Prevention of transport stress in the realization of the adaptive potential of pigs

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Abstract. The article presents the results of research on the realization of the adaptive, productive and reproductive potential of pigs by immunoprophylaxis of transport stress with Pigstim preparations. The transport stress prevention for replacement gilts with immunotropic drugs PigStim-C and PigStim-M contributed to their adaptive and reproductive potential realization by reducing the age of first insemination by 7.7-9.0 days and increasing its fertility, increasing the number of liveborns by 6.8-8.5% and reducing the number of stillborn piglets by 50 and 25%, increasing the viability by 1.72-3.32% and growth rate of piglets during the suckling period by 2.9-4.0% and reducing the weaning-to-insemination period by 6.4 and 8.5%. The immunoprophylaxis of transport stress in weaned pigs ensured their adaptive and productive potential in long-term growing completion and store feeding period by increasing the live weight of stores by the end of growing completion by 1.66 and 2.55 kg and feeding period by 1.23 and 3.17 kg, reducing the incidence by 5.0 and 4.0% and increasing the viability of the livestock by 2.0%, increasing the effectiveness of therapeutic measures.

1. Introduction
A necessary condition for increasing the profitability and competitiveness of the pig industry is the development and improvement of the organizational and economic mechanism for the effective functioning of pig organizations [1]. The key link of this process is the innovative renewal of capital, which is possible through technical, organizational, economic and managerial innovations in organizations [2].

The transition of pig farming to an industrial basis, together with the obvious advantages that increase the profitability of the industry as a whole, has aggravated the existing and provoked new problems, the main of which is the discrepancy between the conditions of the biological needs of the pig’s body [3]. Invention and introduction to the technological process of animals keeping, feeding and servicing effective technologies, although it allows to increase productivity, improve the quality of products obtained and the industry profitability in general, the relationship of the pig body with the environment and the traditional conditions of maintenance and feeding that have developed are often
violated in the process of race development [4]. The process technologies of modern large pig breeding complexes, insufficient exercise, irrational use of antibacterial drugs cause metabolic imbalance, a decrease in the resistance of pig organism, which ultimately leads to high incidence rate and low productivity of the pig stock [5].

The transportation of pigs is an integral part of the modern pig breeding enterprises functioning [6]. The transportation of pigs makes it possible to organize the separate work of pig breeding enterprises and complexes for pig growing and feeding, and also ensures the renewal of the breeding stock [7]. The transportation of animals, keeping and feeding conditions change, diagnostic and preventive measures during the quarantine period have a negative effect on the pig organism, reducing the productive and reproductive indicators [8]. In such conditions, if it is impossible to exclude the action of stress factors, the primary task is to increase the adaptive capacity and resistance of pig organism [9]. An important role in such a case belongs to the immune system, stimulating which, it is possible to minimize the negative consequences of exposure to stress factors [10]. But, unfortunately, the modern veterinary pharmaceutical market doesn't offer effective means that increase the adaptive ability of pigs, the use of which would be economically feasible [11]. This fact emphasizes the need to find and constantly develop new means that reduce the negative impact of stress factors and increase the adaptive and productive qualities of animals [12].

In this situation, complex immunotropic drugs of PigStim series, developed by scientists of the Chuvash State Agrarian University, are promising, which have a complex immunostimulating and antibacterial effect. The objective of this work is to realize the adaptive, productive and reproductive potential of pigs by immunoprophylaxis of transport stress with drugs PigStim.

2. Materials and methods

PigStim-C and PigStim-M are complex immunotropic drugs, developed by scientists of the Chuvash State Agrarian University, to increase the nonspecific resistance of the farm animal organism, prevent diseases and realize their adaptive, productive and reproductive potential. The drugs are an aqueous suspension containing a polysaccharidic complex of yeast cells immobilized in an agar gel with the addition of a benzimidazole derivative and antibacterial agents, groups of cephalosporins (PigStim-C) and macrolides (PigStim-M) (Chuvash State Agricultural Academy, Russia).

2.1. Methodology of the first series of experiments

The research work was carried out from April 2019 to December 2020 and included two sets of experiments.

