Ensuring health, safety, and realization of productive qualities of pigs by immunotropic preparations

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Abstract. Under the conditions of the pig-breeding complex, the effectiveness of the use of immunotropic drugs PigStim-C and PigStim-M to newborn piglets with the aim of realizing the bioresource productivity potential was evaluated. Against the background of the body's immunocorrection of piglets, a decrease in the number of diseases was noted by 1.5–2.9 times, a reduction in recovery time by 11.4–23.5%, an increase in livestock safety to 98.0–100.0%. Immunotropic drugs PigStim-C and PigStim-M activate hematopoiesis, causing a positive dynamics of the hematological and biochemical profiles of the body of pigs during ontogenesis. It was found that animals of the 1st and 2nd experimental groups exceeded their peers in the control by live weight by 7.1 kg or 6.9% and by 8.6 kg or 8.2%, the average daily gain by 34 and 41 g. The slaughter mass of pigs on the background of immunocorrection was higher than the control by 6.22 and 7.08 kg. According to the results of chiselling and trimming of half carcasses of pigs in experimental groups, an increase in the number of trimmed pork by 1.88 and 2.16 kg in the 1st and 2nd experimental groups as compared with the control was established.

1. Introduction
Pig breeding has been an important meat supplier since the early 1970 s. In 2013, 111 million tons of pork meat was produced in the world. In comparison to other four main types of farm animals, pork meat with a share of 36% ranks first in all world meat [1].

Pork has become the number one meat consumed worldwide. Meeting the demand for pork has forced the revolution of swine production from traditional husbandry practices that involved a few pigs or small herds to intensive concentration of swine raised in multisite production systems. This dramatic change has made the production of pork very efficient, but it has also changed the ecology of many swine diseases, may encourage the emergence of new diseases, and amplifies the economic impact of swine diseases. Sustained treatment of diseases in livestock production is not feasible making prevention of disease a priority. Prevention of livestock diseases involves eliminating exposure to pathogens and anti-viral strategies to prevent or reduce clinical disease. For some swine
diseases, efficacious vaccines can be made, however, for other diseases the host/pathogen relationship is more complex and efficacious vaccines are not available. Given the increasing demand for pork, the development of new approaches to improve swine anti-viral immunity is critical [2].

A necessary condition for the growth of profitability and competitiveness of the pig industry is the development and improvement of the organizational and economic mechanism for the effective functioning of pig breeding organizations. The key element of this process is innovation capital renewal, which is possible through technical, organizational, economic and managerial innovations in organizations [3, 4].

The transition of the pig industry to the industrial base, along with the undoubted advantages that contribute to increasing the profitability of the industry as a whole, provoked an aggravation and the emergence of a number of new problems, the main of which is the inconsistency of the environmental conditions of the biological needs of the body of pigs. The development and introduction of efficient technologies for keeping, feeding and supporting animals into the production process, although it allows increasing productivity, improving the quality of the products and profitability of the industry as a whole, often violates the relationship between the organism of pigs with the environment and traditional conditions of feeding and feeding established in the process of phylogensis. Technological methods of modern large pig breeding complexes, lack of exercitation, inefficient use of antibacterial drugs cause impaired metabolism, reduced resistance of the body of pigs, which ultimately leads to high morbidity and low productivity of the pig-livestock [5, 6].

In such conditions, the nature of the animal and the physiological characteristics of the organism are not able to change as quickly as the conditions of housing, feeding, and technology of animal husbandry in general. Often, the animal's body fails to avoid the effects of stress factors and to adapt to changing environmental conditions, which leads to various functional disorders and diseases [7, 8].

In pig production, antibiotics are usually used as animal feed additives for the treatment of bacterial infections and growth promotion. However, the over-use of antibiotics has caused serious problems such as bacterial resistance, drug residue in pork product and environmental pollution, which is harmful for health of animals and human [9].

In view of the fact that it is not possible to eliminate the effect of many stress factors, the prevention of the negative impact on the body of stressors, on the one hand, and the increase of adaptive abilities of animals to the conditions of industrial maintenance, on the other hand, is of primary importance. Newborn piglets require special attention, as they are more exposed to environmental factors, and adaptive mechanisms of their body have not yet been formed. On the other hand, the early period of postnatal ontogenesis is optimal for directed influence on the process of formation of protective and adaptive mechanisms of their organism. From this perspective, the administration of immunotropic drugs for newborn piglets is a promising technique for intensifying the pig industry [10-12].

The purpose of this work is to realize the bioresource potential of the body of pigs by activating non-specific resistance with the new PigStim-C and PigStim-M immunotropic drugs.

2. Material and methods

The research work was carried out in a pig breeding complex of the closed joint-stock company Progress of the Cheboksary District of the Chuvash Republic, and the materials were processed in the laboratory of the Department of Morphology, Obstetrics and Therapy of the Chuvash State Agricultural Academy.

