Innovative technology of pork production with the use of phytobiotics

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Abstract. The purpose of this work is to study a new phytobiotic with bifidogenic action as an alternative for veterinary drug at the early stage of ontogenesis and measuring its effect on physiological state and productivity of animals. 3 groups of large white piglets at the age of one day were formed selected for the experiment on the farm. A total of 90 similar piglets were selected. The animals were kept under standard conditions adopted in the farm. Piglets in the control group received farm standard diet (SD), analogs of experimental group I - SD + veterinary drug 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 - OR + «Lactusil» (in the amount of 0.2 mg / kg of live weight). The use of the biologically active feed additive «Lactusil» in diet of the animals in comparison with a veterinary preparation containing in its composition: «Sulfadimezin» and «Trimethoprim» did not have a negative effect on the physiological state and level of humoral immunity. The high level of live weight, absolute and average daily gains is confirmed by the results of biochemical, morphological and immunological studies in blood of experimental piglets, which may indirectly indicate the level of metabolic processes in their bodies.

1. Introduction

Ensuring the long-term competitiveness of agricultural enterprises is one of the most important tasks in modern conditions of their functioning. This is due to the implementation of structural changes in the Russian economy as a result of the ongoing import substitution program, as well as the increase in export capabilities of livestock farms. At the same time, lack of investment resources makes it impossible for intensive development and sustainability of functioning of existing domestic companies without the use of new effective technologies [1-3].

The global pork market is largely segmented and characterized, among other things, by a downward trend in demand for raw fat, lateral and back fat, that is due to changes in nutritional status of population during the transition to a post-industrial society [4, 5]. Thus, an increase in meat content and a decrease in greasiness of pork carcasses has become a priority area of selection and breeding work in countries with a highly developed pig-breeding complex, world pork exporters: the USA, Canada, Denmark, France, Germany.

Deep and purposeful selection and breeding work in these countries led to development of meat pigs hybrids with an average daily gain of about 900 g and a fat thickness of no more than 1.5 cm. In recently
published work of G A Funikov, 2020, as a result of an experiment by a comprehensive study of morphological composition of carcasses of commercial young pigs of domestic, Canadian and French breeding, that lasted more than 10 years, a significant and reliable superiority of more than 3% of muscle yield tissues of foreign analogues with the lowest adipose tissue content was experimentally established.

In this regard, in Russia there is an active purchase of breeding material, obtained from animals of foreign selection, as well as changes in conditions of keeping and cultivation at pig breeding enterprises. This, in turn, is associated with the risk of stress factors in the adaptation of animals to natural and climatic conditions of regions of the country.

At the same time, the world community is faced with the global challenge of the use of antibiotics in animal husbandry. This threatens the emergence and spread of antibiotic-resistant microorganisms and, as a result, the impossibility of using these drugs for medicinal purposes. As noted in a recent interview by the famous American essist, philosopher, economist and trader Nassim Nicholas Taleb, author of the world bestseller «Black Swan. Under the sign of unpredictability»: "To be honest, in the near future I see a threat more serious pandemic. This increase in resistance of bacteria that occurs due to widespread use of antibiotics" [7].

From the above, we can conclude the importance of scientific research in the field of development and use of promising lactulose-containing drugs in the livestock production including phytobiotics, capable not only of suppressing the growth of potentially pathogenic bacteria, but also acting as bifidogenic and antistress factors [8-10].

The purpose of this work is to study a new phytobiotic with bifidogenic action as an alternative for veterinary drug at the early stage of ontogenesis and measuring its effect on physiological state and productivity of animals.

2. Materials and methods

The scientific research was carried out on basis of farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region in 2019. 3 groups of large white piglets at the age of one day were formed selected for the experiment on the farm. A total of 90 similar piglets were selected.

Subsequently, the piglets were suckled. At the age of 28 days, they were transferred to rearing. The experiment was carried out up to 60 days of age, i.e. before transferring them to fattening.

The animals were kept under standard conditions adopted in the farm. Piglets in the control group received farm standard diet (SD), analogs of experimental group I - SD + veterinary drug (VP) 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 - OR + «Lactusil» (in the amount of 0.2 mg / kg of live weight).

Giving VP began at the age of 5 days and continued for 5 days. There is information from the instruction for using VP that the drug on the 9th day after taking it, is completely excreted from the animal's body.

Starting from the 10th day, the piglets were gradually accustomed to the PK-51 compound feed, and from the 14th day they were completely substituted for milk feeding. 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 animals had free access to water.

In the process of the experimental work, blood samples were taken from tail vein of 2-month-old farm animals.

Evaluation of humoral immunity of pigs was identified by the bactericidal activity of blood serum obtained as a result of standard zootechnical methods.

In order to determine changes in live weight of the experimental animals, they were weighed at birth, at the age of 28 days and at 60 days of age.

The results of experimental studies presented in the article were processed using the methods of variation statistics with the determination of the criterion for the reliability of the difference according to Student-Fischer at three levels of probability in program STATISTICA-6.
3. Results and discussion

In the course of experimental studies, the experimental piglets were weighed (table 1).

Table 1. Dynamics of live weight of piglets.

| Index                        | Group          |            |            |
|------------------------------|----------------|------------|------------|
|                              | control        | I experimental | II experimental |
| Live weight at birth, kg     | 1.10±0.20      | 1.20±0.22 | 1.16±0.19  |
| Live weight at the age of 28 days, kg | 8.25±0.32      | 8.34±0.36 | 8.44±0.28  |
| Live weight at the age of 60 days, kg | 16.49±0.41    | 16.96±0.39 | 17.72±0.42* |

As can be seen from the results presented in table 1, piglets of all experimental groups at birth and at the age of 28 days did not have any significant and reliable differences. However, at the age of 60 days, animals I and II experimental groups were superior to analogs of the control group by 0.47 kg, or 2.85% and 1.23 kg, or 7.46% (P≤0.05). T

The calculation results showed that absolute weight gain of animals I and II experimental groups was higher than of animals of the control group by 0.37 kg, or 2.40% and 1.17 kg, or 7.60% (P≤0.05), by average daily gain - by 6.17 and 19.5 g (P≤0.05), respectively.

