## The Research and Impact of Uterine Microbiome on Livestock Fertility: Dr. Rebecca Poole

## Season 1, Episode 41

[Intro music]

**Kiernan Brandt:**

Welcome to Cattle HQ, a podcast from industry experts and progressive producers discussing cutting edge info about the cow calf sector to keep cattlemen and women in the know and positively affect their bottom line.

**Robin Salverson:**

Welcome to Cattle HQ, brought to you by South Dakota State University Extension. I am Robin Salverson, cow-calf field specialist living the life in Lemmon, South Dakota. I am joined by Dr. Poole. She’s an assistant professor with Texas A&M University. Welcome, Dr. Poole, to this episode. I understand most of your research actually revolves around the long-term goal of optimizing fertility in livestock. I know there’s been quite a bit of work done in the rumen microbiome within livestock. However, during this episode, we’re really focusing our time around the uterine biome and that relationship to fertility. For those listeners out there, that word biome is scary. What does that mean? [Laughter]

**Dr. Poole:**

Well, thank you so much, Robin, for having me. It’s really great to have this invitation and talk to you about some of my work. Yes, biome is a scary word, but really, it’s just referring to ecological environment. In other words, it’s just referring to a particular type of environment that a specific community can thrive in. I’ll give you an example. You brought up rumen microbiome. Microbiome is just referring to the environment that microbes can live in. Then if you just add the rumen part to it, it’s just the microbes that can live and thrive in the rumen. The same is true for the vagina or the uterus. There are microbiomes for both the vagina, the uterus, or any type of organ in the body.

**Robin Salverson:**

A lot of the times, when doing some research on this, in the world of raising animals, bacteria is a bad word, I mean, like that calf is very [[Crosstalk]](http://recordings.civi.com/cgi-bin/player.php?file=PC-00002-CattleHQ-Ep40%5b0%5d.mp3&starttime=135&duration=20)

**Dr. Poole:**

Very, yes.

**Robin Salverson:**

When we look at the biome, bacteria is not necessarily bad, right, I mean, depending on what bacteria it is. Is that correct?

**Dr. Poole:**

Yes, you’re absolutely right. For a long time, bacteria is, when you combine bacteria and the reproductive system, that’s scary, and rightfully so. We do know there are bad bacteria that cause some nasty diseases and uterine infections. So, that’s 100% true. Now that technology is getting better, we’re able to actually pinpoint some of those bacteria that actually aren’t that bad and should be there in maybe the uterus because they play a function for the uterus, so they may actually play an important role for the uterus to establish a pregnancy for example. A lot of those bacteria that were characterized as bad, that’s just because we were limited by the technology at the time. We could only culture, take a swab and do cultures in the lab and have bacteria grow on a plate and typically those are some of the more “bad” bacteria. Now we’re actually trying using some more sophisticated technology actually being able to sift out good versus bad and those kinds of things.

**Robin Salverson:**

So, this doesn’t give the opportunity for people that AI to just go and, beyond sanitary, yes, after this whole conversation. [Laughter] We still need to think about that when we’re trying to get cows bred, and sanitation is extremely critical.

**Dr. Poole:**

Sure.

**Robin Salverson:**

But understanding, like you said, there are certain bacteria that actually help us within the fertility side of things.

**Dr. Poole:**

Yes. Absolutely.

**Robin Salverson:**

Why should ranchers really be concerned about the uterine biome or the vaginal biome? Why should the producers be thinking about this?

**Dr. Poole:**

I think it’s a great question, and it goes back to what we were just talking about. One, knowing that not all bacteria is bad, so knowing that there are resident bacteria in the reproductive system that are good and should be there, and two, because the technology is improving and we’re getting better at knowing what those good bacteria are so that we can actually, five, 10, 15 years down the road, actually have something implementable for producers to be able to “shift” the microbiome to something that would be helpful for establishing a pregnancy or something along those lines. I think it, for producers right now, it’s really just knowing that bacteria in the reproductive tract, not a bad thing always, not always a bad thing at least, and that we are, the technology is ever improving that we’re actually trying to find ways to have implementable strategies on farm.