The objects of research were suckling piglets, weaners and fattening young animals before slaughter for meat. Three groups of newborn piglets (control, 1st experimental and 2nd experimental) were selected on the principle of pairs-analogues, taking into account the clinical and physiological state and live weight of 50 animals in each group.

Immunotropic preparations were administered intramuscularly to newborn piglets in order to determine the effect on clinical-physiological state, hematological and biochemical blood profiles, non-specific body resistance of piglets, as well as on growth, morbidity, preservation and productive qualities.
of young pigs. Piglets of the 1st experimental group were intramuscularly administered preparation PigStim-C, and the 2nd experimental group - PigStim-M, at a dose of 0.3 ml, three times on the 1st, 4th and 7th days of life. No preparations were administered to control group animals.

PigStim-C is a complex immunotrophic drug for the realization of the biological potential of farm animals. Preparation represents aqueous suspension containing polysaccharide complex of yeast cells immobilised in agar gel with addition of benzimidazole derivative(-)-2,3,5,6-tetrahydro-6-phenylimidazo[2,1-b]-thiazole hydrochloride and antibacterial agent of cephalosporin group – cephalazolin.

PigStim-M - complex preparation for stimulation of non-specific body resistance, prevention of diseases of young farm animals, is an aqueous suspension containing polysaccharide complex of yeast cells immobilized in agar gel with addition of benzimidazole derivative(-)-2,3,5,6-tetrahydro-6-phenylimidazo[2,1-b]-thiazole hydrochloride and antibacterial preparation of macrolide group – erythromycin.

Polysaccharides present in the preparations are high molecular weight biologically active compounds with marked immunomodulatory activity, the active component of which is glucan.

Beta-glucan is a kind of functional polysaccharide which widely spreads in the cell wall of fungi, bacterial and cereal seeds (oats, rye and barley, etc.). It has various biological functions such as promotion on immune function, anti-infection and glucose regulation [13]. One β-glucan molecule usually comprises 1,3-linked glucopyranosyl residues with a small number of 1,6-linked glucopyranosyl residues side chains. The special glycosidic bonds and intermolecular hydrogen bonds contribute a kind of unique helical molecular structure which is easily recognized and accepted by immune system. Plenty of research indicates that β-glucan could promote the growth performance of pigs [14] and cattle [15], which is concerned with the function of promoting intestinal health and improving body's immunity.

Feeding pigs at the enterprise is carried out with complete feed based on self-produced grain mixture with the addition of feed concentrates produced by PremiKorm LLC. Prenursery pigs begin to teach to eat feed independently, starting from the 9th day of life. In feeding prenursery pigs it is necessary to use the prestarter feed for piglets aged 9-45 days SPK-3 START. Preparation of mixed feeds for piglets weighing 12-30 kg is carried out by adding to the grain mixture 20% feed concentrate for piglets KBM SK-4. Young pigs with a live weight from 30 to 70 kg are fed with a balanced feed, adding 15% feed concentrate KBMM SK-5, and pigs live weight 70-110 kg - 10% feed concentrate KBME SK-6.

The pig-breeding complex Progress CJSC is an enterprise with a complete pork production cycle. The technological process is organized by a three-phase flow system of growing and fattening pigs, divided into 4 sections (stages): reproduction, farrowing, growing and fattening. Groups of suckling sows are formed with a rhythm of 7 days. Weaning is performed at the age of 25-26 days.

Number of erythrocytes, concentration of hemoglobin, total number of leukocytes were determined on the PCE 90 Vet automatic veterinary hematology analyzer (Erma Inc., Japan). The status of the instrument, measurement, and plotting are displayed on a large LCD display. The device is controlled using an integrated compact keyboard. The analyzer automatically takes the blood sample, dilutes it, mixes it, lyases it, supplies it and washes it.

The total protein level and protein spectrum in serum were determined on the IDEXX VetTest 8008 biochemical analyzer (IDEXX, Russia). The VetTest analyzer offers to perform a series of steps, accompanying each of its offerings with a short audio signal, which helps the user prepare the pipette dispenser in time, insert a sample, and begin the analysis. The dispenser automatically takes the required amount of sample and then distributes it to the slide in sequence of 10 μl. As the sample passes through the slide layers, biochemical reactions occur that result in successive color changes. The VetTest analyzer optical system determines colors and their intensity. The analyzer converts the measured results into numerical measure values that are displayed on the analyzer screen and printed.

Then, phagocytic activity of leukocytes was determined using the daily agar culture of
**Staphylococcus aureus**, lysozyme activity of blood plasma – by agar culture *Micrococcus lysodeikticus*, bactericidal activity of blood serum – using daily agar culture of *Escherichia coli*, as well as the amount of antibodies in the serum was measured on a photoelectrocolorimeter FEK-56M (Zagorsky Optical and Mechanical Plant, Russia). Live weight and average daily gain of animals were determined by monthly weighing.

