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SELF-DEVELOPING VARIETY-COMPLYING TECHNOLOGY OF MARKETABLE PORK PRODUCTION AS A RESULT OF SIMULATION OF BIOLOGICAL, INDUSTRIAL AND ECONOMIC PROCESSES IN THE BELARUSIAN PIG BREEDING

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ABSTRACT
Modern industrial pig breeding cannot provide proper welfare of animals and has increased environmental risks for administrative territories the pig breeding farms and complexes are located in. The aim of our work was to develop appropriate, environmentally balanced, and economically perfect production technology for commercial pork. Scientific knowledge and practical experience were used in pig breeding, engineering aspects and hygiene of growing pigs, and ecological aspects of manure drain at pig-breeding enterprises. An integrated vertical-and-horizontal simulation model of pig breeding enterprise was developed (Animals Hygiene Model Solyanik). Simulation model (MS Excel spreadsheet-based) includes six integrated technological indicators, each of which is optimized by the criterion of the lowest financial and material costs according to hygienic, ethological, and environmental standards and regulations. The final stage of the simulation model is to find the most balanced options between the initial six integrated technological indicators. Computer simulation of marketable pork production technology has been carried out. It has been determined that the critical control point was a sow in the production process with more than one farrowing during productive life. A self-developing variety-complying technology (SV-technology) was proposed including two-phase pork production in a closed cycle, management of all the sex-age groups of pigs, excluding suckling sows with piglets, by a large-group method on a periodically changed deep straw bedding and access to the walking area. The SV-technology allows to improve the pigs' welfare, increase soil fertility, reduce environmental pressure of a pig-breeding enterprise on the community, and increase financial efficiency of pig breeding.
Keywords: pigs, self-developing variety-complying technology (SV-technology), simulation

INTRODUCTION

Computer technology and robotics have had a significant impact on the development of livestock breeding in general and pig breeding in particular in the past quarter of the century. The exact livestock breeding as a scientific area attracting young researchers to solve interdisciplinary problems. For the majority of engineering scientists being neither veterinary medicine doctors, nor zoology (animal) engineers (Higher education Republic Belarus. I stage - specialty 1 74 03 01 Zootechnics (Animal Science; Agricultural), qualification Zooengineer); or animal hygienists (Higher education Republic Belarus. II stage - specialty 1-74 80 03 Zootechnics (Master of Agricultural Sciences); Ph.D. (D.Sc.) of Agricultural Sciences), researching biological objects, including farm and domestic animals of various species, is of a genuine interest. First of all, researchers are interested in the possibility of mathematical and computer descriptions of processes taking place both at the level of an animal, group of animals, or even livestock management facility.

At the same time, the application of the exact livestock breeding results in practice is foremost only increases the cost price of marketable products.
The main problem in our opinion is the fact that when developing innovative solutions in exact pig breeding, an excessive individualization of an animal takes place, its activity, behavior, incidence rate or other ailments are monitored. At the same time, for some reason, it is forgotten that the number of animals, for instance, at Belarusian pig breeding complexes amounts to thousands and tens of thousands. Therefore, there is no need to take into account the growth dynamics of each animal, or even a group of 20-30 animals. Variability of pigs' performance traits conforms to the law of normal distribution. So storing information about how exactly one or another performance indicator of a specific animal was obtained (average daily weight gain, multiple pregnancies, etc.) is of no great practical significance. It is important to know in general feed cost for obtaining pig body weight gain taken to slaughter from a specific stall area. It is mainly the aggregated data that helps to solve the issue of economic efficiency of an enterprise and the financial profitability level for its specific employees.
Climate control systems are widely used in the modern pig breeding facilities, and controlled microclimate, excluding biologically conditioned cold training process, leads to a susceptibility of animals body and immunity. Unpredictable shutdown of ventilation systems leads to stressful situations resulting in decrease of pigs performance, incidence level increase and even death of a significant part of the population.
Lean pork pigs breeding, the susceptibility of meat breed pigs probably led to the appearance of new previously not determined diseases. To obtain lean pork, animals shall be fed with more expensive feed, and the higher the costs of pigs management, the significantly higher the cost of pork production, and the lower the profitability of this type of business.

