analogs of first experimental group - SD + drug for veterinary use (DP), that contains active ingredient colistimethate sodium, at a dosage of 6 mg per 1 kg of animal weight; II experimental group - SD + a mixture of dietary supplements Lactumin and Lactusil at a dosage of 0.2 mg / kg of live weight.

The complex of dietary supplements under study was developed by scientific staff of the State Scientific Institution NIIMMP: biologically active additive Lactusil and biologically active additive Lactumin (RU Specification TU 9229-156-10514645-08) (State registration certificate within the customs union № RU 77.99.11003. E 001910.01.12 from 13.01.2012 г.). The studied drugs contain lactulose, malic and succinic acids, as well as substances obtained by extraction of milk thistle and Jerusalem artichoke.

The mechanism of prebiotics complex is based on positive impact of lactulose to bifidoflora gastrointestinal tract, as well as flavoring and nutritional effect caused by fresh Jerusalem artichoke (contains high-value component inulin) and milk thistle (contains polyphenols - 1.8%, flavonoids - 1.1% and vitamin E 1.3%).

2.2. Second experiment
Experimental animals large white breed of control group were kept under standard conditions adopted in the farm, received SD, analogs of experimental group I - SD + veterinary drug (VD) containing in its composition: «sulfadimezin» (at a dosage of 25 mg / kg of live weight) and «trimethoprim» (at a dosage of 5 mg / kg of live weight), II experimental group - SD + Lactusil (in the amount of 0.2 mg / kg of live weight).

Giving VD began at the age of 5 days and continued for 5 days. In accordance with the instruction for using VP the drug should completely eliminated from the animal's body on the 9th day after its administration. The experimental piglets were accommodated to consumption of compound feed PK-51 from the 10th day, and from the 14th day, there was a complete replacement of mother's milk with compound feed.

One feed unit of compound feed contained: calcium - 4.5 g, phosphorus - 3.7 g, table salt - 6 g, carotene - 5 mg, vitamin D - 250 IU, B1 - 1.5 mg, B2 - 2.5 mg, B3 - 10 mg, B5 - 15 mg, B6 - 1.5 mg, B12 - 11.6 μg or 1.2 mg, vitamin C - 35 mg. The experimental animals had free access to water.

Blood from experimental animals was taken from the tail vein. Level of humoral immunity was assessed according to the results of bactericidal activity of blood serum, obtained from results of zootechnical studies.

Determination of dynamics of live weight was carried out on the basis of results of control weighings and calculation of absolute and average daily gains.
Control slaughter of five animals from each studied group was carried out according to methodology generally of All-Russian Institute of Animal Husbandry accepted in Russia (VASKhNIL, 1983).

Ascertainment of large intestine composition was carried out in accordance with the method for determining content of viable bacterial cells (CFU - colonies of forming units) in 1 g. The method is based on sowing colonies of certain microorganisms on corresponding to them agrarian media under in exactly defined conditions.

All results, obtained in the research were processed by the methods of variation statistics using STATISTICA-6 software package and determining the reliability criterion of the difference according to Student-Fisher at three levels of probability.

3. Results and discussion
It is well known that formation of natural humoral immunity of animals and populations in general is directly related to their genotype. At the same time, metabolic processes occurring in animal body are closely interrelated with level of various indicators of blood: content of erythrocytes, leukocytes, etc. Therefore, quantitative composition in the blood can serve as indirect evidence of a high level of metabolic processes.

3.1. First experiment
Studies of hematological blood parameters showed that in terms of the total protein content in the blood, animals of the I and II experimental groups surpass the analogs of the control group by 2.34% (P≤0.05) and 2.42% (P≤0.05); albumin - by 3.94% (P≤0.05) and 1.73%; globulins - by 6.27% (P≤0.01) and 4.77% (P≤0.05); α-globulins - by 4.04 and 6.88% (P≤0.05); γ-globulins - by 5.64 and 6.33%, respectively. The content of calcium and phosphorus ratio in the blood of experimental animals was within the physiological norm. The level of morphological parameters of blood serum of animals is shown in figure 1.

![Figure 1. Morphological parameters of blood serum obtained from experimental animals (n = 4).](image)

The figure shows that blood serum of the studied pigs of the II experimental group contains more erythrocytes in comparison with analogs of the control and I experimental groups by 0.79 and 1.91% (P≤0.05); leukocytes - by 1.10% (P≤0.05) and 1.59% (P≤0.05); hemoglobin - by 1.45 and 2.44%; ESR - by 34.63 and 42.80%, respectively.
The obtained superiority of animals of the II experimental group in terms of the parameters studied in the blood serum of the animals, in comparison with their peers in the control and I experimental groups, does not exceed the physiological norm and all the animals participating in experiment are clinically healthy.

