FERTEX

A new approach to improving liquid semen extenders

What is FERTEX?

FERTEX is an additive for liquid semen extenders developed to improve the environment in which sperm cells are stored and ultimately inseminated.

Most semen extenders are primarily designed to maintain sperm viability during the period between semen collection and insemination. FERTEX takes a broader approach. It is designed not only to support sperm preservation during storage, but also to influence the physical environment of the insemination dose and its interaction with the female reproductive tract after insemination.

FERTEX combines a carefully selected polymer with protective proteins and peptides. It is not intended to replace existing semen extenders. Instead, it can be incorporated into existing formulations as a functional additive.

The technology is the result of more than 15 years of experimental work with polymers, proteins and liquid semen preservation in pigs and rabbits.

From semen preservation to fertility

A semen extender ultimately has only one purpose: to deliver a sufficient number of functional sperm cells capable of fertilization.

Conventional laboratory parameters such as motility, viability and membrane integrity are essential measures of semen quality, but they do not necessarily describe everything that happens between semen storage, insemination and fertilization.

storage -> insemination -> interaction with the female reproductive environment -> fertilization

This broader approach may help explain why effects observed in commercial insemination trials are not always fully predicted by conventional laboratory measurements alone.

What has been observed in practice?

Swine

The original polymer technology underlying FERTEX was evaluated under commercial conditions on multiple pig farms.

A 2013 field summary included **13 farms representing approximately 12,900 sows**. More than **4,000 recorded litters** from sows inseminated twice with polymer-containing semen showed an average increase of approximately **1.2 total-born piglets per litter** compared with previous farm performance.

A separate group of animals inseminated once also produced encouraging reproductive results. Polymer-containing semen extender was subsequently used commercially for many years.

These field observations were an important reason to continue investigating the mechanisms that might explain the reproductive effects of the technology.

Rabbits

The same general concept was subsequently evaluated in commercial rabbit artificial insemination.

In trials involving **1,666 inseminations**, polymer-containing extender was associated with approximately **4.5 percentage points higher pregnancy rate** and an increase of approximately **0.7 total-born kits per litter**.

Polymer-containing rabbit extender was subsequently used commercially for many years. These results in two different species suggested that the observed effects might extend beyond conventional semen preservation alone.

How could FERTEX work?

FERTEX does not rely on a single proposed mechanism. Its development has led to the hypothesis that several physical and biochemical mechanisms may operate together during storage and after insemination.

1. A weak physical structure during storage

Sperm cells stored in a conventional liquid extender gradually sediment.

FERTEX introduces a weak polymer-based physical structure into the extender. This structure is not intended to immobilize sperm cells or create a rigid gel. Instead, it changes the physical characteristics of the medium sufficiently to reduce rapid sedimentation and dense packing of sperm cells.

We hypothesize that maintaining sperm in a more homogeneous suspension may help preserve a more stable microenvironment around individual sperm cells and maintain exchange with the surrounding preservation medium.

Reducing sedimentation could have another practical advantage. Traditionally, semen doses may be periodically mixed or homogenized during storage. Research in liquid-stored boar semen has shown that repeated homogenization is not necessarily beneficial and may adversely affect sperm quality.

FERTEX therefore offers a different approach: rather than repeatedly resuspending strongly sedimented sperm, it aims to reduce the extent of sedimentation itself.

2. Protective proteins

The protein component of FERTEX originates from earlier research into the use of protective proteins in semen preservation.

Proteins can contribute to the protection of sperm during liquid storage and may help maintain sperm viability and membrane integrity.

Earlier work with whey protein in the long-term boar semen extender TRIXcell+ demonstrated the potential of this approach. In laboratory studies, boar sperm stored in TRIXcell+ maintained commercially acceptable motility for substantially longer than sperm stored in the short-term extender BTS.

The subsequent commercial evaluation involved inseminations on 35 pig farms and demonstrated that the concept could be translated from laboratory semen preservation to reproductive performance.

This earlier work provided an important foundation for the protein component subsequently incorporated into the broader FERTEX concept.

3. Peptides and protection against storage-related stress

Liquid storage is not biologically neutral.

During storage, sperm cells are exposed to changes in their physical and biochemical environment. Oxidative stress and reactive oxygen species can contribute to deterioration of sperm motility, membrane integrity, acrosome integrity and other functions required for successful fertilization.

The peptide fraction of FERTEX was selected to provide an additional level of protection against storage-related stress.

Rather than assigning this effect to one specific molecular pathway, FERTEX uses a combination of proteins and peptides intended to support the protective environment surrounding sperm cells during liquid storage.

The polymer, proteins and peptides should therefore not be viewed as three independent additives, but as complementary components of the same preservation system.

Beyond storage

Perhaps the most interesting aspect of FERTEX begins **after insemination**.