Pig breeding enterprises operation according to existing technologies has long been in contradiction with both the welfare of pigs and the ecology of a particular administrative territory.
Pig breeding in Denmark, the Netherlands and other European countries is mostly based on the operation of separate commercial reproduction farms and pig fattening farms. At the same time, the breeding stock of reproductive farms consists of hybrid sows obtained from breeding and genetic centers. The existence of a genetic selection pyramid had a catastrophic effect on the biodiversity of pig breeds, as a result - most of the indigenous breeds in the EU have disappeared.
Pig breeding is represented by industrial pig breeding complexes of the closed production cycle with a capacity of 1 to 15 thousand tons of marketable pigs' live weight in the countries of the former USSR. At the same time, the official financial cost for the design and construction of pig farms in Belarus come expensive for agricultural enterprises in a huge amount. So the cost of a pig space is 2440 USD. And this is despite the fact that 160-165 kg of body weight

pork averagely is produced at Belarusian pig breeding complexes per year per one pig space, and a little bit over 240 kg at the best enterprises. Considering the low purchase prices for marketable pork, as well as the low level of pork production per pig space, it is not realistic to expect recoupment of new pig farms in the near future.

MATERIAL AND METHODS

Greater part of the tabular data obtained from research and production studies by domestic and foreign scientists, including pig performance, hematological, biochemical, immunological and other indicators, pork quality indicators, bioengineering, animal hygienic, technological, thermal engineering, thermal physical, environmental and other parameters were replaced by linear, curvilinear and nonlinear functions of one and/ or two variables. The designed approximation curves adequately describe the tabular data, i.e. the deviation did not exceed the statistical error.
The obtained mathematical dependences were used in computer block programs for calculating dynamic models of one or another parameter, including herd turnover, livestock movement, pork quality, manure volume, soil fertility, etc. After, the block program output results served as input data for a comprehensive simulation model (Animals Hygiene Model Solyanik) of a pig enterprise.
MS Excel capabilities, in particular, the "Search for Solution" service was used to improve the pork production technology.

The following general restrictions and requirements were established for the development of a computer program for simulation of marketable pork production:
I. Animals: 1) Meat and lard type of pigs, meat yield 60% maximum. 2) Bodyweight of pigs sold for slaughter shall not exceed 150 kg. 3) Backfat thickness - 5 cm maximum. 4) Sows multiple pregnancies is 12 live piglets per farrow maximum. 5) Animals are fed with specialized industrial feed. All the cereal straw used for compound feed production is used as bedding. 6) Sick animals are culled and slaughtered. 7) Veterinary services are performed exclusively for mandatory vaccinations against five diseases maximum.
II. Production technology: 1) Closed production cycle (growing and fattening at one and the same enterprise). 2) Two-phase technology (piglets are kept in sows' stalls from birth till reaching 30 kg of body weight. Then they are taken to another facility for fattening). 3) Self-repair of the main stock. The peculiarity of selection and breeding work at the pig complex consists in fulfilling two requirements: the first is the selection of repair gilts from sows with multiple pregnancy rate of 11 -12 live piglets, and from litter with over 80% of females born. The second requirement is to check all repair gilts during the suckling period regarding activity for seizing the feeder space when there are fewer feeders than animals. 4) Suckling period is 5 weeks maximum. 5) Production rhythm is 1 week. 6) Insemination shall be carried out with the use of purchased sperm products obtained at breeding and genetic stations for pig breeding in the regions of Belarus. 7) The pork production volume per pig space is 250 kg minimum.
III. Management conditions: 1) Cost of pig space for an average annual animal is 250 USD maximum. 2) Enclosures of facilities the pigs are kept in having the highest and economically perfect thermal characteristics, service life is 50 years minimum. 3) All the animals, except for suckling sows with piglets, are kept in a large group on deep periodically changed straw bedding, have free access to the walking area. 4) Urine is drained from the facility and pumped into an airtight storage facility. 5) All the facilities are equipped with free ventilation.
IV. Manure and farmlands: 1) Manure is stored near the facility, it overheats and taken out to the fields in spring (autumn). 2) Humus content and soil fertility are controlled. 3) Nitrates distribution in the groundwater of the areas of manure and urine disposal is monitored.
V. Slaughter and processing: 1) Slaughter and advanced processing of pigs is performed mainly at industrial meat processing plants with merchant network.
VI. Labor management and economics: 1) The number of employees is 10 people maximum per first thousand tons of pork sold in a year counted per body weight, and then 5 people maximum for each subsequent thousand tons. 2) Recoupment of capital costs is 5 years maximum.