Based on the study, it was revealed that animals of I and II experimental groups in terms of content of lysozyme in blood surpass their peers in the control group by 0.48 and 0.59 mg%; attractions - by 50 neutrophils - by 0.15 and 0.16%; the number of phagocytic neutrophils - by 0.20 and 0.56%, respectively. In terms of phagocytic index, pigs of the I and II experimental groups have higher indicators in comparison with analogs of the control group by 0.08 and 0.16% with an insignificant difference.

The results presented above on the study of blood of the experimental pigs show biochemical, morphological and indicators of humoral immunity were within physiological norm.

The study of live weight of the experimental pigs in age period 120-150 days showed that animals of the control and I experimental groups had a higher live weight in comparison with peers of II experimental group by 2.67% (P≤0.05) and 1.87% (P≤0.05); 150-180 days - by 3.25% (P≤0.01) and 2.76% (P≤0.01), 120-180 days - by 2.36 kg (P≤0.05) and 0.98 kg respectively.

According to information from instruction for use of DP it is known that it is excreted from the body in 20 days. In our study, we stopped giving the drug on day 160 of the experiment, i.e. 20 days before control slaughter.

For the control slaughter of the experimental pigs, we selected 5 animals from each group.

As a result of control slaughter, it was found that heavier carcasses were obtained from animals of II experimental group in comparison with analogs of the control group by 3.40% and I experimental group - by 2.86%; slaughter weight - by 5.76 and 4.65%; hot carcass weight - by 5.56 and 4.46%, respectively. It should be noted that the highest rate of slaughter yield was obtained the carcasses of gilts in II experimental group compared with their peers in the control group by 1.20% and in I experimental group - by 0.60%.

In our opinion, introduction of the complex probiotic drugs into diets of the experimental pigs contributed to improvement of intestinal bifidoflora and a more rapid suppression of pathogenic and opportunistic microflora in their bodies in comparison with analogs of the control group. Therefore, the animals of the II experimental group surpassed their analogues in the control and I experimental groups in almost all studied parameters.

It should be noted that there was an inhibition of pathogenic, opportunistic microorganisms and at the same time beneficial microflora in gastrointestinal tract of pigs of I experimental group, received DP, which caused diarrhea and, as a result, a decrease in live weight.

3.2. Second experiment
To scientific experiment newborn piglets were selected – figure 2.

From the presented results in figure 2 it can be seen that the experimental piglets of all studied groups at birth and at the age of 28 days were approximately the same and did not have significant differences.

At the age of 60 days, live weight of animals of I and II experimental groups were more in comparison with the analogs of the control group by 2.85 and 7.46% (P≤0.05). Over the entire period of the experiment, from birth to the age of 60 days, live weight of experimental gilts of I and II experimental groups was higher in comparison with peers of the control group by 2.40 and 7.60% (P≤0.05), in terms of the average daily gain - by 6.34 and 21.14% (P≤0.05), respectively.

It should be noted that animals of the I experimental group surpass the analogs of the control and II experimental groups in content of direct bilirubin in blood of the animals by 32.46% (P≤0.01) and 16.22% (P≤0.05) and total bilirubin - by 22.14 and 11.80%, respectively. Thus, the use of drug complex "sulfadimezin" and "trimethoprim" antibiotic orientation caused an increase in content of direct and total bilirubin in the blood, which indicates an increased pressure on liver.
Figure 2. Dynamics of live weight of piglets (n = 30).

For a more detailed disclosure of the features of protein metabolism in experimental animals, we studied the content of aspartate aminotransferase (AsAT) and alanine aminotransferase (ALT) in blood serum. In the course of experimental studies, it was found that in the blood serum of pigs of the I and II experimental groups, AsAT was less by 4.36 (P \leq 0.05) and 8.16% (P \leq 0.01), and ALT - by 7.35 (P \leq 0.01) and 12.22% (P \leq 0.01) compared to peers of the control group.

The calculated Ritis coefficient (the ratio of ALT to AsAT) for animals of the control group was 0.62%, for peers of the I experimental group - 0.57% and for II experimental group - 0.55%. Inverse Ritis coefficient, as the ratio of AST to ALAT: 1.94, 1.84 and 1.80 respectively.

It was found that a decrease in aspartate aminotransferase and alanine aminotransferase to a physiologically determined norm contributes to normalization of tissue protein metabolism in a body of the experimental animals.

