

# NEW Technology Improves Reproductive Success with AI, ET and IVF

By Heather Smith Thomas

There are several reproductive technologies that enable livestock breeders to produce more high-quality offspring and/or extend the genetics of valuable animals. Artificial insemination, frozen semen, embryo transfer, etc. have become relatively commonplace among seedstock breeders. Currently there are more innovations coming on the scene, to improve the success rates with these techniques.

Dr. Lisa Herickhoff is a scientist who worked with early sexed semen technology, then 10 years ago started her own research and development company called Membrane Protective Technologies, Inc. (MPTI). It's mission is to develop unique technologies to enhance success rates in AI (artificial insemination), ET (embryo transfer) and IVF (in vitro fertilization) in livestock and horses. The focus is on improving the quality of semen and embryos, resulting in more offspring from AI and ET.

Herickhoff studied antioxidants in graduate school and was then hired by XY, Inc.--the company that developed sexed semen. That company was started at Colorado State University by several andrologists (scientists who specialize in male reproductive health), including Drs. George Seidel and Rupert Amann. Later their technology was licensed to ST Genetics of

Navasota, Texas and then became Sexing Technologies.

"I was one of the first two people employed by XY, Inc. and we were able to take the technology that Dr. Larry Johnson developed and commercialize it—as a way to successfully increase the number of sperm cells that made it through the sorter, and increase their health and survival. This enabled us to get reasonable pregnancy rates from sexed semen," says Herickhoff. "I was fortunate to be involved with this; it was a great way to 'cut my teeth' in this science. If I had been able to script my own life, I couldn't have written it better!" she says.

Sexed semen was a great innovation in reproductive technology. "As a young scientist I eventually left that company to grow my own career. I started working in the field of antioxidants, and the application of antioxidants to protect fresh-cut produce such as sliced mushrooms," she says.

"While doing that, my dad had an idea about some antioxidant technologies that might help sorted sperm, and we decided to give it a try. We talked to a friend, Dr. Pat Burns, a scientist at University of Northern Colorado and he graciously allowed us to work in his lab. We collaborated on developing our first product," says Herickhoff.

That product, GameteGuard®, is a plant-based additive.

When incorporated into a semen/extender mixture, it protects sperm from the stresses of freezing and thawing. The result is an increase, often dramatic, in conception rates and in AI pregnancies carried to term—resulting in more AI calves on ground. This additive protects the sperm cell membrane and DNA; the sperm cells are kept healthy and are more effective. If sperm is damaged, the result is lower pregnancy rates. Fertility is most affected by the quality of sperm, so protecting the sperm cells is a high priority for increasing the chance of more offspring.

Her fledgling company received a number of grants to help with research and product development. “We had a National Science Foundation grant first, then several USDA grants that enabled us to breed about 1000 cows. We are currently working with a large bull stud, doing a multi-thousand cow breeding trial with dairy animals. Depending on the bull (and his semen), and on health of the females, estrus detection, etc. (the things that play into the fertility equation) we get between 10 and 35% improvement in pregnancy rates with AI, and this is exciting. We applied this technology last summer when breeding 7400 sows with cooled semen, resulting in 9% increase in farrowing rate and 293 more piglets born alive. This cooled technology we are now using to work with embryos,” says Herickhoff.

When using either cooled sperm, or in vitro embryos that are being held and cultured for 7 days before they are transferred into the surrogate females, it’s a similar situation. “They have many of the same stresses, and our technologies help reduce some of that stress,” she explains.

These are innovations that will be helpful for beef, sheep, goats, horses and other species. “While developing the skills needed for appropriate sperm analysis (to know that our

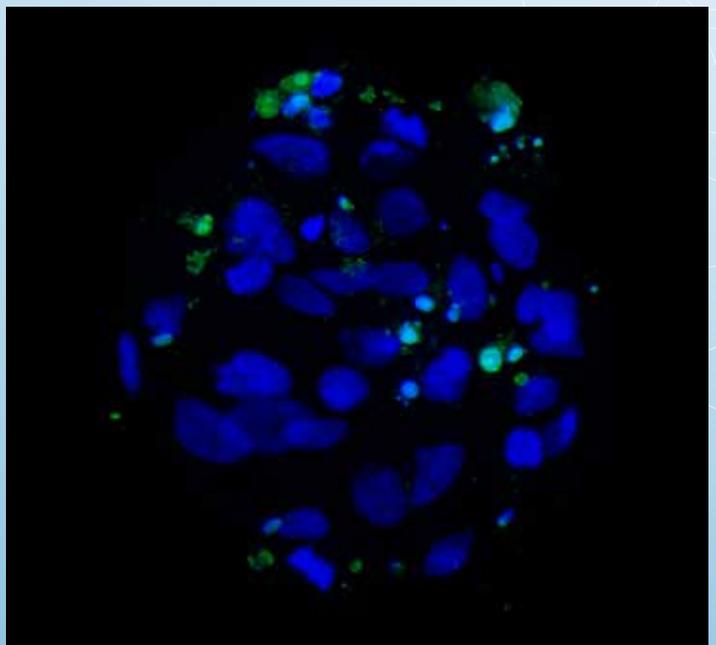
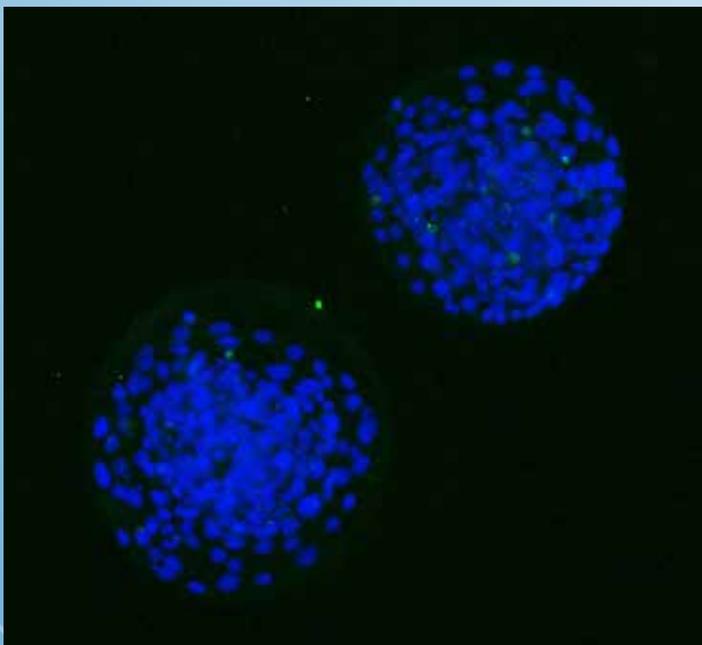
technology would work) we were also able to develop a third-party quality control business. We can examine semen (from any species) that people may be having problems with, or some that they want checked (to know if it is viable and high quality) before they use it. People sometimes want to know if the semen has any problems, or if it’s a good batch. They can send us a couple straws and we analyze it and they can have a better picture about that one-third of the fertility equation (the male side), and remove some of that risk,” says Herickhoff.