The first set of research work was completed in quarter 2-4, 2019. The subjects of research were 30 replacement gilts, aged 123-153 days, of large white breed, imported to the pig-breeding complex of closed joint-stock company (CJSC) Progress of the Cheboksary region of the Chuvash Republic for breeding from the Okuni rural locality in Kirovo-Chepetsk district, Kirov region (Russia), joint-stock company (JSC) Agrofirm Doronichi. The import of animals was approved and authorized by the State Veterinary Service of the Chuvash Republic.

In the process of completing the transported group of pigs, according to the principle of analog pairs, the animals were divided into 3 groups. All 30 replacement gilts were quarantined for 30 days prior to transportation. During the quarantine, all the diagnostic and animal disease control set by the plan developed for the 30-day quarantine were carried out for all animals. In addition to measures provided for by the state veterinary supervision, the gilts of the 1st experimental group were injected three times intramuscularly with the immunotropic drug PigStim-C at a dose of 5.0 ml per head 15, 10 and 5 days before transportation. The gilts of the 2nd experimental group were similarly injected with the immunotropic drug PigStim-M. Animals of the 3rd group were kept as biological control, and no measures were applied to them, except for the provided for in the plan.

Upon arrival at the pig-breeding complex of CJSC Progress, the animals were put under preventive quarantine for 30 days. The animals were accommodated in a separate room, and separate service personnel was assigned.
After removal from the preventive quarantine, in long term production use, the reproductive qualities of replacement gilts were assessed in terms of the age of first insemination and its fertility, prolificacy and the number of stillborn piglets, the viability of piglets during the suckling period, their live weight at weaning and the period duration from weaning to insemination.

2.2. Methodology of the second series of experiments
The second set of research work was carried out in the period from May 2019 to June 2020 on the basis of the pig breeding complex branch of Avangard Tsivilsky Becon limited liability company (LLC), specializing in growing completion and feeding stores to slaughter conditions obtained from a breeding enterprise. The enterprise is satisfactory in terms of infectious and invasive diseases.

The research objects were mongrel pigs during the growing completion and feeding periods. The weaning of piglets at the breeding enterprise was carried out at the age of 21 days, when the live weight reached at least 6 kg. Immediately after weaning, the piglets were transported to a specialized growing completion and feeding facility located 160 km from the breeder. The next batch of weaned pigs was divided into 3 groups of animals (control, 1st and 2nd experimental), 100 heads in each.

The weaned piglets of the 1st experimental group to prevent the negative effects of transport stress, ensure health, enhance growth and development, immediately after transportation, as well as on the 4th and 7th days after it, were injected three times intramuscularly with the immunotropic drug PigStim-C at a dose of 1.0 ml per head. The weaned piglets of the 2nd experimental group were similarly injected with the immunotropic drug PigStim-M. Animals of the control group were not injected with immunotropic drugs. Surveillance over the animals of the experimental groups was carried out during the growing completion and feeding periods, the indicators of incidence rate and viability were recorded. In addition, at the end of the growing completion (71 days) and feeding (171 days) periods, the pigs were group weighed.

2.3. Characteristics of the immunotropic drug and the procedure for its use
The injection of immunotropic drugs in both series of experiments was carried out with an automatic adjustable veterinary syringe VacArt-BM RJ Amersfoort the Netherlands using needles HSW-ECO Luer Lock 16G×1 1/2 (1.6×40 mm) for replacement gilts and HSW-ECO Luer Lock 19G×5/8 (1.0×15 mm) for weaned pigs.

The intramuscular injection was carried out in certain places of the pig body, where there is a significant layer of muscle tissue, and damage to large vessels or nerve trunks is excluded. Replacement gilts were injected into the neck in the area behind the ear, 50-75 mm behind the ear base, at the border of the skin fold and skin, and weaned pigs were injected into the femoral part of the hind limb. The injection site was wiped with a cotton swab moistened with 70% ethyl alcohol. The needle was inserted perpendicular to the skin surface. After removing the needle, the injection site was pressed with cotton swabs moistened with a solution of 70% ethyl alcohol (JSC ‘Rocket and Space Center ‘Progress’, Russia).