Meat carving is one of the stages of meat raw material processing, during which muscle, connective and adipose tissues, i.e., meat, are separated from bone content.

Vests – separation from meat of small bones, tendons, cartilages, blood vessels, film and contaminants.

Animal slaughter was carried out in the slaughter shop of the meat processing enterprise IP Shaleeva O.V. at the address of the Chuvash Republic, Cheboxar district, village of Ishlei, State Farm Str., 4a, according to the rules of veterinary examination of slaughter animals and veterinary and sanitary expertise of meat and meat products.

Veterinary and sanitary examination of meat by organoleptic (appearance, color, texture, smell, condition of fat and tendons, degree of bleeding), cooking sample (smell, transparency, taste of broth) and biochemical parameters (pH, amino-ammonia nitrogen, formal acid reaction, reaction to peroxidase and with copper sulfate) was done in accordance with [16-19].

The carving and venting were carried out after separation of the carcasses into semi-carcasses and cooling in a cholo-dil chamber at a temperature of -3...-5 °C and an air velocity of 1 - 3 m/s for 10 - 13 hours.

The results of the experiments were processed by the method of variation statistics on the reliability of the difference between the compared indicators (P <0.05-0.001) using the Microsoft Office Excel software package.

### 3. Research results

The microclimate parameters in the workshops for the maintenance of suckling sows with piglets weaned piglets and young pigs for fattening for the entire observation period were within the limits of zoohygienic norms and corresponded to the needs of the organism with regard to gender and age groups (table 1).

| Indicator                  | The premise for keeping during the period: |          |          |
|---------------------------|-----------------------------------------|----------|----------|
|                           |                                          | suet     | weaning  | fattening|
| Temperature, °C           | 19.12±0.12                              | 18.80±0.17| 16.00±0.15|
|                           | 28.48±0.10*                             |          |          |
| Relative humidity, %      | 66.80±0.80                              | 65.20±0.49| 61.80±1.16|
| Airspeed, m/s             |                                        |          |          |
| winter period             | 0.10±0.01                               | 0.14±0.01| 0.23±0.01|
| summer period             | 0.31±0.01                               | 0.44±0.01| 0.68±0.03|
| Concentration:            |                                        |          |          |
| carbon dioxide, %         | 0.16±0.01                               | 0.16±0.00| 0.19±0.00|
| ammonia, mg / m$^3$       | 6.40±0.51                               | 13.40±0.75| 15.20±0.58|
| hydrogen sulfide, mg / m$^3$ | 3.00±.32                          | 3.40±0.51| 4.20±0.58|
| Microbial contamination, thsn/ m$^3$ | 18.80±0.58                      | 19.60±0.75| 26.60±1.03|

Notes: * air temperature at the piglets' resting place (den) in the first week of life with local heating with infrared lamps.

The conditions of keeping and feeding of pigs at the pig-breeding complex of Progress CJSC of the Cheboksary District of the Chuvash Republic comply with the recommended and contribute to the manifestation in animals of the genetically laid potential of productivity, and compliance with the veterinary and sanitary rules and the mode of operation of the enterprise ensures its veterinary well-
During the experimental period, piglets of all groups were observed with fixation of body temperature, heart rate, and respiratory movements.

Over the entire observation period, there were no obvious differences in the behavioral responses of animals, with the exception of a short-term stress response in piglets of the experimental groups after intramuscular injection of immunotropic drugs, as well as sporadically occurring cases of diseases in the experimental groups described below.

The results of the study of hematological parameters of piglets of the experimental groups are presented in table 2.

**Table 2. Hematological parameters of young pigs.**

| Indicator                  | 1     | 14    | 30    | 60    | 90    |
|----------------------------|-------|-------|-------|-------|-------|
|                           | control group |       |       |       |       |
| Erythrocytes, ×10¹² / l    | 4.52±0.07 | 4.52±0.06 | 4.56±0.08 | 6.02±0.10 | 6.68±0.11 |
| Hemoglobin, g/ l           | 98.80±1.16 | 96.80±0.80 | 91.80±0.97 | 93.00±1.30 | 95.20±2.08 |
| Leukocytes, ×10⁹ / l       | 7.04±0.19 | 13.22±0.21 | 12.64±0.26 | 12.10±0.62 | 11.92±0.72 |
|                           | 1st experimental group |       |       |       |       |
| Erythrocytes, ×10¹² / l    | 4.50±0.07 | 4.76±0.05* | 4.90±0.07* | 6.48±0.13* | 7.02±0.08* |
| Hemoglobin, g/ l           | 99.00±0.95 | 99.80±0.86* | 95.80±1.43* | 97.40±1.21* | 100.20±1.07 |
| Leukocytes, ×10⁹ / l       | 7.06±0.20 | 14.78±0.13*** | 15.84±0.11*** | 14.24±0.29* | 13.86±0.32* |
|                           | 2nd experimental group |       |       |       |       |
| Erythrocytes, ×10¹² / l    | 4.52±0.07 | 4.78±0.06* | 4.96±0.09* | 6.50±0.12* | 7.06±0.09* |
| Hemoglobin, g/ l           | 98.80±1.07 | 99.60±0.81* | 95.60±1.29* | 97.60±1.08* | 99.80±1.16 |
| Leukocytes, ×10⁹ / l       | 7.04±0.18 | 14.80±0.10*** | 15.90±0.07*** | 14.32±0.24* | 13.72±0.24* |

Notes: * P<0.05; *** P<0.001.