RESULTS AND DISCUSSION

Application of the basic laws of zoology engineering and zoology hygiene, the basic principles of HACCP and ISO 22000 and 14000, as well as multi-stage computer simulation (Animals Hygiene Model Solyanik) allowed to determine:
- the critical reference point in marketable pig breeding sows in a technological process having over one farrowing during the productive life, i.e. group of the main sows;
- to improve the welfare of pig stock, the group and large-group free management of all the sex and age groups of pigs is required, with the exception of sows in the farrowing area. '

Sows with multiple pregnancies at marketable pig farms with a closed production cycle have become the main source of diseases at livestock facility. From the point of view of production arrangement and calculation of livestock movement in the production cycle, there is a dry period for the main sows, and it is also required to constantly control the size of the buffer group and its location. Sows are subjected to multiple immunizations and treatment of various diseases during the productive life. After piglets weaning, feeds are spent for the sows which may not be recouped at the new farrowing, as soon as the sow can become dry. It is impossible to obtain high-quality pork for consumption from sows having several farrows.

Exclusion of main sows from production technology, intensification of the reproduction process in order to obtain a more predictable result in the farrowing area, transfer of culled and dry gilts and sows after piglets weaning allows increasing production volume at a pig-breeding complex by 15-25%.
Simulation modeling of marketable pork production technology allowed to develop the self-developing variety-complying technology (SV-technology) (Fig.).

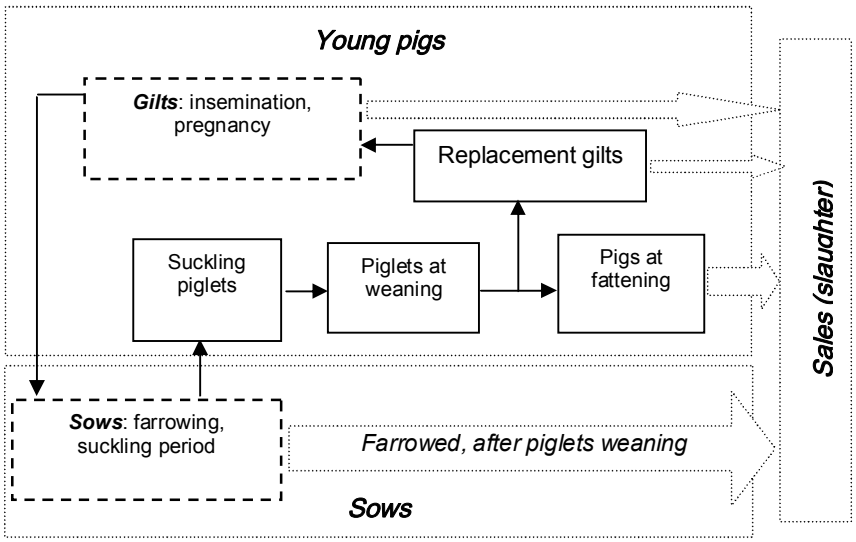

Fig. SV-technology layout

The main peculiarity of the SV-technology is the exclusion of sows from the herd with over one farrowing. Intensification of breeding process at a marketable pig breeding complex by selecting pigs from sows with higher multiple pregnancy and milk yield, as well as testing their the activity for occupying feeder space, allows obtaining 11-12 pigs from first litter gilts permanently. Variety-complying management of pigs in large groups on a periodically changed straw bedding with free access to the walking area allows increasing the animals' immunity and performance. Refusing meat pigs in favor of meat and lard breeds reduces the requirements for diet energy and feed protein composition, which will affect the cost positively. Low financial costs for space per animal, the predominant use of free ventilation makes it possible to quickly recoup material costs and obtain higher net profit.
Bedding manure as an organic fertilizer will contribute to an increase in humus and soil fertility.

CONCLUSION
Thus, innovative technology has been proposed for the functioning marketable pig-breeding enterprises in Belarus, allowing to increase production volume, create variety-complying conditions for the management of all the sex and age groups of pigs, which positively affects their welfare, minimize environmental consequences of pig breeding in particular administrative area.

REFERENCES
(Literature from the authors on request: Val_Sol_v@mail.ru)