**Robin Salverson:**

You’d mentioned maybe five to 10 years, you can’t confirm that, and I get that. [Laughter]

**Dr. Poole:**

Yes. [Laughter]

**Robin Salverson:**

No way.

**Dr. Poole**:

Yes.

**Robin Salverson:**

However, it is really promising for our producers that there could be something to help us better understand fertility, A, and then also then maybe, like you said, help them shift, maybe shift that biome to benefit higher conception rates. I have to admit, so what does a good uterine biome look like to your research? What have you found?

**Dr. Poole:**

Well, unfortunately, as far as what is a good microbiome, we’re still trying to figure that out. I think we’re actually really good at figuring out what the bad microbiome looks like. It’s easier to find the bad bacteria because then you see a uterine infection or something. It’s easier to find those guys. It’s harder to find, it’s like finding a needle in a haystack. It’s harder to find the good ones that we want there, and then, on top of that, it’s harder to find “Okay. What are ways that we can shift that population to those good bacteria?” That’s where my research is looking at, one, finding those good bacteria, identifying them, and then two, finding ways to easily shift it towards those good bacteria. I will just add a sidenote. For cattle in particular, they are particularly tricky as far as finding a good bacteria, because unlike some other species like humans, so humans, we have microbiomes as well in all of our systems, for humans, for the reproductive side of things, there really is only one type of bacteria that is good and it’s the overwhelmingly dominant bacteria in the reproductive system. So, it’s easier to shift it towards that one type of bacteria. For cattle, it seems like they have a lot more bacteria in the reproductive system and it’s harder to say, “Are these all the ones we want there or is it just a few?” They have a lot more and so it’s harder – again, like I said, it’s like finding a needle in a haystack. It’s harder to pinpoint “This is the one, or these are the few that actually are the gamechangers, the good ones.” So, it is a lot harder.

**Robin Salverson:**

You’ve said that’s what you’re working on within your research and – there at Texas A&M. Can you share some more highlights from your research, and how, like you said, you’ve been trying to identify it’s harder, it’s like tying to find a needle in a haystack, but what are some of those things that you are finding that are like “Wow. This is super cool and this can really help our producers in the future?”

**Dr. Poole:**

Sure. One thing my research highlights is “What are things that are changing the microbiome or shifting the microbiome?” One thing we do know is that, depending on where she is in her estrus cycle or where she is in her cyclicity, that changes what her microbiome looks like. Her microbiome at ovulation, when she is ovulating or in heat, looks quite different than two weeks prior, when she’s not in heat. They actually do look very different in the bacteria that are there, and that’s, we think, maybe hormone driven, you have different hormones when she’s ovulating versus when she’s not. So, we think that could play a role. We also think that these hormones also change the immune system and we know, when you think of bacteria or microbes, the immune system goes hand in hand with that, so the immune system helps control which ones should be there, which ones shouldn’t be there, and so that’s kind of it’s tying together the hormones that are naturally circulating in the animal, the immune system, and then the microbes that are there. That’s the highlight of my research right now. It’s interesting, you can’t just compare the microbiome when she’s in heat versus when she’s not in heat. They actually look very different. That’s probably the biggest highlight right now.

**Robin Salverson:**

Based on your current research and what you’re doing, where does your future research lead you then in this world of microbiomes?

**Dr. Poole:**

When I think of hormones and I think of shifting it, I think, my first thought is estrus synchronization and how does using the tools that we already have on farm, like these hormones we’re giving to change, what structure she has on the ovary, or using a seeder, things like that, how would that change in the microbiome? Is it a good thing? Are we shifting it in the right way to optimize fertility and optimize the likelihood she’s going to get pregnant? So, not just thinking about just having her in heat but is she also reshifting those bacteria in a positive way that also increases the likelihood that a pregnancy will occur.

**Robin Salverson:**

Within the research of the rumen biome and microbiome, obviously, a lot of management things that producers do affect that. Does that hold true somewhat in what you’re saying when it comes to the estrus synchronization? Is that basically what you’re saying is how we’re, like you said, the microbiome changes whether they’re in heat or not in heat? So, what we’re doing to those animals when we’re synchronizing them could be impacting them. Is that correct or no?