The dynamics of the number of erythrocytes and leukocytes, as well as the concentration of hemoglobin in the blood of piglets from the control, 1st and 2nd experimental groups for the entire observation period corresponded to the regularity of age-related changes in the blood picture and, was within physiological norms.

At the age of 14 days, the number of erythrocytes in the blood of piglets from the 1st experimental group was significantly higher by 5.3%, and the 2nd experimental one - by 5.8% than in the control group. At 30, 60 and 90 days of age, the number of erythrocytes also turned out to be higher than the control indicator in the blood of animals of the 1st experimental group by 7.5, 7.6 and 5.1%, and the 2nd experimental group - by 8.8, 8.0 and 5.7%, respectively (P <0.05).

The hemoglobin concentration in the piglets of the 1st experimental group in the 14th, 30th and 60th day of age was higher compared to the control by 3.1, 4.4 and 4.7%, respectively, and in the blood of the 2nd experimental animals groups - by 2.9, 4.1 and 4.9%. At 90 days of age, the hemoglobin concentration in the piglets of the 1st and 2nd experimental groups also turned out to be higher than the control indicator by 5.3 and 4.8%, respectively, but not statistically significant.

An increase in the number of erythrocytes and an increase in the hemoglobin concentration in the blood of piglets from the experimental groups indicate an increase in hemopoiesis against the background of intramuscular administration of the immunotropic drugs PigStim-C and PigStim-M in the early period of postnatal ontogenesis.

The number of leukocytes in the blood of piglets of the 1st experimental group at the age of 14, 30, 60 and 90 days turned out to be higher than the control parameters by 11.8%, 25.3, 17.7 and 16.3%, and the 2nd experimental one - 12.0%, 25.8, 18.3 and 15.1%, respectively. It should be noted that the number of leukocytes in the experimental groups did not go beyond the limits of physiological norms. Consequently, leukocytosis occurs, not exceeding physiological norms.

Differentiation of blood leukocytes in piglets is presented in table 3.
Table 3. Leukocyte formula of piglets.

| Group of          | 1     | 14    | 30    | 60    | 90    |
|-------------------|-------|-------|-------|-------|-------|
|                   | Basophils, % |       |       |       |       |
| Control           | 0.2±0.2 | 0.2±0.2 | 0.4±0.24 | 0.4±0.24 |       |
| 1st experimental  | 0.6±0.24 | 1.0±0.32 | 1.2±0.20* | 1.2±0.20* |       |
| 2nd experimental  | 0.8±0.20 | 1.0±0.32 | 1.4±0.24* | 1.2±0.20* |       |
|                   | Eosinophils, % |       |       |       |       |
| Control           | 0.6±0.24 | 0.8±0.20 | 1.0±0.32* | 0.8±0.37** |       |
| 1st experimental  | 0.2±0.20 | 0.4±0.24* | 1.2±0.20* | 1.2±0.20* |       |
| 2nd experimental  | 0.6±0.24 | 1.0±0.32 | 1.0±0.32 | 0.8±0.37 |       |
|                   | Immature neutrophil, % |       |       |       |       |
| Control           | 0.6±0.24 | 0.8±0.20 | 0.6±0.40 | 0.8±0.37 | 0.8±0.20 |
| 1st experimental  | 0.4±0.24 | 0.8±0.20 | 0.6±0.24* | 0.8±0.37 | 1.0±0.32 |
| 2nd experimental  | 0.6±0.24 | 1.0±0.32 | 1.0±0.32 | 0.8±0.37 |       |
|                   | Banded neutrophil, % |       |       |       |       |
| Control           | 10.8±0.37 | 6.8±0.37 | 3.0±0.45 | 3.0±0.45 | 3.0±0.45 |
| 1st experimental  | 10.6±0.40 | 3.6±0.40*** | 1.4±0.24** | 1.6±0.24** | 2.4±0.24* |
| 2nd experimental  | 11.0±0.45 | 3.8±0.37*** | 1.6±0.24** | 1.8±0.20** | 2.2±0.20* |
|                   | Segmented neutrophil, % |       |       |       |       |
| Control           | 37.6±0.40 | 34.2±0.58 | 33.8±0.58 | 37.8±0.37 | 42.2±0.37 |
| 1st experimental  | 38.4±0.51 | 27.2±0.58*** | 22.4±0.51*** | 27.6±0.51*** | 35.8±0.37*** |
| 2nd experimental  | 37.2±0.37 | 28.4±0.40*** | 23.2±0.37*** | 28.2±0.37*** | 36.4±0.40*** |
|                   | Lymphocytes, % |       |       |       |       |
| Control           | 47.0±0.71 | 53.4±0.51 | 58.0±0.55 | 53.0±0.71 | 47.8±0.37 |
| 1st experimental  | 46.8±0.51 | 64.8±0.37*** | 71.0±0.45*** | 65.0±0.55*** | 55.6±0.51*** |
| 2nd experimental  | 47.2±0.66 | 63.2±0.37*** | 70.4±0.51*** | 63.4±0.51*** | 55.0±0.45*** |
|                   | Monocytes, % |       |       |       |       |
| Control           | 3.8±0.37 | 3.6±0.24 | 3.0±0.32 | 3.2±0.37 | 3.8±0.37 |
| 1st experimental  | 4.0±0.32 | 2.8±0.37** | 2.4±0.24* | 2.8±0.37* | 3.2±0.37* |
| 2nd experimental  | 3.8±0.37 | 2.4±0.24*** | 2.0±0.32* | 3.0±0.32* | 3.2±0.20* |

