Metrological aspects of using probiotics

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Abstract. The article presents studies on the influence of lactulose-containing feed additives in the feeding diets of piglets from 60 to 180 days of age. Experimental studies were conducted on the basis of the Lenin MANPADS of the Surovikinsky district of the Volgograd region in 2020. To do this, we formed 3 groups of large white piglets with 30 heads each at the age of 2 months. The control group of animals received a general household ration (RR), the animals of the I experimental group received RR + Feed additive "Drug No. 1" in a dosage of 0.45 g/kg of live weight; II experimental group-OR + Feed additive "Drug No. 2" - at a dose of 0.4 g/kg of live weight. The highest results were obtained for animals of the First experimental group.

1. Introduction
Currently, the world's largest pork producers are China, the European Union, the United States, Brazil and the Russian Federation [1-2]. Pig farming is one of the priority sectors of the agricultural sector, which allows you to quickly increase the number of livestock due to the beneficial biological characteristics of these animals. Further development of the industry will follow the path of increasing production in accordance with the strategy for the development of the agricultural sector of Russia until 2030 [3-4].

More than 80% of the total pig population is concentrated in the countries of Asia and Europe [5]. In Russia, pork production is gaining momentum. In 2020, more than 365 companies are engaged in pork production in Russia, and large pig farms produce 85% of all pork produced [6].

The development of animals is greatly influenced by the factor of nutrition, which must be balanced in all nutrients, which is currently provided through the use of various feed additives, biologically active substances and other components of diets [6-8].

It should be especially noted that in pig breeding, the most common cases of dysbiosis occur, the occurrence of which is affected by a change in feeding rations and the quality of feed. At the same time, the treatment of such dysfunction is associated with the long-term use of terrapeutics or the use of feed additives to improve the biocenosis of the gastrointestinal tract [9, 10].

One of these feed products are various products based on lactulose-containing components. Lactulose, which is a natural prebiotic, enters the body of animals and is involved in the activation of the symbiotic microflora of the gastrointestinal tract, namely, lacto- and bifidoflora. Lactulose is able to be absorbed only in the lower part of the intestine, which contains specific enzymes necessary for its cleavage, while, according to a number of Russian and foreign scientists, energy and carbon are released. In addition, such feed additives play a crucial role in the formation of natural immunity [9-12].
In this regard, the deepening and expansion of knowledge on the impact of new prebiotic feed additives on the animal body is an urgent area of scientific research. The purpose of this work was to study the effectiveness of the use of new lactulose-containing feed additives on the body of pigs.

2. Methods and materials
Experimental studies were conducted on the basis of the Plemzavod named after Lenin of the Surovikinsky district of the Volgograd region in 2020. We formed 3 groups of large white piglets with 30 heads each at the age of 2 months.

The control group of animals received General diet (GD), animals of the experimental group I received the GD + feed additive Preparation No.1" in a dosage of 0.45 g/kg of live weight; II group – GD + feed additive Preparation No. 2, in the dose of 0.4 g/kg body weight.

Preparation No. 1 is a mixture consisting of natural biologically active substances, obtained by combining flour obtained from sprouted pumpkin seeds and dried to a dry state of lactulose, with the introduction of malic acid. In general, 100 g of the finished product contains: lactulose not less than 18.0 g, polyphenols not less than 19.5 g, flavonoids not less than 0.0003 g, vitamin E not less than 0.0016 g, malic acid 0.25 g. The drug is developed and produced by the NVC "New Biotechnologies", Volgograd.

Preparation No. 2 is a multicomponent mixture containing at least 21.6% lactulose, as well as salts of elements such as calcium, phosphorus, magnesium and other trace elements. All this allows you to use this supplement for all types of farm animals and poultry. The biocorregating effect of lactulose increases due to the catalysis of the process of isomerization of lactose from lactulose as a result of the action of amino acids in an alkaline environment. The drug is produced in the dairy plant "Stavropol".

Animals of the control group received specialized compound feeds SK-5, SK-6, SK-7 for feeding pigs in accordance with the norms of feeding farm animals, depending on age, live weight.

Feeding was carried out in the morning and in the evening, access to water was free.

Blood was taken from a vein located under the root of the tail, from 5 animals from each group. The level of immunoglobulins of individual classes was determined quantitatively using the Mancini radial immunodiffusion method on blood serum taken from animals.

The experiment continued until the animals reached the age of 180 days. Weighing of the piglets was carried out monthly, starting with the setting of the experiment.

3. Results and discussion
In the course of the research, the manifestation of dysbacteriosis in the piglets of the control group was established during the change of diets, and in the experimental groups, the animals calmly reacted to the gradual change of feed. One of the stages of working with new feed additives was to establish their effect on the body of pigs. In this regard, the biochemical parameters of the blood were studied, which are presented in table 1.