2.4. The method of determining the analyzed parameters
The body temperature was measured in a non-contact manner at a distance of 3-5 cm from the skin surface with a GP-300-pyroterm (Protherm, China) infrared thermometer, designed for instantaneous body temperature measurement. Respiratory rate and pulse rate were assessed by calculating functional respiratory and cardiac murmurs by auscultation using a microstethophone (CS Medica CS-417, China).

Data on the age of first insemination, the duration of period from weaning to insemination, prolificacy, the number of stillborn piglets, incidence rate and viability of the livestock were obtained from the zootechnical and veterinary statistical reports of enterprises.

The fertility of insemination was determined by diagnosing pregnancy from the 20th day after insemination using the AcuVista VT98m Veterinary Ultrasound Scanner (Acuvista, China).

The weighing of pigs was group, using the scales for weighing piglets VSP4-150 ZhSO, (JSC
‘WEIGHT-SERVICE’, Russia) and the MVSK S-NN-1.5 (1.5x1.5) scales (Vector-PM LLC, Russia) with a fence for weighing animals. The weight of one head was determined by a calculation method by dividing the weight of a group of animals by the number of animals in the group.

The average daily gains in live weight were determined by calculation by dividing the difference in weights of pigs at the end and beginning of the calculation period by the number of days of the calculation period.

2.5. Statistical analysis

The digital material was processed by the analysis of variance for the reliability of a difference between the compared indicators (P<0.05-0.001) using a personal computer in Microsoft Excel.

3. Results and discussion

3.1. Results of the first series of experiments

The microclimate parameters of the premises for keeping experimental replacement gilts during the periods of quarantine and subsequent economic use were within the limits of zoohygienic standards and corresponded to the organism needs.

The animals were fed with complete compound feeds based on the grain mixture of our own production with the addition of feed concentrates produced by PremiKorm LLC.

The indicators of reproductive qualities of replacement gilts in experimental groups are presented in table 1.

Table 1. Reproductive characteristics of replacement gilts.

| Indicator                                      | Group of animals                        |
|------------------------------------------------|----------------------------------------|
|                                                | Control                  | 1<sup>st</sup> experimental | 2<sup>nd</sup> experimental |
| Number of replacement gilts, heads             | 10                       | 10                         | 10                         |
| Age of the first insemination, days           | 241.0±2.17               | 233.4±2.79*               | 232.0±3.38*               |
| Fertility of the 1<sup>st</sup> insemination, % | 90.0                     | 100.0                     | 100.0                     |
| Repeated insemination, %                      | 10.0                     | –                         | –                         |
| Farrowed, heads, %                            | 10/100                   | 10/100                    | 10/100                    |
| Prolificacy, heads                            | 11.8±0.58                | 12.6±0.51                 | 12.8±0.58                 |
| Number of stillborns, heads/clutch            | 0.8±0.37                 | 0.4±0.24*                 | 0.6±0.24*                 |
| Average number of weaned piglets, heads/breeding pig | 10.8±0.20               | 12.0±0.32*                | 12.0±0.55                 |
| Mortality up to 25 days of age, heads          | 1.0±0.45                 | 0.6±0.24*                 | 0.8±0.37*                 |
| Mortality up to 25 days of age, %             | 7.82±3.45                | 4.50±1.84*                | 6.10±2.75*                |
| Viability up to 25 days of age, heads          | 92.18±3.45               | 95.50±1.84                | 93.90±2.75                |
| Live weight at weaning (25 days), kg          | 7.56±0.05                | 7.78±0.10                 | 7.86±0.14                 |
| Period from weaning to insemination, days     | 4.7±0.25                 | 4.4±0.19*                 | 4.3±0.12*                 |

