

Eliminating beef cattle pregnancy loss with CRISPR/Cas9 technology

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Cow-calf operations depend on getting a live calf with every pregnancy. Credit: Texas A&M AgriLife photo by Laura McKenzie

Calves on the ground eventually mean dollars in the pocket and steaks in the meat case. It's the basics of the beef industry.

However, reproductive inefficiency costs the beef industry billions every year. Most of that is driven by embryonic mortality and [pregnancy loss](#), said Ky Pohler, Ph.D., an associate professor in the Department of Animal Science and chair of the Pregnancy and Developmental Programming Area of Excellence at the Texas A&M College of Agriculture and Life Sciences.

"We're conducting a series of studies to evaluate what's really important to the developing [pregnancy](#)," Pohler said. "We want to determine how much of the loss is coming from the physiology of the animal vs. how much is genetic."

When a cow loses a pregnancy or undergoes embryonic mortality, the cow may not get pregnant again in that breeding season.

"Beef producers are paid on pounds of calf weaned or a live calf," Pohler said. "If there is no calf born, then there's no profit. And the producer's input costs continue to increase. Our cow-calf operations must get more efficient, or we won't be able to maintain them."

A recent \$500,000 Agriculture and Food Research Initiative grant from the U.S. Department of Agriculture National Institute of Food and Agriculture will fund Pohler's project to advance understanding of embryonic mortality and pregnancy loss in the cow.

The project, Physiological Function of Prostaglandins and Pregnancy Associated Glycoproteins in Late Embryonic Mortality in Cattle, is part of a series of studies Pohler is conducting to evaluate various aspects of a developing pregnancy.

Successful completion of the study is expected to provide foundational information on the physiological and molecular mechanisms associated with embryonic survival and mortality in beef cattle. This knowledge

will lead to a better understanding of the causes and potential strategies to prevent such reproductive loss, which is causing major economic problems for the beef and dairy industries.

Applying genetic knockout technology

The new grant allows Pohler's team to study gene knockouts, using the CRISPR/Cas9 technology in cattle.

"You basically knock out a single gene and see what happens with the developing embryo when you do that. Does the pregnancy develop forward, or does it terminate right there?" he said. "We're excited to start using this technology in our projects to really understand pregnancy and developmental programming."

Pohler said their study aims to show the impact of a gene family called pregnancy associated glycoproteins or PAGS. These proteins have been known for years; they are the foundation for blood and milk-based pregnancy testing in cattle. The team will remove those genes one by one to determine if they are important to the developing pregnancy.

"We know ways to minimize pregnancy loss," he said. "But we don't know how to eliminate it, because we don't know what the true causes are. This is an opportunity to understand the causes and then develop management strategies specific to those causes."

Developing more than a band-aid for beef cattle pregnancy loss

The No. 1 economically important thing on a cow-calf operation is pregnancy.

"All the other things we do are important, but pregnancy is 20 times more financially important than any other production trait," Pohler said. "If you take it all the way to the consumer level, if you don't have the pregnancy, you will never realize the potential of that animal to generate a steak for the consumer."

That is why he is concentrating on ending embryonic mortality.

Pohler said he tells people the industry's current practices are like putting a band-aid on the situation—"like, I know if I do this, it will help me decrease it, but it doesn't help me eliminate it. So, we want to understand what the real mechanisms are and how do you eliminate it."

Will pregnancy loss ever be completely eliminated? No, Pohler said.

"But we can develop genetic tests. We can develop other types of tools to help minimize that loss. I think what we will be able to do is develop better management strategies."

One of the other projects Pohler and his team are working on is to determine how much contribution to embryonic mortality comes from the bull and how much from the cow.

"We're studying all sides of it," he said. "This project is really female-focused. But there is a whole opportunity on the bull side as well. And I think understanding both sides is going to be critical. If it ends up being on the bull side, and you can develop a genetic test, there are a lot fewer bulls than there are cows. So, you can make a lot bigger impact in a shorter time. If it ends up being on the cow side, it will take a lot longer time to make that impact."

Applying technology at the ranch level

Currently, Pohler estimates only about 25% of [beef producers](#) use pregnancy diagnosis in their herds, even though the technology has been around for years.

Using pregnancy diagnosis can help determine when an animal loses a pregnancy. With technology and better management practices, that producer can be more efficient in generating calves, have animals with better genetics than the previous year, and produce a more uniform calf crop. All these things work toward making a producer's beef cattle operation more financially sustainable.

"Don't adopt technology for the sake of adopting technology," Pohler said. "Use the [technology](#) you need to get where you need to go. You have to capture the value on it."

Provided by Texas A&M University

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