More complete information about content of colostral antibodies in blood serum of experimental gilts indicates not only the level of natural, but also acquired immunity, based on the level of specific immunoglobulins.

There are studies by foreign and Russian scientists in which it was proved that immunoglobulins of IgG isotype are produced by passive immune system of an animal body and contribute activation of protective antibodies against various stimuli. It has been proven that blood serum of larger piglets contains more immunoglobulins of IgG isotype.

At the initial stage of life, newborn piglets receive first immunoglobulins of IgA isotype with maternal colostrum, which contribute to development of primary protection of gastrointestinal tract.

Piglets are helped to cope with infectious diseases by immunoglobulins of the IgM isotype, which provide a high level of antibacterial protection.

The study of immunoglobulins content in blood serum of the experimental piglets showed that piglets that received feed additive Lactusil as part of compound feed have an increased content of immunoglobulins of the IgG isotype in comparison with peers in the control group by 15.36% (P \leq 0.05) and with peers of I experimental group - by 29.15% and immunoglobulins of the IgA isotype - by 16.24% (P \leq 0.01) and 27.31% (P \leq 0.01), respectively.

It is known from literature that the use of pre- and probiotic feed additives in compound feeds makes it possible to improve digestion of large intestine.

As a result of the study of microbial composition of large intestine, it was found that automicroflora of the experimental young animals, which received the studied prebiotic additives in compound feed, was in a certain parity and can be considered "Normobiosis".
To establish the effect of prebiotics and antibiotics on the state of microflora of gastrointestinal tract of the experimental piglets, samples of contents of large intestine of experimental animals were studied. In the large intestine of piglets that received feed additive Lactusil in composition of compound feed, there was more lactobacilli by one degree from $10^7$ to $10^8$ in comparison with animals of the control group, and with analogues that received a veterinary drug containing "sulfadimezine" and "trimethoprim" more by two units from $10^6$ to $10^8$, and bifidobacteria from $10^7$ to $10^9$ and from $10^5$ to $10^9$, respectively. Among the contents of large intestine of piglets of the control group, presence of yeast-like fungi and microorganisms of genus Klebsiella was revealed, which have a depressing effect on saccharolytic microflora, and, as a consequence, on production of metabolites that provide an equilibrium relationship between macro- and microcenosis.

Due to the fact that giving a prebiotic drug to piglets for two months had significant positive changes, the decision to study content of microflora in the large intestine of pigs that received a prebiotic preparation during the fattening period in comparison with analogs that received an antibiotic and without was made. It should be noted that the detailed study of microbial contents of large intestine showed that the microflora of the experimental animals contains yeast-like fungi, molds, and streptococcus. These forms of microorganisms were also found in large intestine of analogs of the experimental groups, even when using VD. The use of DP for cultivation piglets allowed to reduce the proportion of yeast by 5 times, streptococci by 2.4 times, eliminated the hemolyzed form of E. Coli, the level of bifidobacteria and lactobacilli increased in comparison with the control variant by 1.4 times. The use of compound feed with a complex of prebiotic feed additives Lactumin and Lactusil in feeding pigs reduced rate of yeast by 3.2 times, streptococcus by 1.9 times, excluded hemolyzed form of E. coli, level of bifidobacteria and lactobacilli increased by 2.9 times compared to level of the control group.

In general, when studying microbicenosis of large intestine of piglets from the experimental groups, no microorganisms of genus Klebsiella were found in them.

### 4. Conclusion

Introduction of a complex of biologically active substances Lactumin and Lactusil into the diets of experimental pigs contributed to manifestation of a higher level of metabolic processes in their bodies, improved biochemical, morphological indicators and the level of natural resistance, and also influenced increase in live weight and slaughter indicators.

The use of feed additive Lactusil in compound feed of the experimental piglets, in comparison with their peers who received the veterinary drug containing "sulfadimezine" and "trimethoprim", had a positive effect on live weight gain, as well as on physiological health of animals.

Summarizing foresaid, we can make following conclusion: animals in the first and second experiments, who received VD and DP respectively, were ultimately inferior in terms of productivity to the animals that received biologically active additives. In our opinion, this is due to higher growth of useful bifidoflora in their gastrointestinal tract.

It was found that in the large intestine of animals of the control group there are microorganisms of genus Klebsiella, preventing development of saccharolytic microflora, which negatively affects their productivity. At the same time, higher productivity indicators were noted in animals of the II experimental group, which received prebiotic preparations in the form of a complex of feed additives Lactumin and Lactusil, associated with a higher level of bifidobacteria and lactobacilli in comparison with analogs of the control and I experimental groups.

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