*P<0.05

According to the data presented in the table, all animals of all groups were ready for productive insemination. But, it should be noted that against the background of prevention of transport stress with immunotropic drugs, the age of the first insemination of heads in the 1<sup>st</sup> experimental group was 7.7 days, and in the 2<sup>nd</sup> it was 9.0 days less than in the control group. In addition, the fertility of the first insemination in both experimental groups was 100%, while in the control group only 9 of 10 gilts were fertilized during the first insemination, one pig was fertilized during the second insemination. Therefore, the immunoprophylaxis of transport stress with immunotropic drugs PigStim-C and PigStim-M helps to reduce the age of the first insemination of replacement gilts and increases the fertility of insemination.
All the pigs in experimental groups farrowed successfully. There was no statistically significant difference in the number of liveborn piglets, but in the experimental groups, against the background of immunoprophylaxis of transport stress, the number of live piglets was 0.8 heads or 6.8% more when using the PigStim-C and by 1.0 head or 8.5% more for the PigStim-M. The number of piglets born dead in the 1st and 2nd experimental groups was lower than the control values by 50.0 and 25.0%. The revealed fact indicates that against the background of immunoprophylaxis of transport stress of replacement gilts, the number of liveborn pigs increases and the number of stillborn pigs decreases.

After injection of immunotropic drugs PigStim-C and PigStim-M, the replacement gilts before transportation showed positive changes in viability and growth indicators of piglets during the suckling period. So, in the control group during the sucking period, an average of 1.0±0.45 heads or 7.82±3.45% of piglets per nest box died, in the 1st experimental group – 0.6±0.24 heads or 4.50±1.84%, and in the 2nd experimental – 0.8±0.37 heads or 6.10±2.75%. The survival rate of piglets in the suckling period was 92.18±3.45% in the control group, 95.50±1.84% in the first and 93.90±2.75% in the second experimental group. The increase in prolificacy and the decrease in mortality during the suckling period predetermined a greater number of piglets weaned from the breeding sow. So, 10.8±0.20 piglets were weaned from the breeding sows of the control group, 12.0±0.32 and 12.0±0.55 piglets – from the breeding sows of the 1st and 2nd experimental groups, which is 11.1 % more than reference values. In addition to the increase in the number of piglets weaned from the breeding sow, their live weight at weaning increased. The weight of the control group piglets at weaning (25 days) was 7.56±0.05 kg, in the 1st experimental group – 7.78±0.10 kg, and in the 2nd group-7.86±0.14 kg, which is 0.22 and 0.30 kg or 2.9 and 4.0% more than the control indicator.

The use of immunotropic drugs PigStim-C and PigStim-M for the prevention of transport stress in replacement gilts reduced the duration of the period from weaning to insemination by 0.3 and 0.4 days or by 6.4 and 8.5%.

3.2. Results of the second series of experiments
The microclimate parameters of the premises for keeping pigs during the growing completion and feeding periods of the branch of Avangard Tsivilsky Becon LLC for the entire observation period were within the limits of zoohygienic standards.

The pigs are fed at the enterprise with complete compound feed based on a grain mixture of its own production with the addition of feed concentrates (LLC ‘Research and Production Company Bioenergiya’, Russia).

The preparation of compound feeds for feeding is carried out in our own compound feed production workshop. The compound feed, after production before feeding, is temporarily stored in hoppers located on the territory of the enterprise outside the livestock house, from where the feed is automatically fed to the feeders of the corresponding group of pigs by means of a spiral feeding system.

Immunotropic drugs did not have a negative effect on the clinical and physiological state of the pigs, as shown in table 2.

As can be seen from the table, the indicators of body temperature, pulse rate and respiration rate of pigs of all groups were within the physiological range and didn't have statistically significant differences between the groups, and the dynamics of these indicators corresponded to age-related changes.

The veterinary and statistical reporting analysis results on the incidence and viability of pigs in the experimental groups during the growing completion and feeding periods against the background of immunoprophylaxis of transport stress of weaned pigs are presented in table 3.

According to the data of veterinary and statistical reporting among stores of the control group during the growing completion and feeding periods, diseases occurred in 21 animals, which is 5 and 4 heads more than among stores of the 1st and 2nd experimental groups, respectively. The therapy was effective only in 18 sick animals of the control group, which amounted to 85.7%, the remaining 3
In the 1st experimental group, 15 of 16 sick animals were recovered, and in the 2nd experimental group – 16 of 17, 1 head in each group died. Consequently, the use of immunotropic drugs PigStim-C and PigStim-M ensures the prevention of diseases of store pigs during the growing completion and feeding periods and increases the effectiveness of therapeutic measures.

