Pork production method involving the use of new feed additive «Chlorelact»

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Abstract. The article presents materials on the development of an effective pork production technology involving the use of biologically active additive complex of biocorrective action "Chlorelact", made on the basis of lactulose and microalgae chlorella, aimed at obtaining high meat productivity, as well as physiological indicators of young pigs. The scientific research were carried out on farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region. The experiment involved 3 groups of animals, 25 heads each at the age of 2 months. The use of feed additive «Chlorelact» made it possible to stabilize tissue metabolism and thus significantly increase in live weight gain of animals from experimental groups in comparison with animals of control group. The best results were obtained from animals that received a complex biologically active additive «Chlorelact» as part of a compound feed.

1. Introduction
Active increase in production volumes of enterprises of agro-industrial complex is associated with the risk of loss of quality and, as a result, profitability and competitiveness of products. That is why improving quality of livestock products is an integral part of The Food security Doctrine of the Russian Federation and at the present stage is impossible without the implementation of innovative developments in the field of breeding, genetics, as well as technological solutions in animal feeding systems.

One of the priority global trends of pig breeding development at the moment is the rejection of antibiotics in diets of farm animals. This is due to widespread dissemination of infections caused by multidrug-resistant pathogenic bacteria. Their huge number, plasticity of genetic material, as well as the ability to exchange genetic information between completely different species have opened the way for these bacteria to endless adaptation. It is believed that appearance of such bacteria is provoked by intensive and long-term use of antibiotics in veterinary medicine and agriculture [1].

A promising alternative to antibiotics is the introduction of new biologically active feed additives based on chlorella microalgae into pigs diet. Chlorella contains all essential amino acids and vitamins. Due to its complex effect on animals body it allows to increase productivity and significantly reduce mortality of farm animals. And that is why the widespread and active cultivation of chlorella algae is currently observed.

Chlorella is one of the most famous natural producers of proteins, carbohydrates, lipids, vitamins, with an easily regulated ratio of these compounds. Depending on cultivation conditions of the
microalgae, it is possible to achieve protein content in the cell up to 88%, lipids – up to 86% and carbohydrates – up to 38% calculated on dry matter [2, 3, 4].

Jung Hyun Kwak, Seung Han Baek, Yongje Woo, Jae Kab Han, Byung Gon Kim, Oh Yoen Kim (2012) in their article, based on in-vitro studies, confirm that chlorella suspension is a powerful modifier of immune reactivity of animals organism.

Known studies of the feed additive «AlgaVet» (Chlorella vulgaris 2 g / l, or 0.2% of dry biomass) for feeding young pigs in which its high efficiency was determined in reducing feed consumption by 9.1%, crude protein - by 9.6% and metabolic energy - by 8.9% per unit of gain, reliable (P≤0.05) increase in live weight of hybrid piglets by 6.9%, average daily gains - by 9.9%, compared with analogs of the control group. The results were confirmed in 2016 in production conditions of Zhivaya priroda LLC pig farm, Klin, Moscow region.

Thus, the direction of developing resource-saving technologies for keeping and feeding pigs aimed to pork production through the use of chlorella biomass as a replacement for more expensive components of the diet of farm animals is especially relevant [2].

The purpose of this work is to develop an effective technology of pork production involving the use of complex biologically active additive of biocorrective action «Chlorelact», made on the basis of lactulose and microalgae chlorella, aimed to obtaining high productivity, as well as high physiological parameters of young pigs.

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 2020. The experiment involved 3 groups of animals, 25 heads each at the age of 2 months.

Animals of the control, I and II experimental groups were kept in the same conditions of keeping, corresponding to zootechnical standards.

The experimental groups differed from each other in that animals of the control group received a standard feeding ration (SR), and analogs of the I experimental group - SR + drug for veterinary use with main active ingredient - chlortetracycline (VP) at a dose of 7.5 g / kg of live weight (the first 5 days orally), II experimental group - SR + "Chlorelact" in a dosage of 0.2 ml per 1 kg of live weight of animal.

| Index                  | Group               |
|------------------------|---------------------|
|                        | control             | I experimental     | II experimental |
| Live weight, kg        | 16.21±0.48          | 16.34±0.53         | 16.28±0.42      |
| Dosage of test drugs   | VP 7.5 g/kg         | «Chlorelact» 0.2 mg/kg |

It should be noted that VP after taking it, is completely removed from the body of the animal on day 20.