Notes: * P<0.05; ** P<0.01; *** P<0.001.

On the first day of life, basophils were absent in the blood of pigs of all studied groups. There was a higher concentration of basophil by 0.4%, 0.8, 0.8 and 0.8% in the blood of pigs of the 1st experimental group in the 14th, 30th, 60th and 90th day of age and the 2nd experimental group - by 0.6%, 0.8, 1.0 and 0.8%, respectively, rather than in control.

The number of eosinophils in the blood of piglets from the experimental groups was significantly lower than in the control, starting from the age of 14 days. This fact is more pronounced in piglets of the second experimental group.

No significant differences in the proportion of young neutrophils were observed in the experimental groups (P > 0.05). The relative number of the stab and segmented neutrophils and monocytes was lower in the blood of piglets from the experimental groups, starting from the age of
14 days (P <0.05 - 0.001) than in the control group. Moreover, the most pronounced difference was observed in segmented neutrophils. So, at the 14th, 30th, 60th and 90th day old piglets of the 1st experimental group, the relative number of segmented neutrophils in the blood was lower than the control indicator by 7.0%, 11.4, 10.2 and 6.4%, and the 2nd experimental - by 5.8%, 10.6, 9.6 and 5.8%, respectively. It should also be noted that in the 1st and 2nd experimental groups, despite the apparent decrease in the proportion of segmented neutrophils in the total number of leukocytes, their number relative to all neutrophils increased relative to the control group. Thus, there is a decrease in the number of neutrophils with a nuclear shift to the right.

Analysis of the relative number of lymphocytes indicates a significant (P <0.001) increase in their number in the 1st and 2nd experimental groups, starting from the age of 14 days. This indicator remained higher than that of the control group in animals of the 1st experimental group at the 14th, 30th, 60th and 90th day, respectively, by 11.4%, 13.0, 12.0 and 7.8%, and in animals of the 2nd experimental group - by 9.8%, 12.4, 10.4 and 7.2%, respectively. Therefore, the tested immunotropic drugs cause lymphocytosis in the blood of pigs.

It was found that at the age of 14 days the phagocytic activity of blood neutrophils in pigs of the 1st and 2nd experimental groups was higher than the control indicator by 4.8 and 5.6%, respectively, in the 30-day age-by 5.0 and 5.4%, in the 60-day – by 3.8 and 4.2% and in the 90-day age – by 5.8 and 6.4%, respectively.

The bactericidal activity of the blood serum of the piglets in the experimental groups did not have significant differences at the age of 1 day. However, already at the age of 14 days, it was significantly higher than the benchmark by 3.6 and 3.4% in piglets of the first and second experimental groups, respectively. At 30, 60 and 90 days of age, the bactericidal activity of the blood serum of pigs from the first experimental group was higher than the control indicator by 6.2, 8.4 and 8.6%, and in piglets from the second experimental group - by 6.6, 7, 8 and 9.2% respectively.

Plasma lysozyme activity in piglets of the experimental groups had significant differences between the 14-day age and the end of the observation period. Thus, at the 14-day-old age, the lysozyme activity of the blood plasma of the control group of piglets was lower than the first and second experimental groups by 4.8 and 4.0%, respectively, in the 30-day one - 6.2 and 5.4%, in 60 daily - 7.4 and 7.2%, at 90-day age - by 8.6 and 8.0%.

Thus, the results of immunological blood tests indicate that intramuscular administration of piglets immunotropic drugs PigStim-C and PigStim-M in the early period of postnatal ontogenesis promotes activation of cellular and humoral factors of nonspecific resistance of the body.