**Table 2.** Clinical and physiological parameters of pigs.

| Indicator          | Group of animals       | Control   | 1st experimental | 2nd experimental |
|--------------------|------------------------|-----------|------------------|------------------|
| Body temperature, °C|                        | 39.35±0.06| 39.39±0.05      | 39.49±0.08      |
|                   |                        | 39.39±0.05| 39.51±0.04      | 39.63±0.07      |
|                   |                        | 39.55±0.06| 39.53±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.61±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.31±0.04| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.41±0.08| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.53±0.07| 39.57±0.07      | 39.63±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.34±0.06| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.38±0.05| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.53±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.31±0.04| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.41±0.08| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.53±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.34±0.06| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.38±0.05| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.31±0.04| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.41±0.08| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.53±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.34±0.06| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.38±0.05| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.31±0.04| 39.38±0.05      | 39.46±0.06      |
|                   |                        | 39.41±0.08| 39.51±0.07      | 39.57±0.07      |
|                   |                        | 39.53±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.51±0.07| 39.63±0.07      | 39.63±0.07      |
|                   |                        | 39.63±0.07| 39.63±0.07      | 39.63±0.07      |

**Table 3.** Incidence rate and viability of pigs.

| Indicator                                    | Group of animals       | Control   | 1st experimental | 2nd experimental |
|----------------------------------------------|------------------------|-----------|------------------|------------------|
| Livestock at the beginning of the experiment, |                        | 100       | 100              | 100              |
| head                                         |                        |           |                  |                  |
| Total number of sick pigs, heads, %          |                        | 21/21     | 16/16            | 17/17            |
| Recovered, heads, %                          |                        | 18/85.7   | 15/93.75         | 16/94.1          |
| Dead, heads, %                               |                        | 3/14.3    | 1/6.25           | 1/5.9            |
| Number of sick pigs with the syndrome of     |                        | 7/7       | 5/5              | 6/6              |
| Respiratory system lesion, heads, %          |                        |           |                  |                  |
| Recovered, heads, %                          |                        | 6/85.7    | 5/100            | 5/83.3           |
| Dead, heads, %                               |                        | 1/14.3    | 0/0              | 1/16.7           |
| Duration of sickness, days                   |                        | 4.7±0.54  | 3.1±0.29**       | 3.4±0.51*        |
| Number of sick pigs with the syndrome of     |                        | 9/9       | 7/7              | 7/7              |
| Digestive system lesion, heads, %            |                        |           |                  |                  |
| Recovered, heads, %                          |                        | 8/88.9    | 6/85.7           | 7/100            |
| Dead, heads, %                               |                        | 1/11.1    | 1/14.3           | 0/0              |
| Duration of sickness, days                   |                        | 3.6±0.43  | 2.7±0.20*        | 1.9±0.33**       |
| Viability, %                                 |                        | 97.0      | 99.0             | 99.0             |

*Р<0.05; **P<0.01.
The incidence rate analysis for pigs revealed that among 21 case of piglets' sickness in the control group, 7 were the symptoms of respiratory organs lesion, the therapy for 6 of them was successful. In the 1st experimental group of 16 sick animals, 5 had respiratory lesions, and in the 2nd experimental group, out of 17 there were 6. At the same time, all 5 in the 1st experimental group recovered, and in the 2nd experimental group only 5 out of 6 animals recovered. The duration of the course of respiratory diseases in stores of the control group averaged 4.7±0.54 days, which is 1.6 days more than the corresponding indicator of the 1st experimental group, and 1.3 days – of the 2nd experimental group. Consequently, immunotropic drugs PigStim-C and PigStim-M, when injected intramuscularly to weaned piglets in order to prevent the negative effects of transport stress, reduce the incidence of respiratory diseases in stores and shorten the recovery time, with a more pronounced effect of the PigStim-C, which, in addition, increases the effectiveness of therapeutic measures.