| Indicator          | Group Control | I experiment | II experiment |
|--------------------|---------------|--------------|---------------|
| Total protein, g/l | 81.27±0.29    | 82.64±0.39   | 82.56±0.41    |
| Albumins, g/l      | 40.56±0.25    | 41.16±0.41   | 41.26±0.35    |
| Globulins, g/l     | 40.71±0.22    | 41.48±0.26   | 41.76±0.31    |
| α-globulins, g/l   | 12.26±0.15    | 13.08±0.19   | 13.21±0.20    |
| β-globulins, g/l   | 8.83±0.07     | 9.54±0.09    | 8.56±0.14     |
| γ-globulins, g/l   | 19.62±0.31    | 18.86±0.26   | 19.99±0.29    |
| Calcium, mg%       | 10.73±0.14    | 10.80±0.15   | 10.93±0.13    |
| Phosphorus, mg%    | 4.68±0.06     | 4.71±0.09    | 4.78±0.05     |
It can be seen from table 1, total blood protein, the animals in groups I and II were superior to their counterparts in the control group by 1.37 g/l, or 1.66% (P≥0.95) and of 1.29 g/l, or 1.56%; albumin – 0.6 g/l, or 1.46% and 0.7 g/l, or of 1.70%; the globulin – 0.77 g/l, or of 1.86% and 1.05 g/l, or of 2.51% (P≥0.95); α-globulins – 0.82 g/l, or of 6.27% (P≥0.95) and 0.95 g/l, or of 7.19% (P≥0.95); β-globulin – 0.71 g/l, or 7.44% (R≥0.99) and 0.27 g/l, or 3.15%, respectively. The content of calcium and phosphorus was at approximately the same level in all the studied groups. It is worth noting that according to the content of γ-globulins, animals of the I experimental group had the lowest indicator in comparison with the analogues of other groups. Gamma globulins in the blood have the lowest mobility and contain immunoglobulins of all types (IgG, IgA, IgM, IgE), providing humoral immunity of the body.

Figure 1. Hematological parameters of experimental animals (n=5).
To establish the physiological state of the animals, in connection with the introduction of the studied feed additives into the animal feeding diets, the morphological composition of the blood of all experimental piglets was studied (figure 1).

The data presented in figure 1 showed that the sub–pigs of the I and II experimental groups in terms of the content of red blood cells exceeded the control group analogues by 0.49 10^12/l, or 7.38% (P≥0.99) and 0.33 10^12/l, or 5.09% (P≥0.95); white blood cells – by 0.35 10^9/l, or 2.39 % (P≥0.95) and 0.21 10^9/l, or 1.44%; hemoglobin-by 5.12 g/l, or 4.33 % (P≥0.95) and 3.92 g/l, or 3.35% (P≥0.95), respectively. The rate of erythrocyte sedimentation was slightly and unreliably higher in the animals of the experimental groups compared to the control group.

Currently, domestic and foreign scientists have paid attention to the increase in the indicators of humoral immunity and, to a large extent, to the refusal of the use of antibiotics for the prevention of various diseases. This is due to a decrease in the burden on the end user, as cases of infections, viruses, pathogens and bacteria that are virulent in relation to various antibiotics have become more frequent.

The study of blood serum of experimental piglets showed that IgG – type immunoglobulins were found more in animals of the I experimental group in comparison with the control and II experimental groups by 0.23 mg/ml, or 1.76% (P≥0.95) and 0.09 mg/ml, or 0.63%; IgA – by 0.33 mg/ml, or 2.23% (P≥0.95) and 0.16 mg/ml, or 1.34%; IgM-by 0.18 mg/ml, or 5.21% (P≥0.95) and 0.06 mg/ml, or 0.17%, respectively (figure 2)

![Figure 2. The amount of immunoglobulins in the blood serum of experimental piglets, mg / ml.](image)

It is well known that the most important and significant in the body is the proper functioning of the gastrointestinal tract, since the work of all organs and tissues depends on it. The content of immunoglobulins in the blood serum also directly depends on the level of lactic acid bacteria in the gastrointestinal tract, and in such a way that an increase or decrease in them in the gastrointestinal tract also increases or reduces the level of immunoglobulins such as IgG and IgA.

In response to the appearance of various infections or pathogens in the body, IgM-type immunoglobulins are produced. In our experimental studies, it was found that the animals of the First experimental group had the highest amount of immunoglobulins compared to the analogues of other groups.

Thus, it can be indirectly assumed that the best metabolic processes occur in the body of animals of the I experimental group in comparison with the analogues of the control and II experimental groups.
On the basis of the monthly weighings of experimental young pigs, the absolute live weight gains in all groups of piglets were calculated (table 2). Table 2 shows that the animals of the I and II experimental groups in the age periods from 60 to 90 and from 90 to 120 days of age slightly exceeded the analogues of the control group. However, starting from the period from 120 to 150 days of age, the animals of the I and II experimental groups were larger than the control group analogues by 1.6 kg, or 5.8% (P ≥ 0.99) and 1.3 kg, or 4.76% (P ≥ 0.99), respectively. For the entire period of the experiment from 60 to 180 days of age, the animals of the I and II experimental groups exceeded the analogues of the control group – by 4.8 kg, or 4.16% (P ≥ 0.999) and 3.1 kg, or 2.73% (P ≥ 0.99). In general, for the entire experiment, the animals of the control group had 641 g of average daily weight gain, and the analogues of the I and II experimental groups – 657 and 652 g, which is more by 16 and 11 g.

**Table 2. Indicators of the absolute live weight gain of experimental animals (n=30).**

| Age, days | Group | Control | I experiment | II experiment |
|-----------|-------|---------|--------------|--------------|
| 60-90     | 22.0±0.11 | 22.4±0.13 | 22.2±0.09 |
| 90-120    | 25.6±0.24 | 26.3±0.22 | 26.0±0.26 |
| 120-150   | 26.0±0.27 | 27.6±0.24** | 27.3±0.26* |
| 150-180   | 27.4±0.28 | 29.3±0.20*** | 28.7±0.23** |
| 60-180    | 115.3±0.46 | 118.2±0.41*** | 117.3±0.48** |

In the studies of Russian and foreign scientists, it was found that the content of microorganisms in the gastrointestinal tract directly correlates not only with the assimilation of nutrients, but also with the metabolism occurring throughout the body. In general, reducing the level of pathogenic microflora can significantly improve the metabolic processes within the animal body [13, 15].

**4. Conclusions**

In the course of experimental studies, it was found that the development and introduction of new feed additives in animal diets can increase the absolute gains in live weight, improve the indicators of metabolic processes, as well as the level of humoral immunity. At the same time, there was no significant difference in effectiveness between the lactulose-containing feed additives studied.

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