During the periods of neonatal and suction, diseases characterized by diarrhea of non-infectious etiology were predominantly recorded. Diseases proceeded without fever, severe anorexia and hypodynamia. Therapy for emerging diseases was carried out using complex methods adopted in the household, using broad-spectrum antibacterial drugs.

As can be seen from table 4, among the piglets of the control group, 26 cases of the disease were recorded during the neonatal period and suction, while the treatment for the diseases that occurred was successful only in 24 cases, 2 pigs died from exhaustion and dehydration as a result of diarrhea of non-communicable etiology.

In the 1st experimental group 11 diseases of piglets were recorded, of which 10 were cured and 1 died, and in the 2nd experimental group - 9 cases of diseases of pigs, all of which were cured. The average duration of disease in piglets of the control group was 1.96 days, the 1st experimental one was 1.55 days, and the 2nd experimental group was 1.67 days. The incidence of piglets of the 1st and 2nd experimental groups turned out to be lower than the control index, respectively, by 30 and 34%, besides, the indicator of the effectiveness of therapeutic measures and the safety of piglets significantly improved.
Table 4. The incidence and safety of piglets in the periods of newborn and suction.

| Indicator                  | Control | 1st experimental | 2nd experimental |
|----------------------------|---------|------------------|------------------|
| Number of pigs             | 50      | 50               | 50               |
| Got sick                   | 26      | 11               | 9                |
| Recovered                  | 24      | 10               | 9                |
| Died                       | 2       | 1                | –                |
| Disease duration, days     | 1.96    | 1.55             | 1.67             |
| Safety, %                  | 96.00   | 98.00            | 100.00           |

Among the diseases of post-weaned pigs (table 5), the leading place was occupied by an edematous disease, accompanied by symptoms of redness and swelling of the eyelids, conjunctivitis, watery effusions from the eyes, as well as deterioration of the general clinical condition, manifested by precarious gait, refusal of food and water. Therapy for emerging diseases was performed immediately at the first clinical signs, before the symptoms of damage to the nervous system, generally accepted in veterinary treatment regimens. Just as in the nursing period, there were cases of diseases with symptoms of diarrhea and non-infectious etiology among weaned piglets. In addition, in the weaning period, individual cases of other diseases, such as arthritis, were recorded.

Table 5. Incidence and safety of weaned piglets.

| Indicator                  | Control | 1st experimental | 2nd experimental |
|----------------------------|---------|------------------|------------------|
| Number of pigs             | 48      | 49               | 50               |
| Got sick                   | 14      | 7                | 5                |
| Recovered                  | 13      | 7                | 5                |
| Died                       | 1       | –                | –                |
| Disease duration, days     | 2.43    | 1.86             | 2.00             |
| Safety, %                  | 97.92   | 100.00           | 100.00           |

Notes:* Preservation for all previous periods.

Among the weaned pigs of the control group, 14 diseases of non-communicable etiology were registered, 13 of them were successfully treated with total disease duration of 2.43 days, one weaned pig died. In the 1st experimental group, 7 cases of diseases were recorded, the treatment of all of them was successful, and the average duration was 1.86 days. In the 2nd experimental group 5 diseases of piglets were recorded, all of which recovered on average after 2.00 days. Thus, the use of immunotrophic drugs contributed to reducing the number of diseases of piglets during the weaning period by 2.0–2.8 times, and their duration by 0.43–0.67 days.

Among the diseases of young pigs of all three groups in the fattening period, the most frequent were bronchitis, manifested by cough without increasing body temperature and worsening of the general clinical condition (table 6). Also often there were diseases with signs of joint damage. Therapy in case of occurring diseases was carried out by methods and treatment methods generally accepted in veterinary medicine and in this household.
Table 6. Incidence and safety of fattening pigs.

| Indicator                  | Group of animals |         |         |
|----------------------------|------------------|---------|---------|
|                            | Control          | 1st experimental | 2nd experimental |
| Number of pigs             | 47               | 49       | 50      |
| Got sick                   | 12               | 7        | 8       |
| Recovered                  | 12               | 7        | 8       |
| Died                       | -                | -        | -       |
| Disease duration, days     | 3.25             | 2.86     | 2.88    |
| Safety, %                  | 100.00           | 100.00*  | 100.00* |

Notes:* Preservation for all previous periods.

During the fattening period among the pigs of the control group, there were 12 cases of diseases, in the 1st experimental - 7, and in the 2nd experimental – 8. The average duration of disease in young animals was 3.25 days in the control group, 2.86 days in the 1st experimental and 2.88 days in the 2nd experimental. In this case, therapy in all cases of disease was effective and the case was not recorded.

During the period of experience, pigs of all three groups were weighed regularly. Individual assessment of the live weight of individuals was not carried out, each group of pigs was weighed, followed by the determination of the average weight (table 7).