Diseases in 9 animals of the control group were characterized by the symptoms of gastrointestinal system organs lesion. In the 1st and 2nd experimental groups, intestinal pathologies occurred in 7 animals in each one. The therapy of gastrointestinal diseases that appeared during the experimental period was successful in 100% of cases only in the 2nd experimental group, one head died in the control and 1st experimental groups. The duration of the course of intestinal diseases in animals of the control group averaged 3.6±0.43 days, and in the 1st and 2nd experimental groups – 2.7±0.20 days and 1.9±0.33 days, respectively, that is 0.9 and 1.7 days less than the control indicator. Consequently, complex immunotropic drugs PigStim-C and PigStim-M prevent the onset of diseases with symptoms of digestive system lesion and shorten the recovery time, with a more pronounced effect of PigStim-M, which, in addition, increases the effectiveness of therapeutic measures.

Thus, the analysis of incidence rate and viability of stores for the growing completion and feeding periods has established that immunotropic drugs PigStim-C and PigStim-M reduce the incidence rate, shorten the recovery time and increase the effectiveness of therapeutic measures. A more pronounced positive effect of the PigStim-C use in case of diseases characterized by the respiratory system lesion, and the PigStim-M in case of the gastrointestinal tract lesion was revealed.

The growth dynamics of pigs during the growing completion and feeding periods against the background of transport stress immunoprophylaxis is presented in table 4.

**Table 4. Pig growth dynamics.**

| Period                        | Group of animals                      |
|-------------------------------|---------------------------------------|
|                               | Control | 1st experimental | 2nd experimental |
| Live weight, kg               |         |                  |                  |
| At the beginning of growing completion (21 days) | 6.81     | 6.81             | 6.81             |
| At the end of growing completion (71 days)  | 31.86    | 33.47            | 33.09            |
| When stopping store feeding (171 days)    | 121.64   | 124.19           | 124.81           |
| Average daily gain in live weight, g       |         |                  |                  |
| Over the growing completion period     | 501.0    | 533.2            | 525.6            |
| Over the store feeding period         | 897.8    | 907.2            | 917.2            |
| On average over the growing completion store feeding period | 765.5    | 782.5            | 786.7            |

The results of group weighing of pigs in experimental groups indicate the growth-stimulating effect of the immunotropic drugs PigStim-C and PigStim-M use. Thus, the prevention of transport stress with the immunotropic drug PigStim-C contributed to an increase in the live weight of pigs at the end of the growing completion period 1.61 kg more than the control values and by the end of the feeding period by 2.55 kg. Intramuscular injection of the complex immunotropic drug PigStim-M to weaned piglets increased the live weight of store pigs relative to control herd mates at the end of the growing completion period by 1.23 kg, and feeding one by 3.17 kg. A similar regularity was revealed in the dynamics of average daily gains in live weight. Thus, the average daily gain in live weight of animals
of the 1st and 2nd experimental groups turned out to be more than the control values by 32.2 and 24.6 g during the growing completion period and by 9.4 and 19.4 g during the feeding period. In general, for the entire experimental period, the average daily gains in live weight of store pigs of the 1st and 2nd experimental groups were higher than those of the control herd mated by 17.0 and 21.2 g, respectively.

4. Conclusion
The prevention of transport stress in replacement gilts with immunotropic drugs PigStim-C and PigStim-M contributed to their adaptive and reproductive potential realization. Thus, the age of the first insemination decreased by 7.7 and 9.0 days, and its fertility increased, the number of liveborn piglets increased by 6.8% and 8.5%, and the number of stillborns decreased by 50.0% and by 25.0% respectively, and the viability rate (by 3.5% and 2%) and the intensity of growth of piglets (by 0.22 and 0.3 kg) increased in the suckling period, the period duration from weaning to insemination also decreased by 0.3 and 0.4 days.

The immunoprophylaxis of transport stress in weaning pigs ensured their adaptive and productive potential realization in the long-term growing completion and feeding periods. The live weight of pigs in experimental groups was significantly higher ($p < 0.05-0.01$) than the control values at the end of the growing completion period by 1.23 and 1.67 kg, and at the end of the feeding period by 3.17 and 2.55 kg. Average daily gains in live weight of pigs during the growing completion period were higher by 24.6 and 32.2 g, and during the feeding period – by 19.4 and 9.4 g.