**Dr. Poole:**

Yes. I’ll use your example of the rumen microbiome. We know that if, yes, you feed different things, you feed a high-grain versus a high-forage diet, that’s going to change the microbiome in the rumen. The microbiome, whether you’re talking, let’s say, about the rumen microbiome, it’s pretty resilient in that there’s like a core microbiome, one that should always be in the rumen, and then when you shift it one way or shift it another way, over time it will revert back to its natural state what it should be. If you want to maintain a consistent change or shift in the microbiome, let’s say you would have to continuously feed a high-grain diet or something like that to continuously see the change in the microbiome. It’s not as though you could feed a high-grain diet one day and it’s always changed. It will revert back to its original rumen microbiome state. Does that make sense?

**Robin Salverson:**

Yes, it sure does.

**Dr. Poole:**

Yes. It’s the same idea with the reproductive or the vaginal or uterine microbiome. It’s ebbs and flows. It will shift this way and then it will shift back another way depending on what is happening. For example, if you put a seeder in, that will change the microbiome of the vagina. After you pull the seeder, two days later, it reverts back to what it looked like before you put the seeder in. The seeder doesn’t continuously alter it forever. The microbiome, those core bacteria that should be there, they’ll come back and they’ll populate that microbiome over time.

**Robin Salverson:**

Is the biome that we have in our vagina is different than what we have in the uterus? Correct?

**Dr. Poole:**

Yes. That’s just because the cervix that we’re all used to, we have to pass the rod through the cervix, that it does separate those two environments to where the uterus and the vagina do look quite different.

**Robin Salverson:**

With that being said, the vagina probably is, I’m going to use the word less sterile very loosely, it probably has more bacteria and – versus the uterus. Right?

**Dr. Poole:**

Yes. That is very true.

**Robin Salverson:**

Those young heifers, those virgin heifers, are they – does their microbiome change over time from, like you said, it always goes back to that status quo for a microbiome?

**Dr. Poole:**

Yes.

**Robin Salverson:**

Have you looked at them in young calves to when they are cows? How does that change the microbiome?

**Dr. Poole:**

That’s a great question. I think, yes, I think if you look at a heifer, her microbiome in the uterus is going to look a little different than now when she’s a postpartum cow and afterwards. It’s going to look a little different. It could just be slight changes in certain bacteria, and so – but I don’t know, I have not done that kind of research to track a female over her lifetime, what does it look like here and then after subsequent pregnancies. I have not looked at that but I wouldn’t be surprised if you do see some changes. Then, I think that’s interesting just on – that would be really something interesting to look at. How does it change over time? What does it look like in a virgin heifer? She hasn’t had anything. Well, the uterus has had no “exposure.” What does it look like? How much does it change? That would be really interesting to look at. For most of my research, I do focus on either heifer or postpartum cow. I don’t really combine them together because they do look quite different.

**Robin Salverson:**

Look different.

**Dr. Poole:**

Yes.

**Robin Salverson:**

So, there’s a lot of research in those world of the uterine biome that can be done, yes, you’re just starting to chip away at it.

**Dr. Poole:**

That’s right.

**Robin Salverson:**

That’s really exciting. [Laughter]

**Dr. Poole:**

Yes, hopefully a long and fruitful career. [Laughter]

**Robin Salverson:**

That’s right. When we think about the female reproductive tract and in conception, the uterine microbiome is affecting, I’m sure, affecting fertilization, it’s affecting implantation, things like that, but that sperm, I’m assuming, is also being impacted by that uterine microbiome, is that correct, whether it’s through natural service or through artificial insemination, is it? Yes.