“Many people know how to synchronize their cows, and detect estrus, but have no way to determine what’s in that straw of semen. Third-party testing on straws can help. If they are having low pregnancy rates they need to know whether it is because of the person who inseminates the females or because the semen isn’t very good,” she explains.

One bull might be better than another regarding how his semen makes it through the freezing and thawing processes. “Sometimes a bull may get sick, affecting his sperm. It takes 60 to 90 days before his semen might be normal again. If it’s a low-grade infection, you might not realize the bull is sick, yet his semen quality might be terrible. It is worth testing every batch of semen,” she says.

There is also a human factor. “The person doing the freezing might not be having a good day and doesn’t freeze the semen as well as they would have on another day. There are many factors that play a role in semen fertility,” says Herickhoff.

Her company has a number of patents on the technology she has developed. “We also have patents that pertain to protocols for semen handling. From the time of collection and all the way through the time of insemination, we’ve determined the protocol for taking care of that sperm cell so that it doesn’t experience the



*The one photo shows normal healthy embryos and the other photo shows an embryo that has a few cells (the green dots) that are starting to die.*

stresses that occur in an in vitro environment. This environment is hard on cells; they don't like to be outside the body. We've figured out ways to minimize stresses throughout the process."

Her company has been working on these innovations for 10 years. It takes time to accomplish and verify success. The first breeding trial was only 25 animals—12 controls and 13 treated with GameteGuard. "We wanted to make sure those calves were on the ground and normal before we bred any more animals," she explains.

"It takes time to get the necessary research accomplished. We wanted to know for sure that it worked, because this affects people's livelihoods. We don't want to take chances with that, so we've taken it slowly. I'm thankful that a local dairy farmer kindly let us work with 25 of his heifers, which was a big help in the beginning. We had good evidence, with in vitro trials, to indicate that it would all be ok, but we needed some animals to work with," says Herickhoff.

At this point they have done more with dairy cattle than beef cattle because it's easier to do breeding trials. "We did one beef trial with the Noble Foundation in 2018, with nice results. We bred 50 beef heifers and the pregnancy per AI was 58% for GameteGuard® treated sperm and 44% for control (untreated) sperm in a split ejaculate trial using only 1 bull," she says. To date, MPTI has bred 1000 cows in robust trials.

"The embryo transfer technology is exciting and I'm writing a Phase II grant for that. We see a great increase in success rates by supplementing the media for in vitro fertilization and in vitro culturing. We've seen an increase in total number of embryos and also better quality of embryos—significantly more Grade 1 embryos. We haven't put any of those in cows yet; that will be coming in Phase II. But we think (and there are other studies that show) that the quality of the embryo improves pregnancy retention." The cow is less likely to lose the pregnancy early on,

By improving DNA quality and improving overall embryo quality, pregnancy retention and the total number of calves produced will increase. "This is what is important to the people who are doing embryo transfers," says Herickhoff.

Some of the innovations in reproduction that were experimental several decades ago with AI and ET are now commonplace. In the future, some of the new technologies she and other scientists are working on will be helping improve the reproduction rates in these various protocols. "I have a great team of people I work with. Our scientists have advanced degrees in Assisted Reproductive Technologies, Andrology, Reproductive Physiology, Bacteriospermiology, Veterinary Medicine, Cytogenetics, Animal Husbandry, and Molecular Biology, and we all care about agriculture," she says.

Her father grew up on a dairy farm and all her aunts and uncles have livestock. "Some have beef cattle, some are hog farmers and some have dairy cows. This is their livelihood." Her family had the same dairy farm in Germany since 1625, so she has very strong roots in animal agriculture.

"We love to help people who have questions about sperm quality. One of the things we do in our quality control program is help veterinarians with pre-purchase exams or breeding soundness exams. We're not just looking at sperm motility and morphology but also the other factors that affect semen quality.

We examine sperm cells to see if the acrosomes are intact, and note the details about how that sperm cell is swimming, and all these assessments that a veterinarian can't do out in the field with a typical semen check," she says.

For a sperm to effectively fertilize an egg, it needs an intact acrosome and good quality DNA. We can tell you how the sperm in the straw looks, or the raw ejaculate relative to other samples." This can help purebred breeders who are spending a lot of money for a bull and taking a risk. It's good to know more about that bull's sperm, and how they go through the freeze, for instance. If you know the sperm quality is good before you breed, you'll have a greater chance of a full term pregnancy and more babies on the ground. **U**