Moving forward

Semen quality in insemination of pigs

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In the last ten years, the insemination of pigs has developed rapidly all over the world. High semen quality has been proved to be the key for fertility in pig breeding farms. The reproductive research opens up new perspectives to ensure high quality in semen collection centers. However, breeders and veterinarians are also important, when it comes to talk about semen quality and fertility.

The artificial insemination (AI) in pigs has been developed comparatively slowly, but now exceeds the share of AI in cattle. In Germany, currently more than 95% of the 2.2 million of the breeding sows are inseminated. Actually, the semen collection centers of Germany are producing 12.5 million of semen doses annually. At the beginning, the efficiency of semen production was the most important thing, but now the focus is increasingly shifting to the quality of semen. An efficient quality management and quality control requires profound knowledge of relevant quality parameters and potential risks of the production process. At the same time, reliable standards and validated diagnostic methods must be available to verify the effectiveness of the quality assurance measures.

What do you call good semen quality?

Good semen must come from high quality boars, must be microbiologically safe and should have a high fertilization rate. In addition, the semen dose should contain a sufficient high number of sperm cells and should be storable for at least three days without a loss of quality. The semen quality can basically be evaluated by standarized spermatologic parameters and thus, ejaculates of minor quality may be identified. However, good motility and morphology are no guarantee for high fertility. On their long way to the egg, the sperm cells are exposed to different components to which they have to adapt and to react. Among the greatest challenges are the formation of sperm reservoirs, the survival in the oviduct and the capacity for capacitation with consequential acrosome reaction. Modern diagnostic methods can test these important basic properties of the sperm cells in vitro. The heterogeneous characteristics of sperm cells of one semen sample can be displayed using computer-assisted semen analysis (CASA) and flow cytometry. A high degree of standardization, the analysis of high numbered sperm cells and the simultaneous collection of a great number of different sperm characteristics represent the advantages of the new diagnostic possibilities. The forecast of fertilization after a single spermatologic test remains utopia — however, the identification of subfertile or infertile animals through a clever combination of test procedures has become more real.

Quality standards for semen

There are no mandatory rules by law concerning the spermatologic minimum requirements of a semen dose. The german organisation of organised pig production (Zentralverband der Deutschen Schweineproduktion ZDS e.V.) together with the Institute's laboratories of standards of the University of Veterinary Medicine Hannover and the Institute for the Reproduction of Farm Animals (IFN) Schönow have created guidelines concerning the requirements for boars regarding their suitability for use in AI (www.zds-bonn.de/standardisierung.html). They contain details about minimum requirements for boar ejaculates and have become a benchmark for the evaluation of semen. As a result of a long term research cooperation between the member organizations of ZDS and the Institute's laboratories of standards in spermatology, a ZDS standard has been developed some years ago (see below) which includes, beside the guidelines for semen production, also external quality controls.

Science-based quality assurance

The establishment of quality standards is a dynamic process that evolves with increasing scientific knowledge. Currently, eleven insemination organizations consisting of 26 boar studs in Germany, Austria and Switzerland, as members of the development association for biotechnology (FBF e.V.), support practice oriented research projects to ensure semen quality at AI centers in pigs. Actual research projects concerning boar semen deal with markers for boar semen quality, optimization of conservation as well as with the analysis of station audit data and quality monitoring data for an early detection of possible crucial points in the production process. Particular emphasis is placed on the transfer of the results in practice. This is done in close cooperation with the scientific Institute's laboratories of standards, the FBF and its member organizations in subject-specific user seminars and training of the station staff. Thus, the findings of the research will be directly implemented in quality-enhanced measures on the station.
What can breeders and veterinarians do?
In pig breeding farms, boar semen is often stored before used for insemination. The storage conditions must be checked regularly. Test criteria are the storage temperature (exclusion of temperature drop below 15°C), protection against UV light and the hygiene of the air conditioned boxes. Semen should not be stored longer than three days and should be carefully mixed prior to the insemination. Using long term extenders, the shelf life can be extended by a few days. If not specified, the recommended storage time can be obtained from the AI station. If the semen quality is suspected, a semen analysis should be obtained and the semen collection center should be included in the investigation at an early stage.

The most common errors in practice

- „Semen must be delivered cooled to the center.“ Wrong. For the quality of semen, it is advantageous to cool down slowly the semen to the storage temperature of 16 to 18°C. Freshly ejaculated boar spermatozoa are highly sensitive to cold shock and therefore, should be cooled down slowly for a better shelf life. Therefore, „warm“ semen of a temperature up to 25°C indicates freshness and a gentle equilibration to lower temperature zones. It is recommended to store cool, however the temperature must not drop below 15°C.
- „The fresher, the better.“ Not necessarily. Within the first three days, a gentle semen processing using controlled temperatures and good storage conditions are more crucial than the age of the semen cells.
- „The more, the better.“ Wrong. There is a threshold in the number of sperm cells per insemination dose, above which the fertility is not expandable. This value is different for each boar and depends, among other things, on the semen quality. ZDS quality standard has defined a minimum 1.8 billion of sperm cells per insemination dose. However, recent studies show that excellent fertility rates are achievable even with a lower number of sperm cells.
- „Semen quality accounts for 50% of fertility success.“ Wrong. Under normal conditions, the influence of semen on the fertility in pig breeding is only between 5 to 7%. The main influence is found in the insemination management, in particular in the time of insemination. Also general operation influences and pathogenic organism may significantly influence the success of insemination.

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Martin Schulze studied veterinary medicine at the Free University of Berlin (FU Berlin) and received his Dr. med. vet. degree in 2010. Today, Dr. Schulze is the deputy director of the Institute for the Reproduction of Farm Animals in Schönow (IFN). His main research lies in the boar fertility, the spermatozoa and the semen conservation. Since 2008, he leads international quality audits at boar studs and participates in national and international projects.

ZDS standards for semen

- semen assessment and quality management according to the ZDS manual
- Systematic quality monitoring and controlling by experts of institutional laboratories of standards
- Education and training of AI staff
- Testing
- Selection of young boars according to the guidelines of ZDS
- Assistance contracts for crisis situations
- Definition of a product standard
- Support of practice oriented research projects for quality assurance at AI center
- Transfer of research results and their implement in AI center

take home

The production of high quality semen has priority for semen collection centers. New diagnostic methods allow a better evaluation of sperm cells and thus, a safer forecast of fertility. Due to the ZDS standards a science-based quality management and training system is available which is supported by the foundation for biotechnology research and accompanied by accredited institutional laboratories of standards in spermatozoa. The influence of semen quality on fertility in sows is often overestimated. Typical errors may lead to a misjudgement of semen quality in pig breeding.