Table 7. Growth dynamics of pigs.

| Age   | Group of animals |         |         |
|-------|------------------|---------|---------|
|       | Control          | 1st experimental | 2nd experimental |
|       | Pre-slaughter live weight, kg |         |         |
| 1     | 1.00             | 1.00    | 1.00    |
| 30    | 6.59             | 7.02    | 7.09    |
| 60    | 15.23            | 16.23   | 16.46   |
| 90    | 26.84            | 28.65   | 29.02   |
| 120   | 41.81            | 44.61   | 45.22   |
| 150   | 59.32            | 63.42   | 64.20   |
| 180   | 79.94            | 85.50   | 86.58   |
| 210   | 103.79           | 110.92  | 112.34  |
|       | Average daily weight gain, g |         |         |
| 1-30  | 186              | 201     | 203     |
| 30-60 | 288              | 307     | 312     |
| 60-90 | 387              | 414     | 419     |
| 90-120| 499              | 532     | 540     |
| 120-150| 584             | 627     | 633     |
| 150-180| 687             | 736     | 745     |
| 180-210| 795             | 847     | 859     |
| 1-210 | 489              | 523     | 530     |

As can be seen from the presented table, the live weight of the pigs of all three groups increased steadily until the end of the experimental period. At the same time, the live weight of pigs of the 1st experimental group by the end of the fattening period was equal on average in the group – 110.92 kg, which is 7.13 kg or 6.87% more than the benchmark. The live weight of pigs from the 2nd experimental group also turned out to be more than the benchmark by 8.55 kg or 8.24% and averaged
112.34 kg for the group.

Average daily weight gains of pigs of the 1st and 2nd experimental groups were higher than the benchmarks. So, the specified indicator of pigs of the 1st experimental group for the 1st, 2nd, 3rd, 4th, 5th, 6th and 7th months of cultivation was higher than the control by 15 g, 19, 27, 33, 43, 49 and 52 g, and in pigs of the 2nd experimental group on the same dates - by 17 g, 24, 32, 41, 49, 58 and 64 g, respectively. The average daily gains of pigs of the 1st and 2nd experimental groups on average for all periods of suction, weaning and fattening were higher than the benchmark by 34 and 41 g.

Therefore, the administration of immunotropic drugs PigStim-C and PigStim-M to piglets in the early period of postnatal ontogenesis contributes to their more intensive growth during periods of suction, weaning and fattening.

At the age of 210 days, a control slaughter of five pigs from each group was carried out. Slaughter of animals was carried out in a slaughterhouse of a meat processing plant, according to the rules of veterinary examination of slaughter animals and veterinary and sanitary examination of meat and meat products. According to the results of the control slaughter of pigs (table 8), it was revealed that the slaughter yield in the pigs of the control group was 67.83%, with an average carcass weight of 70.4 kg. The slaughter mass of pigs of the 1st and 2nd experimental groups had an average of 76.62 and 77.48 kg, which is 6.22 and 7.08 kg more than the benchmark.

In addition to the absolute increase in the slaughter mass of pigs against the background of the administration of immunotropic drugs, they also increased the slaughter yield. Thus, the slaughter yield in pigs of the 1st and 2nd experimental groups had a value of 69.08 and 68.97%, which is 1.25 and 1.14% more than the benchmark.

**Table 8.** Meat productivity of pigs.

| Indicator                      | Group of animals       |
|--------------------------------|------------------------|
|                                | Control | 1st experimental | 2nd experimental |
| Pre-slaughter weight, kg       | 103.79  | 110.92           | 112.34           |
| The absolute growth, kg        | 102.79  | 109.92           | 111.34           |
| Average daily growth, g / day  | 489     | 523              | 530              |
| Slaughter weight, kg           | 70.4±0.28 | 76.62±0.48       | 77.48±0.62       |
| Slaughter yield, %             | 67.83   | 69.08            | 68.97            |

The muscle tissue of all investigated carcasses was well developed, especially in the dorsal and coxal parts, the fat was mostly white, and in some carcasses had a pale pink tint. The mass of pig carcasses of all groups ranged from 39 to 98 kg, inclusive, and the thickness of the fat over the spinous processes between the 6th and 7th thoracic vertebrae ranged from 1.5 to 4.0 cm, not counting the thickness of the skin. Therefore, according to GOST 7724-77 "Meat. Pork in carcasses and half-carcasses", pork obtained from animals of all studied groups, should be attributed to the II category (meat young).

After separation of the carcasses into half carcasses and cooling in the refrigerating chamber at a temperature of -3 ... -5 °C and airspeed of 1 - 3 m/s for 10 - 13 hours, pork on bones obtained from all three groups was directed to chiselling and trimming. The results of chiselling and trimming of pork are presented in table 9.

