## Male Reproduction

## Season 1, Episode 30

[Intro music]

**Interviewer (Robin Salverson and Kiernan Brandt):**

Welcome to Cattle HQ, where we continue our conversation with Dr. Tom Geary from the Fort Keogh research station in Miles City, Montana. I am Robin Salverson cow/calf field specialist based out in Lemmon, along with Olivia Amundson from the Sioux Falls Regional Center, and Kiernan Brandt from the Watertown Regional Center. This episode will focus on the research conducted at Fort Keogh to help identify the markers of fertile bulls. Sit back, listen, and enjoy as we join part two of our conversation with Tom.

**Respondent (Tom Geary):**

So, we’ve been conducting work in bulls and with semen from bulls with the goal of identifying some new biological markers on the surface or within sperm that are indicative of fertility. One of our goals is to develop a quantitative full fertility index that allows ranking of bulls based on fertility. The current bull fertility evaluation, referred to as a breeding soundness exam, or BSE, is a pass-fail exam that does not allow for identifying the most fertile bulls within a herd. Thus, it also does not allow for any selection for fertility either. Before I go any further, I want to emphasize to our audience that a BSE is still very valuable because it can identify infertile bulls so they can be eliminated from breeding, but we’re merely trying to improve the evaluation, and provide producer with opportunities to utilize more fertile bulls differently, or perhaps select for fertility in their herd.

As you had mentioned earlier, we had a PhD student from South Dakota State working in our laboratory and conducted a major study of his PhD here. He had some field fertility data from Brazil on some bulls that he had used for AI. These five bulls, that’s how many there were, they varied a little bit in field fertility, so it allowed us to evaluate the correlations between some of our fertility biomarkers and the field fertility in those bulls. There was only about a 7.5% difference between the highest fertility and the lowest fertility bull among those five, so it wasn’t the most stringent test of our biomarkers. But we’ve identified and we use these biomarkers with flow cytometry, and maybe it’s valuable to introduce our audience to flow cytometry, in that it’s a laboratory machine now that we use to evaluate functional sperm traits.

**We can evaluate sperm biomarkers very rapidly and easily with this equipment, and it’s very informative. The way it work is we add a fluorescent labeling on specific targets of** a sperm cell, and then we can run it through this machine, and it has automatic counting of sperm that fluoresce as they go past a laser single file, and it can evaluate more than 10,000 sperm in less than a minute. So, those sperm are really cruising when they flow by it.

The biomarkers we’ve evaluated include acrosome integrity. The acrosome is important because it contains enzymes that allow the sperm to penetrate the zona pellucida, the covering on the egg. We evaluate viability, the energy production potential, the ATP production essential, DNA integrity. We evaluate reactive oxygen species, which include the ability of that sperm to survive in a stressful environment. We have markers for molecular identification of impending cell death and capacitation, which is what Salo worked with primarily when he was here. Capacitation is in an event obligatory to final fertilization potential. Our efforts are to try to identify the most valuable fertility markers.

So, we’ve used a number of different procedures to try to identify more and less fertile bulls. We’ve used something called nano purification, where we are able to remove the damaged sperm from an ejaculate before extending and placing that sperm in AI straws for field trials and IVF trials. We’re evaluating sperm differences with flow cytometry. Some of the highest and lowest fertility dairy bulls, and how they’ve done as far as IVF trials go, as well as now with some beef bulls with IVF trials and field fertility trials. Those are the things we’re trying to do. They’re handheld, programmable flow cytometers, not much bigger than a cell phone, that if we identified the best biomarkers, which ones are more meaningful, veterinarians in the future could be better equipped to evaluate full fertility shoot side. We think that will be valuable.

I keep getting asked a question, “How far is that from commercialization?” and I know that was coming from one of you. I keep saying five years and I’ve been saying it now for three years, so we should only be two years away, but we’re not. I bet we’re still five years away. I think the potential exists, though. We have to have a better measure of bull fertility than pass-fail breeding soundness exam. Otherwise, we can’t select for fertility, and we should be able to select for fertility. I disagree with geneticists.