**Dr. Poole:**

Yes. This has always been a question that I – and another question I want to chip away at and better understand. I think, yes, is the uterine microbiome, is it impacting the sperm’s ability to do their job? I think, yes, perhaps if I had to take a stab at it, because it - and it goes back to the immune system. Let’s say within the uterus something happened where a few bad bacteria got in there before insemination and so the immune system kicks in to help fight some of those bacteria that shouldn’t be there. If the immune system’s already kicked on and you inseminate, well, now the immune system’s going to further attack those sperm cells more so than they already would have. Perhaps it would act – and so in that regard, it’s not necessarily the microbes that are impacting the sperm cells, it’s the microbes impacting the immune system that did impact the sperm cells to do their job. That’s how I see it at least. That’s my approach is incorporating the immune system and how it is impacting something like fertilization or sperm in the female tract. Another thing, another layer on top of this, especially when you think of natural service, is the semen has its own microbiome, and so what is the combination of the semen microbiome and the vaginal and uterine microbiome? What does that look like? Does there need to be compatibility between the microbiomes? I don’t know. That’s something I’m also interested in. Is that another part of the story?

**Robin Salverson:**

Yes, it takes both the female and the male side to make a pregnancy, so… [Laughter]

**Dr. Poole:**

That’s right. We always like to focus on the female but we can’t forget the male. The semen also has a microbiome and it also serves a function, and so that’s also something in the back of my mind for research purposes.

**Robin Salverson:**

Yes, that’s really interesting. You’re absolutely right. Then, when we teach AI schools, a lot of people are really surprised when we say that sperm were a foreign object to that female and so that immune response may kick in, and so - and they’re like, “Really?” Like, “Yes. You know what I mean? That’s why we have to do due diligence and everything each step of our AI process because there’s things we can’t control.”

**Dr. Poole:**

Yes.

**Robin Salverson:**

What’s interesting right now is what you’re talking about is that biome plays a factor into fertility and at this point in time, we’re just understanding that biome and what is good and what is bad, and into the future, hopefully we can start shifting that biome if I got that.

**Dr. Poole:**

Yes. Once we actually nail down “Okay. This is what’s an ideal microbiome looks like when she’s in heat,” what can we do while we’re synchronizing her to ensure that microbiome occurs when she’s in heat, when we would want to AI or turn her out with the bull or something like that? That’s, yes, just the area or the way I’d like to go with my research.

**Robin Salverson:**

I’m just going to go back quickly to this sperm microbiome. How much work has been done in that area and in understanding the microbiome of the male side of things?

**Dr. Poole:**

Far less. Us as reproductive physiologists, we’re guilty of focusing on the female quite a bit, we – and rightfully so, right? She’s the one who has to carry the pregnancy and nurse the calf and so on and so forth, so rightfully so, we do focus on the female, and we forget about the male a little bit. So, not much, but he – a redemption arc is coming for the male. We’re starting to look more in the microbiome. Because when we think of, also, bacteria and semen, bad thing, right, we add antibiotics in when we extend semen or something like that, but maybe we need to take a step back. What if some of these antibiotics we’re adding or disrupting some of the microbes that should be in semen? I don’t know. Obviously, we do want to get rid of any contaminant bacteria, the bad ones, certainly. Antibiotics do play a role in that but we’re taking a backstep and trying to figure out, for the semen microbiome, what bacteria should be there? Where do they come from? Do they come from the male reproductive tract, or not? How do those impact the sperm cells? Things like that. Yes, there have – starting to be some research in that world as well and looking at the male side of things.

**Robin Salverson:**

Well, like you said, you have a long and fruitful career in front of you. [Laughter]

**Dr. Poole**:

I sure certainly hope so. [Laughter]

**Robin Salverson**:

I think it’s about time we wrap up this episode of cattle HQ, but are there any last thoughts, any last comments that you have before we close this down?

**Dr. Poole:**

The only thing I’d say is, for producers, keep doing what you’re doing. If it’s working, it’s working, but know that – don’t forget the little guys. Don’t forget the bacteria. They are playing a bigger role than you think, and hopefully, in the near future, we’ll have something out there that can really help out.

**Robin Salverson:**

I very much appreciate having you on this episode of Cattle HQ, Dr. Poole. You explained the word microbiome. That to me is a very scary word. You explained it so well that it’s no longer scary.

**Dr. Poole:**

Yes. Good.

**Robin Salverson:**

I do appreciate having you and joining us from Texas and sharing your information with us. Once again, this has been 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, remember, there’s always a reason to smile.

**Kiernan Brandt:**

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[Outro music]