Half carcasses from all three groups met hygienic requirements for the safety and nutritional value of meat of slaughter animals. So, the crust of drying of pale pink color was well expressed on all samples. The muscles in the incision were wet by touch but did not leave a wet spot on the filter paper, the color corresponded to benign pork and was from light pink to red. The consistency of the meat was elastic, the fossa formed by pressing with a finger quickly leveled. The smell was peculiar to pig meat. The fat was mostly white, sometimes pale pink. The consistency was soft and elastic. The tendons were dense, elastic, with a smooth, shiny articular surface.
Table 9. Chiselling and trimming of pork half carcasses.

| Indicator                          | Group of animals |
|-----------------------------------|------------------|
|                                   | Control          | 1st experimental | 2nd experimental |
| The weight of chilled half-carcass, kg | 34.74±0.13      | 37.78±0.24       | 38.22±0.31       |
| Veined pork, kg                   | 21.65            | 23.53            | 23.81            |
| Fat, kg                           | 4.93             | 5.36             | 5.43             |
| Skin, kg                          | 2.36             | 2.57             | 2.60             |
| Ribs for smoking, kg              | 3.13             | 3.40             | 3.44             |
| Tendons, kg                       | 0.66             | 0.72             | 0.73             |
| Technical stripping and loss, kg  | 0.07             | 0.08             | 0.08             |
| Bone, kg                          | 1.95             | 2.12             | 2.14             |

As can be seen from the table, the chiselling and trimming of half carcasses did not reveal a significant increase in the share of the yield of individual components, however, at the same time, the amount of trimmed pork significantly increased. Thus, the mass of chilled half carcasses in the skin, with tenderloin, without tanks and without legs of pigs of the 1st and 2nd experimental groups turned out to be more than the mass of the control half carcasses by 3.04 and 3.48 kg. In this regard, it is quite understandable that the number of trimmed pork received from the pigs from the experimental groups has also increased. Thus, the amount of trimmed pork obtained from one-half carcass of the pig of the 1st experimental group turned out to be 1.88 kg more than the benchmark, and the 2nd experimental group - by 2.16 kg. In addition, from the half carcasses of the 1st and 2nd experimental groups, the amount of fat obtained was increased by 0.43 and 0.50 kg, and the ribs for smoking — by 0.27 and 0.31 kg, respectively. In connection with the increase in live weight and, accordingly, the weight of the half carcasses of pigs from the experimental groups, the number of pelts, tendons and cartilage, bone and technical losses also increased.

After deboning, the content of basic nutrients and the energy value of the average samples of trimmed pork were determined (table 10).

Table 10. The content of basic nutrients and the energy value of pork.

| Indicator                          | Group of animals |
|-----------------------------------|------------------|
|                                   | Control          | 1st experimental | 2nd experimental |
| Water, 100 g of pork              | 52.51±0.11       | 52.84±0.22       | 52.62±0.48       |
| Protein, 100 g pork               | 14.32±0.08       | 14.82±0.17*      | 14.98±0.16**     |
| Fat, 100 g pork                   | 33.32±0.13       | 31.40±0.10***    | 31.46±0.46***    |
| Ash, 100 g pork                   | 0.96±0.04        | 0.94±0.04        | 0.94±0.05        |
| Energy value, kcal 100 g pork     | 356.40±2.29      | 360.20±1.24      | 359.40±2.25      |

Notes:* P<0.05; ** P<0.01, *** P<0.001.

As can be seen from the table, the content of basic nutrients and the energy value of meat of pigs of all three groups also corresponded to category II pork. However, it should be noted that the protein content was significantly higher in the pig meat of the experimental groups. Thus, the protein content in 100 g of pig meat of the 1st experimental group was higher than the control indicator by 0.50 g, and the 2nd experimental one - by 0.66 g. In addition, there was a lower fat content in the pig meat of the experimental groups, by 1.92 g in the 1st experimental and by 1.86 g in the 2nd experimental group. The difference in the energy value of the meat of pigs of the three groups was not statistically significant.

Thus, it can be concluded that intramuscular administration of the immunotropic preparations PigStim-C and PigStim-M to the piglets in the early period of postnatal ontogenesis contributed to the increase in their meat productivity. Hus, more meat was obtained from pigs of the experimental
groups, both on the bone and trimmed, moreover, the protein content in pig meat of the experimental groups significantly increased and the fat content decreased.

4. Conclusion
Summarizing the above, it is necessary to conclude that the research conducted confirms the feasibility of body immunization of piglets in the early period of postnatal ontogenesis with PigStim-C and PigStim-M immunotropic drugs in order to realize the biological potential of their organism. On the background of intramuscular administration of immunotropic drugs PigStim-C and PigStim-M to piglets three times, with an interval of three days on the 1st, 4th and 7th day of life at a dose of 0.3 ml per head, a significant increase in growth rates is observed, health and the safety of the young pigs is ensured, the amount of pork produced increases in the absence of a negative impact on the clinical and physiological condition of the pigs and ensuring the sanitary quality of products.

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