**Interviewer:** I agree 100%. I think it’s so important that you actually identify the critter that’s actually getting the cows bred, like a $5,000.00 bull that breeds zero cows is not doing anybody any good. Olivia, feel free to cut me off and circle back if you want to jump in, but I just wanted to pose a hypothetical. So, for the guy that’s 100% natural service, obviously, no access to a flow cytometer, the measure for that individual, the most fertile bull he has is the one that gets the most cows bred, right? So, is there anything on that, from a very simple cowboy definition? Is there anything that we can learn from him through veto, linking back to these markers and these indicators of fertility, is there a bridge somewhere?

**Respondent:** Yes, you’re right. It’s difficult to make progress in the natural service field because we have libido or drive for breeding cows, we have bull dominance within a breeding herd, and we have fertility. You can think of it that the bull that sires most of the calves is either the most dominant bull or the most fertile bull, but this is why the BSE is so important, is if that dominant bull is a sterile bull or an infertile bull, that bull is not going to sire the calf, somebody else is, but those calves are going to come later in the calving season the next year because that dominant bull fought off those other more fertile bulls and prevented them from breeding until later in the breeding season. So, it’s difficult to make progress there.

So, once we identify the right markers, and initially, we’re going to probably start out with five markers, after another year we might have 7 or 9 or 11, and we could just come up with a both fertility index. We do selection indexes for genetics all the time. Just like when we select a bull for AI, we might select for milk production of his daughters, we might select on heifer fertility, we might select on meat traits, growth traits, things like that, and put different weighting systems. We can do that with a fertility index as well. Once we identify what the players are that are related to fertility.

**Interviewer:** Tom, I don’t know how to ask this question, and I don’t know, maybe it’s not as relevant as I think, but talking about some of the bull fertility markers and being able to decipher what bulls are going to be more fertile than others, in some of these bull catalogs from some of these semen companies, they have bulls that are described as like “concept plus” and things like that. I guess, how is what you’re doing different from what they’re trying to sell?

**Respondent:** Sure. That’s a great question, and I think you framed it pretty well. There are some of these AI studs that are marketing bulls as being more or less fertile. They get rid of the bulls that are less fertile, right? But there are a lot of bulls in their catalog that they might come and say, “This was the number one bull last year,” yet they don’t have that fertility indicator for that bull. So, why don’t they? If that bull was really the one used the most last year, they should have that information, you would think.

They’re trying to sell a product as well, and they’re trying to sell the best genetics and fertile semen. They’re trying to look at it from a standpoint of field fertility from all the data that we gather from producers and from AI technicians. It’s not perfect, but it’s a start. I applaud them for doing it. I especially applaud those who actually give a number as opposed to those that just say - what did you call it, “conception plus” or something?

**Interviewer:** Concept plus, and I had a short stint in the semen rep industry there for a while, and you’re out there selling these bulls and you’re guaranteeing so much fertility on these males compared to these, and it just got me thinking, and it makes sense, you have this large group of - or you have this bull that sired so many females. You’re getting that information back, and a lot of these bulls are being used on dairy females. So, a lot of that is just readily available information.

You’re right, I think it’s a great way to start, but I think the way that you guys are going about this process and maybe being able to determine some of those markers that are there so that we’re not having to sire all these females before we’re getting that information is going to be a gamechanger in terms of pushing out some of those better bulls and continuing to get these females pregnant faster, I guess.

**Respondent:** Yes. Well, I think it has a lot of potential, but you’re always going to find some bull that has got some gene missing or mutated, and even though he has all of these markers that suggests he’s the most fertile bull, he’s going to be a dud, and we won’t know why until we get down that road a little bit further either.

**Interviewer:** Tom, I also noticed that you have done some work on trace minerals and the effect on both fertility. Would you share some on that and what you found?