In order to determine physiological parameters of health of the experimental pig population, biochemical studies of blood parameters of animals were carried out.

Bilirubin is one of the most important indicators that can track liver function of animals. In our studies, content of direct and total bilirubin in blood of animals of I and II experimental groups is lower in comparison with analogs of the control group by 0.56 mmol / L, or 16.24% (P≤0.05) and 0.86 mmol / L, or 32.46% (P≤0.01) and total bilirubin - by 0.68 mmol / L, or 10.34% and 0.94 mmol / L, or 22.14%, respectively. In our experimental studies, a decrease in content of direct and total bilirubin in the blood was noted, that allows us to conclude that metabolic processes occurring in body of animals of I and II experimental groups have improved.

One of the interesting issues considered in our research is the effect of the drugs on protein metabolism in the animal's body. In this regard, we have determined the content of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in blood serum of the experimental animals. During the research, it was found that animals of experimental groups were inferior to analogs of the control group: I – by 0.89 U / L, or 4.36% (P≤0.05) and 1.79 U / L, or 8.16% (P≤0.01), and II - by 1.14 units / L, or 7.35% (P≤0.01) and 13.25 units / L, or 12.22% (P≤0.01) respectively AST and ALT.

The de Ritis coefficient was calculated as the ratio of ALT to AST: in the control group it was equal to 0.62, in the I experimental group - 0.57 and in the II experimental group - 0.55, in the case of the ratio of AST to ALT: 1.94, 1.84 and 1.80, respectively. Thus, a decrease in the level of AST and ALT to physiological norm helps to stabilize tissue protein metabolism in the body of experimental pigs.

The increased level of urea in piglets of the experimental groups also confirms the high intensity of protein metabolism.

During the experiment, biochemical parameters of the pigs' blood were studied. Analysis of these parameters made it possible to determine the improvement of metabolic processes in the piglets' body, that, in our opinion, is caused by normalization of intestinal microflora. The morphological composition of blood serum obtained from experimental animals is presented in table 2.

Table 2. Morphological parameters of blood serum.

| Index                              | Group          |            |            |
|------------------------------------|----------------|------------|------------|
|                                    | control        | I experimental | II experimental |
| Erythrocytes, 10^{12}/ L           | 5.89±0.02      | 6.12±0.03 | 6.26±0.04  |
| Leukocytes, 10^9/ L                | 8.56±0.34      | 8.66±0.32 | 8.74±0.36  |
| Hemoglobin, g / L                  | 100.4±0.67     | 113.4±0.84 | 106.7±0.79 |
| Erythrocyte sedimentation rate (ESR), mm / h | 4.57±0.18      | 4.76±0.22 | 4.84±0.24  |
According to the content of erythrocytes in the blood of piglets, animals of the II experimental group surpass the analogs of the control and I experimental groups by $0.23 \times 10^{12}$/L, or 3.90% ($P \leq 0.01$) and $0.27 \times 10^{12}$/L, or 6.28% ($P \leq 0.01$), leukocytes - by $0.10 \times 10^{9}$/L, or 1.17% and $0.18 \times 10^{9}$/L, or 2.10%, hemoglobin - by 13.0 g/L, or 12.95% ($P \leq 0.01$) and 16.3 g/L, or 6.27% ($P \leq 0.01$), ESR - by 0.19 mm/h, or 4.16% and 0.27 mm/L, or 5.91%, respectively.

Thus, it should be noted that 2-month-old piglets of the II experimental group were superior to the analogs from the control and I experimental groups in terms of the content of biochemical and morphological parameters in serum and preserved blood. This indicates high regulatory role of the biologically active additive «Lactusil» in metabolic processes in body of the animals.

The analysis of colostral antibody content was carried out in blood serum of pigs at 28 days of the piglet age. The content of colostrum, passive and acquired immunoglobulins was determined.

Domestic and foreign researchers have proven that IgG immunoglobulins are actively involved in the formation of passive immunity in body of piglets, are responsible for the production of antibodies against viruses, bacteria and toxins. Usually pig blood serum contains about 80% of all immunoglobulins. A higher content of IgG immunoglobulins is observed in piglets with a large birth weight.

Immunoglobulins IgA are involved in production of antibodies in gastrointestinal tract, that enter piglets body in the first days of life with mother's milk. Immunoglobulins IgM appear in response to infectious diseases and provide antibacterial protection of the body.

Quantitative content analysis of immunoglobulins in piglets blood serum piglets showed following. Animals of II experimental group had higher level of immunoglobins IgG and IgA-isotypes in comparison with the analogs of the control and I experimental groups: according to the first parameter, by 1.17 mg/ml, or 15.36% ($P \leq 0.05$) and 2.56 mg/ml, or 29.15% ($P \leq 0.01$) and to the second - by 0.14 mg/ml, or 16.24% ($P \leq 0.01$) and 0.18 mg/ml, or 27.31% ($P \leq 0.01$), respectively.

4. Conclusion
The use of the biologically active feed additive «Lactusil» in diet of the farm animals in comparison with a veterinary preparation containing in its composition: «Sulfadimezin» and «Trimethoprim» did not have a negative effect on the physiological state and level of humoral immunity.

The high level of live weight, absolute and average daily gains is confirmed by the results of biochemical, morphological and immunological studies in blood of experimental piglets, which may indirectly indicate the level of metabolic processes in their bodies.

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