Among pigs of experimental groups, against the background of immunoprophylaxis, the livestock incidence rate decreased and the viability increased. In pigs of the 1st and 2nd experimental groups, recorded sickness cases were less (by 5 and 4, respectively) than in pigs of the control group. The effectiveness of therapeutic measures increased by 8 and 8.4%, and the recovery time decreased by 1.6 and 1.3 days, respectively. Also, a more pronounced positive effect of the PigStim-C use in case of diseases characterized by the respiratory system lesion, and the PigStim-M in case of the digestive system lesion was revealed.

References
[1] Makara A, Kowalski Z, Lelek L and Kulczycka J 2019 Comparative analyses of pig farming management systems using the life cycle assessment method. J. Clean. Prod. 241 118305 doi:10.1016/j.jclepro.2019.118305
[2] Iyai D A et al. 2021 Analyses of interlinked actors in determining the potential business beneficiaries of small-scale pig farming systems in West Papua, Indonesia. Heliyon 7(2) e05911 doi:10.1016/j.heliyon.2021.e05911
[3] Gongora Perez R D, Milan Sendra M J and Lopez-i-Gelats F 2020 Strategies and drivers determining the incorporation of young farmers into the livestock sector. J. Rural. Stud. 78(7) 131 doi:10.1016/j.jrurstud.2020.06.028
[4] Martins J M, Fialho R, Albuquerque A, Neves J, Freitas A, Nunes J T and Charneca R 2020 Growth, blood, carcass and meat quality traits from local pig breeds and their crosses. Animal 14(3) 636 doi:10.1017/S1751731119002222
[5] Luu Q H, Nguyen T L A, Pham T N, Vo N G and Padungtod P 2021 Antimicrobial use in household, semi-industrialized, and industrialized pig and poultry farms in Vietnam. Prev. Vet. Med. 189 105292 doi:10.1016/j.prevetmed.2021.105292
[6] Leenhouwers J I, Ten Napel J, Hanenberg E H A T and Merks J W M 2011 Breeding replacement gilts for organic pig herds. Animal 5(4) 615 doi:10.1017/S175173111000220X
[7] Bryer P J, Sutherland M A, Davis B L, Smith J F and McGlone J J 2011 The effect transport and space allowance on the physiology of breeding age gilts. Livest. Sci. 137(1-3) 58 doi:10.1016/j.livsci.2010.09.026
[8] Sutherland M A, Bryer P J, Davis B L, Smith J F and Mc Glone J J2012 The combined effects of transport and food and water deprivation on the physiology of breeding age gilts. Livest. Sci. 144(1-2) 124 doi:10.1016/j.livsci.2011.11.005
[9] Gallois M, Rothkotter H J, Bailey M, Stokes C R and Oswald I P 2009 Natural alternatives to in-feed antibiotics in pig production: Can immunomodulators play a role? *Animal* 3(12) 1644 doi: 10.1017/S1751731109004236

[10] Galassi D, Galassi P, Pelliccioni A and Semprini P 1986 Clinical results obtained in cattle and swine by means of biological immunostimulators. *Comp. Immunol. Microb.* 9(2-3) 285 doi: 10.1016/0147-9571(86)90023-8

[11] Cao J, Wang X, Du Y, Li Y, Wang X and Jiang P 2010 CD40 ligand expressed in adenovirus can improve the immunogenicity of the GP3 and GP5 of porcine reproductive and respiratory syndrome virus in swine. *Vaccine* 28(47) 7514 doi: 10.1016/j.vaccine.2010.09.002

[12] Wang H, Xu L, Yu M, Wang Y, Jiang T, Yang S and Lv Z 2019 Glycosaminoglycan from *apostichopus japonicus* induces immunomodulatory activity in cyclophosphamide-treated mice and in macrophages. *Int. J. Biol. Macromol.* 130(11) 229 doi: 10.1016/j.ijbiomac.2019.02.093