**Respondent:** Sure. The take-home message is, I don’t think we can do very much from a nutritional standpoint once a bull has reached puberty to change his fertility. Now, all of our measures, and we’ve done some trace mineral supplementation, different types of minerals, different quantities of minerals, and we can’t improve fertility in the measures that we’re making. Realize, the measures we’re making are laboratory measures, they’re not field fertility. Realize also that we’re making these measures in peripubertal bulls, or we’re doing it in mature bulls in the non-breeding season. So, what we don’t know still is that minerals available during the breeding season still could be critical. I don’t know how often I’ve seen a bull stick his head into a mineral lick or a tub that is full of mineral, but I’m not saying that minerals aren’t important. We just haven’t been able to demonstrate an improvement in fertility with different mineral supplementation.

The only nutritional thing that we did that affected fertility was with Carl Dahlin at North Dakota State University, and he had bulls that were mature bulls, and he had some of them that he put on a nutrient restriction diet during the winter, during the non-breeding season, and others he fed the heck out of. Those ones that he restricted the nutrient availability appeared way more fertile than the ones that were becoming too over conditioned and too fat, and likely, had some temperature things affecting their scrotum and sperm production. That was the only nutritional study that I can say after a bull reached his puberty has had any effect on fertility.

**Interviewer:** That’s interesting, and thank you for sharing the facts that you’ve seen and how that can influence bull fertility. And I want to thank Olivia for asking the question you did earlier, about the various fertility factors that we see in our AI catalogs because I was thinking the same question, [Laughter] so I’m glad you asked that. That was in my mind too. So, with that, is there anything additional we want to ask Tom during this episode before we wrap up?

**Interviewer:** I had something. It totally just left my brain. Dr. Dahlin has done some of that bull work. My former advisor, Dr. McClain, has done a similar study, and they noticed something different or noticed something consistent with that, that those radical adjustments to steady state has the potential to throw the body way out of whack. I think that’s fairly consistent with what you would see in humans even. Those massive metabolic changes can throw the body haywire. But I think that was a really impactful statement that you made, about the potential to impact the bull’s fertility, considering that the majority of the industry purchases post-pubertal bulls that have already – so the potential to impact that is fairly limited. So, what are your general thoughts on potentially raising your own bulls, or the importance of finding a bull producer whose environment and management system really closely interconnects with that of your own?

**Respondent:** Sure. That’s a great question, Kiernan. I work with a lot of producers who do raise some of their own bulls, generally from AI. From AI, maybe their elite cows or something in their herd. They do it because, yes, they want calves that are growthy if they’re selling weaned calves, let’s put it that way. They want calves with high weaning weights, and grow well and do well in the feed lot and things, but their number one issue has got to be having a calf on the ground. Their number one goal is to just have a fertile bull. That’s the most important. Second is the genetics of that bull and how it improves their herd or it achieves their goals for their production scenario.

I do think it’s important to use bulls from a similar environment. However, the data suggests that that’s true, but I haven’t seen where it demonstrates necessarily a bull produced in a lush environment - I don’t even know where to pick - let’s say in the Midwest, is going to produce any different pregnancy rates in the desert of Nevada than a bull produced there if you’re using AI, for example. If we’re raising them both in those different environments and then putting them into the breeding herd in Nevada, then I think you’ve got a much bigger problem, probably, on your hand. The reverse though, might not be true. If you take a bull from Nevada and put it into a lush environment, I don’t know how rapidly we’d see a decline in fertility. That bull might have thought he died and went to heaven with all the food available, but they still have one thing maybe on their mind if they’re a good bull more than eating, and that is getting cows bred.

**Interviewer:** Anything else guys that we want to quiz Tom about before we close this episode down? Well, thank you, Tom for joining us. We always appreciate visiting with you, and with that, once again, this is Cattle HQ, brought to you by SDSU extension headquarters for all things beef cattle. Visit extension.sdstate.edu for the latest beef information. Until our next episode. The cheapest way to improve your looks is to wear a smile.

[Outro music]