

## **Habilitation thesis**

### ***Current Milestones and Prospects in the Reproduction, Production, and Welfare Systems in Pigs***

#### **Summary**

The habilitation thesis encompasses the evolution of scientific, professional, and academic activities in the fields of animal husbandry, reproductive biotechnologies, and applied welfare in pig farming since the completion of the doctoral thesis, as well as career development plans for the future. The first segment of the professional, academic, and research journey at the University of Agricultural Sciences and Veterinary Medicine in Cluj-Napoca concluded with the completion and presentation of the doctoral thesis in 1999 at the University of Agricultural Sciences and Veterinary Medicine in Bucharest. The second phase concludes with the completion of this habilitation thesis, titled ***“Current Milestones and Prospects in the Reproduction, Production, and Welfare Systems in Pigs,”*** which highlights the most significant personal, scientific, and professional achievements within the areas of expertise developed throughout the career thus far.

In this regard, the first section of the thesis, which includes scientific achievements, is structured into five approaches as follows: 1. Evaluation of in vitro maturation, capacitation, and viability of swine germplasm; 2. Establishing biotechnical solutions for the cryopreservation of swine oocytes and embryos; 3. Identifying immunoprophylactic and biocidal products usable in controlling African Swine Fever (ASF) and epidemiological risk factors in Romania; 4. Innovative integration of research and practice in swine welfare at regional, national, and international levels; 5. Scientific study results regarding conditions in commercial and non-commercial pig farming in Romania from a welfare perspective.

Chapter 1, titled ***“Scientific Achievements Regarding the Evaluation of In Vitro Maturation, Capacitation, and Viability of Swine Germplasm,”*** presents original studies related to establishing quality criteria for sow follicular oocytes, the raw material necessary for obtaining in vitro embryos. This is based on the specific characteristics of gametes in this species and their correlation with the potential for in vitro cultivation and the objective evaluation of the oocyte-cumulus oophorus complex.

Subsequently, aspects concerning the evaluation of viability and the potential for in vitro maturation of oocytes intended for the production of swine embryos are extensively presented and

discussed. These considerations take into account the challenges of objectively assessing these parameters due to the opacity of ovoplasmic structures in this species, which hinders the visualization of polar bodies associated with the phases of oocyte maturation.

Additionally, I investigated and identified optimized possibilities for inducing in vitro sperm capacitation in boars, using bioactive compounds employed for this purpose in other domestic mammal species. Finally, I tested the development of various cryoprotectant agent formulations with the potential to preserve oocyte viability following their freezing.

The difficulty of this endeavor stemmed from a particular trait of swine oocytes, which exhibit a high sensitivity to low temperatures due to the negative effects on the meiotic spindle and the lipid compounds found in the ooplasm in much greater quantities compared to other species.

Chapter 2, titled "*Scientific Achievements Regarding the Establishment of Biotechnical Solutions for the Cryopreservation of Swine Oocytes and Embryos*," encompasses research conducted in the field of cryobiology. As mentioned earlier, it is well known that in this species, cellular entities are more sensitive to the effects of cold compared to other species. Within this context, I opted for both classical long-term preservation techniques, such as cryopreservation, and more recent techniques, such as vitrification.

By analyzing the overall results, it was observed that glycerol has a higher toxic effect than propylene glycol, a fact also confirmed by the relatively low percentage of embryos that resumed their normal development process following in vitro culture. These results indicate that, regardless of the type of intracellular cryoprotectant used, swine embryos also require an external cryoprotectant, which is particularly important during the thawing process. On the other hand, applying the vitrification method yielded superior results, not only due to the freezing technique itself or the concentration of the cryoprotectant but also due to the type of cryoprotectant used and the addition of sucrose during the thawing process.

In Chapter 3, "*Scientific achievements regarding the identification of technical solutions usable in controlling African Swine Fever (ASF) and the epidemiological risk factors in Romania*," the focus is, first and foremost, on the working protocols aimed at achieving the proposed objectives, considering that the research is in the early stages of the project.

Nevertheless, preliminary results concerning the testing of biocidal products effective in neutralizing ASF virus (ASFV) have shown that the methodologies applied thus far to investigate

the virucidal activity of chemical substances are limited to laboratory experiments, which do not adequately reflect field conditions. Additional laboratory protocols should be developed to simulate the variety of epidemiological scenarios of ASFV.

This is essential because ASFV is a complex virus causing a complex disease with two epidemiological cycles (domestic and wild), which require different approaches from a disease management perspective.

Chapter 4, titled *“Innovative Integration of Research and Practice in Swine Welfare at Regional, National, and International Levels,”* presents the preliminary results of the first phase of the research project and includes an analysis of the main challenges faced by farmers in meeting the higher animal welfare requirements applicable to swine farms, following the upcoming enforcement of the new European Commission regulation.

The primary objective is to identify scientifically validated solutions that address the challenges encountered by farms in the countries participating in the Horizon-WelFarmers consortium. These solutions are intended to be effectively disseminated to all stakeholders in the pork production chain, particularly to support farmers in making sustainable decisions.

Chapter 5 presents the results of the *“Scientific Study on Conditions in Commercial and Non-Commercial Pig Farming in Romania from a Welfare Perspective.”*

The central issue addressed in this study concerns the general use of individual stalls for housing sows during the lactation period as well as those in the breeding/gestation phase. This analysis can only be objective if it begins with the structural reality of Romania’s pork production sector at this time—namely, the fact that the swine population is approximately evenly distributed between the two farming systems: commercial-intensive and household-extensive.

This structure of the swine sector is unique among EU countries, placing Romania far ahead as the country with the highest number of pigs raised in household settings, specifically in operations with fewer than five pigs. Moreover, the research could not overlook the epidemiological situation Romania has faced since 2017 regarding the continuous spread of the African Swine Fever virus (ASFV), as this situation has significant implications for the health and, consequently, the welfare of swine.

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The scientific research and publishing activity conducted after completing the doctoral thesis can be quantified as follows: three specialized books, one as the sole author and two as first author/co-author; two teaching manuals, one as the sole author and one as co-author; one practical works guide (co-author); two course materials (sole author) for Master's students specializing in the English-language program "Ethology and Human-Animal Interactions" within the Faculty of Animal Science and Biotechnology at USAMV Cluj-Napoca; one course for year 1 undergraduate students specializing English-language "*Animal Behavior and Welfare*" program.

I have authored and published, as first author, corresponding author, or co-author, a total of 10 ISI-indexed articles and 55 BDI-indexed articles. Additionally, the research has materialized through participation in 8 scientific research projects (CNCSIS, ADER, Horizon 2020, EFSA,), where I have contributed as project director/leader or as a member of the research teams.

The second part of the habilitation thesis outlines the plans for teaching, scientific research, and academic development. The teaching development plan aims to improve the quality of the teaching process and enhance students' competencies through the diversification of teaching methodologies, supporting students in their learning process, and actively involving them in the learning and evaluation processes.

For the development of research activities in the coming years, the proposed objectives aim to ensure my personal scientific growth, develop the human resources involved in research, strengthen university-level research, and, most importantly, expand the applied aspects of research.

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