A semen dose does not remain in the plastic tube in which its quality was measured. After insemination it suddenly enters a completely different biological and physical environment.

The insemination fluid encounters reproductive-tract mucus, tissue surfaces and physiological fluids. Sperm must remain functional while moving from the insemination site towards the region where fertilization can occur.

Interaction with reproductive-tract mucus

The polymer component gives FERTEX weak viscoelastic properties.

After insemination, these physical properties may facilitate interaction between the insemination fluid and mucus present in the female reproductive tract.

We hypothesize that this may promote more gradual mixing of the insemination dose with the surrounding mucus rather than rapid physical separation of the two fluids.

The polymer-protein system may also influence interfaces between sperm, fluid, mucus and tissue surfaces.

These mechanisms have not yet been fully elucidated and are therefore presented as working hypotheses rather than established mechanisms. However, they offer a possible explanation for an important observation from the development of the technology: improvements in reproductive performance can be greater than would be expected from conventional sperm-motility measurements alone.

Could FERTEX reduce backflow?

Loss of part of the insemination dose after insemination is a familiar phenomenon in animal artificial insemination.

A weak polymer structure that interacts more effectively with reproductive-tract mucus could potentially reduce rapid separation and backflow of the insemination fluid.

If so, a larger proportion of the inseminated sperm population could remain available within the reproductive tract.

This mechanism remains to be investigated directly, but it represents one of the most interesting hypotheses arising from the FERTEX concept.

More functional sperm rather than simply more sperm

These mechanisms lead to a broader question.

Artificial insemination traditionally compensates for losses by inseminating large numbers of sperm cells. But what if the environment surrounding those sperm cells could be improved instead?

If more sperm cells remain functional during storage, if fewer are lost through sedimentation, handling or interaction with surfaces, and if the insemination dose interacts more effectively with the female reproductive environment, it may become possible to obtain the same reproductive performance with fewer sperm cells.

Could we reduce the number of sperm cells per insemination dose?

This is particularly relevant to AI organisations because reducing sperm numbers per dose could increase the number of insemination doses produced from genetically valuable males.

The commercial consequences could therefore extend beyond a modest improvement in pregnancy rate or litter size. This possibility now requires controlled dose-reduction studies.

From short-term to longer-term preservation?

The same concept raises another practical question.

Could FERTEX improve the preservation capacity of a relatively simple short-term extender?

BTS is widely used as a short-term boar semen extender. The earlier TRIXcell+ work demonstrated that selected protective proteins can substantially increase the period during which commercially acceptable sperm motility is maintained.

FERTEX now combines protein protection with a polymer-based physical system and protective peptides.

This creates the possibility that addition of FERTEX could improve the preservation characteristics of a short-term extender and potentially move its performance towards that of a longer-term preservation system.

In other words: **Could FERTEX help turn BTS into a long-term extender?** This is a testable hypothesis and represents one of the next experimental directions for the technology.

A platform rather than a new extender

FERTEX is deliberately being developed as an **additive rather than another complete semen extender**.

Extender manufacturers have spent many years developing and optimizing their own formulations. Replacing those formulations is neither necessary nor desirable.

FERTEX offers another approach: **keep the existing extender and add a new functional layer.**

This makes it possible to evaluate FERTEX in combination with different commercial and experimental extender formulations.

The concept is currently focused on **liquid-stored semen**, with pigs and rabbits providing the main experimental and commercial background. The possible application to other species, including poultry, remains an area for future investigation.

The next step: independent evaluation

The development of FERTEX has reached a point where the most useful next step is evaluation by other organisations.

We are therefore interested in cooperation with **semen-extender manufacturers, artificial insemination organisations, breeding companies and university research groups.**

FERTEX can be supplied as an experimental additive for incorporation into existing extender formulations.

Particularly interesting areas for investigation include reproductive performance under commercial conditions; reduction of sperm concentration per insemination dose; extension of semen storage time; interaction with short-term and long-term extenders; comparison of laboratory sperm parameters with field fertility; investigation of semen-mucus interaction and post-insemination behaviour; and evaluation in additional species.

Not simply to preserve sperm for longer, but to increase the probability that the sperm cells that are inseminated remain functional and ultimately contribute to fertilization.

That is the principle behind FERTEX.

Scientific background

Van den Berg BM, Reesink J, Reesink W. TRIXcell+, a new long-term boar semen extender containing whey protein with higher preservation capacity and litter size. Open Veterinary Journal. 2014;4(1):20-25.

Menegat MB et al. Sperm quality and oxidative status as affected by homogenization of liquid-stored boar semen diluted in short- and long-term extenders. Animal Reproduction Science. 2017;179:67-79.

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Additional references concerning oxidative stress, sperm preservation, seminal-plasma proteins and reproductive-tract interactions can be incorporated into a final technical version.