For feeding the experimental pigs in all groups, we used compound feed with the following quality indicators: metabolizable energy 12.34 MJ; dry matter 88.24%; crude protein 16.22%; crude fiber 5.86%; lysine 0.62%; methionine with cystine 0.47%; threonine 0.54%; calcium 0.66%; phosphorus 0.52%, as well as a group of vitamins (A, D3, E, K3, B1, B2, B3, B4, B5, B6, B12) and trace elements (iron, copper, zinc, manganese, cobalt, iodine and selenium). The animals were fed in the morning and in the evening. The pigs had free access to water. Gilts were fed up to 6 months of age.

Blood samples of animals aged 180 days were taken from tail vein.

Determination of natural immunity of the experimental pigs was studied on the basis of bactericidal activity of blood serum using standard zootechnical methods.

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

One of the most important stages in pig fattening is increasing meat productivity. In our research, we studied meat productivity based on monthly weighing of experimental young animals.

From the beginning of the experiment up to 3 months of age, the live weight of the experimental young animals varied within insignificant limits. However, starting from the age period of 120-150 days, the animals that received VP and "Chlorelakt" in composition of compound feed exceeded the peers of the control group in live weight by 0.79 kg or 0.67% and 1.29 kg or 1.87% (P≤0.05); 150-180 days - by 2.09 kg, or 2.76% (P≤0.05) and 2.32 kg, or 3.36% (P≤0.01), respectively.

According to results of the studies, animals of all experimental groups had a high live weight, which fluctuated insignificantly: 116.98 kg in the control group, 118.76 kg in experimental group I and 119.34 kg in experimental group II.

Such an increase in live weight in experimental animals of the I and II experimental groups contributed to an increase in absolute and average daily gain in live weight in comparison with analogs of the control group in period from 60-90 days by 0.2 kg, or 0.88% and 0.3 kg, or 1.32%; 90-120 days - by 0.3 kg, or 1.31% and 0.5 kg, or 2.16%; 120-150 days - by 0.80 kg, or 3.01% and 1.5 kg, or 5.49%; 150-180 days - by 0.80 kg, or 2.77%, respectively (table 1).

| Age, days | Absolute gain in live weight, kg |
|-----------|---------------------------------|
|           | control | I experimental | II experimental |
| 60-90     | 22.4±0.09 | 22.6±0.07 | 22.7±0.08 |
| 90-120    | 22.6±0.18 | 22.9±0.19 | 23.1±0.17 |
| 120-150   | 25.8±0.11 | 26.6±0.14* | 27.3±0.19** |
| 150-180   | 28.1±0.16 | 28.9±0.15* | 28.9±0.14** |
| 60-180    | 101.37±0.19 | 103.8±0.27* | 104.42±0.25** |

* P<0.05; ** P<0.01.

At the same time, over the entire period of the experiment, animals of II experimental group who received an additional biologically active feed additive "Chlorelakt" in composition of combined feed exceeded the analogs of the control and I experimental groups by 3.04 kg, or 2.91% and 0.62 kg, or 0.59%.

In general, evaluating the meat productivity of the experimental pigs, it can be concluded that the animals that received studied feed additive with the compound feed more fully revealed their potential productivity in comparison with the analogs of the control and I experimental groups.

A sharp increase in productivity of the young pigs fed with "Chlorelakt" can occur, firstly, due to inclusion in it of a plant component consisting of microscopic algae Chlorella. They, in turn, can improve the digestive capacity of gastric juice, and also protein, vitamin and mineral metabolism in the animal's body. One of positive effects of such processes is high growth energy of young animals at significantly lower feed costs per unit of production. The result of these processes is high growth energy with lower feed costs per unit of production, strengthening of the skeleton and better general health of the animals.

The second component for such changes is the presence of lactulose in feed additive "Chlorelakt", which has a positive effect on microflora of large intestine, increasing content of lactobacilli. As a result of bacterial metabolism of lactulose in the large intestine, a number of organic acids are released, which reduces the pH of the medium (pH) [5, 6].

Because of the use of the new biologically active feed additive "Chlorelakt" in the feeding of experimental fattening pigs, we also decided to study its effect on the physiological state of the animals [7].

The parameters of the physiological state of the animals were assessed on the basis of biochemical parameters of blood of the pigs.
The content of bilirubin in blood of animals affects the normal functioning of liver. In the course of experimental studies, it was found that content of direct bilirubin in blood of animals of II experimental group is higher compared to the analogs of the control and I experimental groups by 0.44 mmol / l, or 13.56% (P≤0.05) and 0.79 mmol / L, or 26.67% (P≤0.01) and total bilirubin - by 0.72 mmol / L, or 12.37% and 1.22 mmol / L, or 32.24%, respectively. The higher content of bilirubin in blood of pigs from experimental groups I and II suggests that they have an increase in the level of metabolic processes occurring inside their body.

Protein metabolism is a key process that determines meat productivity of animals. To evaluate it, we conducted level of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) analysis in blood serum of experimental pigs. As a result, it was found that content of aspartate aminotransferase (AST) in blood serum of pigs of the II experimental group is higher than that of the analogs of the control and I experimental groups by 2.34 U / L, or 10.32% (P≤0.01) and 1.26 U / L, or 5.36% (P≤0.05); alanine aminotransferase (ALT) - by 12.65 U / L, or 16.40% (P≤0.01) and 2.15 U / L, or 1.67% (P≤0.01), respectively.

Calculations have shown that the coefficient de Ritis (ALT / AST) in terms of the control group equal to 0,68%, experimental group I - 0.64 and experimental group II - 0.54, and if the ratio of AST to ALT: - 2.14, 1.67 and 1.59, respectively.

The introduction of the tested drugs into technology of feeding pigs made it possible to achieve a decrease in content of aspartate aminotransferase and alanine aminotransferase in the blood serum to a physiologically determined norm, which indicates stabilization of tissue metabolism in the body of animals.

The high level of protein metabolism in the experimental pigs was also confirmed by the increased content of urea.

4. Conclusion
The use of VP and feed additive «Chlorelact» made it possible to significantly increase in live weight gain of animals from experimental groups in comparison with animals of control group. The best results were obtained from animals that received a complex biologically active additive «Chlorelact» as part of a compound feed.

The assessment of physiological state of the experimental animals showed that pigs that received «Chlorelact» as part of the feed had such a set of studied parameters, which is characterized by most stable tissue metabolism in the animal organism.

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References
[1] Dzhioev Yu P et al. 2019 Analysis of the "Superbacteria" issue and contemporary approaches to its solution Proceedings of iniversities. Applied chemistry and biotechnology 4(31) 665-78
[2] Melnikov S and Manakina E 2017 The use of chlorella in feeding farm animals Engineering Journal: Science and Innovation 8(90) 40-3
[3] Uribe-Wandurraga Z N, Iguil M, García-Segovia P and Martínez-Monzó J 2020 In vitro bioaccessibility of minerals from microalgae-enriched cookies Food and Function 11(3) 2186-94
[4] Abdelnour S A, Sheiha A M, Taha A E, Swelum A A, Alarifi S, Alkahtani S and Ismail I E 2019 Impacts of enriching growing rabbit diets with chlorella vulgaris microalgae on growth, blood variables, carcass traits, immunological and antioxidant indices Animals 9(10) 788
[5] Makarov D Yu, Ruzheinikov F V, Shkalenko V V and Nikolaev D V 2012 Lactulose-containing feed additives and their effect on the productivity of experimental pigs Pigbreeding 5 61-2
[6] Nikolaev S I, Volokolupov S I, Vodiyannikov V I and Shkalenko V V 2016 Biologically active fodder additives «laktumine», «lactofen» and «laktofleks» influence on piglets’ hematological parameters *Izvestia of the Lower Volga Agro-University Complex* 2(42) 147-52

[7] Khramtsov A G, Ryantseva S A, Budkevich R O, Akhmedova V R, Rodnaya A B and Marugina E V 2018 Prebiotics as functional food ingredients: terminology, choice and comparative evaluation criteria, classification *Problems of nutrition* 87(1) 5-17