Decode 6

DECODING CARBON AND ECOSYSTEM SERVICES

What We Know (& Don't Know) About Enteric Methane Emissions

Featuring Sara Place

Associate Professor of Feedlot Systems, CSU AgNext

DJ May 00:01
Welcome to the Decode 6 Podcast, where we take your questions about carbon and ecosystem services and match them to the experts with the answers. I'm your host, DJ May. Today we're talking gas enteric methane to be specific. What do we know about enteric methane, and what are our opportunities to improve emissions from livestock production? Our expert with the answers is Dr. Sara Place, associate professor at Colorado State University AgNext. Sara is an expert in livestock systems sustainability with over a decade of experience in academia, industry associations and private industry. Most recently, Sara served as the Chief Sustainability Officer at Elanco animal health. Prior to Elanco. She was the senior director for sustainable beef production Research at the National Kettlemans Beef Association, and an assistant professor in sustainable beef cattle systems at Oklahoma State University. She received her PhD in Animal Biology from the University of California Davis, and a BS in animal science from Cornell University. Sara is a native of upstate New York where she grew up on a dairy farm. She's no stranger to enteric emissions, and she's a great person to talk about this today. Sara, welcome to the show. It's great to have you.

Sara Place 01:18
Thank you for having me. Appreciate it.

DJ May 01:20
We're gonna dive right into this. So what is enteric? Methane?

Sara Place 01:25
Yeah, so enteric methane is methane that's naturally produced from the gut of animals, right? So that's what that word enteric means. And primarily where it's coming from, from a farm animal perspective is ruminant animals. So cattle, sheep, goats are all of our domesticated livestock species that are ruminants. And so they have this large component of their stomach that we call the four stomach that has the rumen reticulum, oh, Mason altogether. And the main takeaway is like that, for stomach has trillions of microbes microbes in it. And so when cattle, for example, eat, feed, eat grass, it goes to that forestomach. And there's a whole bunch of fermentation processes that take place. As a byproduct of that fermentation. There's a little group of rumen microbes called advantages, and they actually make methane from the end products of fermentation. So basically, those little advantages are part of the ecosystem that lives within the gut, especially ruminant animals. enteric methane from non ruminants is fairly minor. So ruminant animals, again, cattle, sheep, goats for domestic animals, giraffes, for example. There are wild ruminant deer, bison, there's other ruminants as well, but for our livestock species has mainly cattle, sheep and goats.

DJ May 02:45
Okay, so essentially, it's like you have your cattle, sheep, goats eating grass, and then it's really not their fault. It's the microbes that are causing the methane.

Sara Place 02:55
Yeah, it's actually not the animals themselves that are making it's the little, you can say little freeloaders that live inside them, right. They have that symbiotic relationship with those microbes. The animals get a lot from those microbes and the microbes get a lot from the animals, but part of that whole process is methane production.

DJ May 03:12
Cool. Okay, so tell me more about methane. How does it compare to like, I know we're very familiar with like carbon dioxide is a greenhouse gas. But where does methane land?

Sara Place 03:20
Yeah, so carbon dioxide is, of course, the most important greenhouse gas, but methane is basically number two in terms of total contribution to the warming that we've observed thus far. And methane is potent in terms of its heat trapping ability, right? So that greenhouse effect is those gases go into the atmosphere, sunlight comes down hits, planet Earth gets rerouted back up into the atmosphere, and these greenhouse gases have the ability to absorb that infrared radiation and shoot it back in all directions. And so methane's ability to do that, or it's reinforcing is quite potent. It's more potent than co2, actually. But methane is also short lived, so it doesn't last in the atmosphere too long. So methane emitted from any given source will only be around in the atmosphere for roughly 10 or 12 years, that that time most of the methane will get oxidized. So methane, CH4 will actually get oxidized through a whole series of chemical reactions in the atmosphere to CO2. So it's kind of a part of a carbon cycle from a standpoint of, for example, ruminants, right? They're eating carbon that's captured by photosynthesis. They consume some of that carbon some of it gets emitted as methane. And then after a while, right, that methane will get oxidized to CO2 and it can be taken up by plants again, right with photosynthesis. So basically, cattle or other ruminants, with this enteric methane are temporarily transforming that carbon to a higher potency greenhouse gas.

DJ May 04:52
Okay, okay. And for a decade, and so, yeah, when we think about that, does it change kind of strike energies for reducing enteric methane are.

Sara Place 05:03
Yeah, so that's why if if folks are familiar, right, we've heard about things like the global methane pledge, for example. And there's an interest in trying to do stuff in the near term to lower methane emissions. And a big part of that is because it is short lived in the atmosphere. And so basically the fruits of our labor, if we cut methane emissions will show up in atmospheric concentrations faster. So that's a positive from a standpoint of what we do with methane. If we decrease it, there's a potential there to show a climate impacts in the near term relative to CO2. But the same thing is true. If we increase methane emissions, then we're gonna see that increase in warming faster as well. So it's kind of a double edged sword. Mainly, it's just the short lived nature makes methane more responsive to what we do in the atmosphere.

DJ May 05:48
Okay. Okay. So like, say we leave giraffes out of this. And we're just talking about like, like dairy cows and cattle. What are some ways that we can implement like right now to start reducing? enteric methane emissions?

Sara Place 06:02
Yeah, so in the US, if we think about total contribution of enteric, methane, about 3% of us greenhouse gas emissions is enteric methane, and a lot of that is coming from beef, cattle, and then dairy cattle as well. So what can we do about it? So some of the things we already do in the beef industry helped to cut methane emissions. And that is, we finished cattle on grain based diets. And so, the forage to concentrate ratio or being like the amount of hay or whole, you know, silage, like the whole core plant, chopped up and permitted relative to corn grain, influences how much methane animals produce. So, for example, we have animals right now that we're measuring at Colorado State where they were in a facility where we measure methane when they were eating the high forage diet, and now they're eating a high Carlson trade diet, and their methane emissions per

unit of feed that they eat per pound of feed have actually been cut basically in half. So that's one of those key ways that we can reduce methane emissions that we know now. We can also do things like feed, supplemental fat, we can feed. In some cases, ionophores can be effective. So these are tools to help alter rumen fermentation slightly and basically give less food for those methane producing bugs to produce methane. So those are some of the things that we can currently do. So there are ways for us to try to move the needle. But there's also lots of research happening on more game changing type of technologies, right? Are there things that we can use to target those methane producing bugs more specifically, and try to get bigger reductions than our current baseline situation?

DJ May 07:42
Okay, I want to back up a little bit, because you mentioned that the finishing process actually helps reduce methane and I feel like feedlots sometimes get a bad rap. So that's sort of an interesting combination, you know, you have something that people see is kind of bad, that actually does help with this emissions reduction. Can you talk me through that? Why is it that green helps so much with cutting emissions? Yeah,

Sara Place 08:07
So, when we think about enteric, methane, specifically, it is basically a loss of feed calories that the animal eats. So they eat these, this energy, some of that energy gets lost as methane. And when cattle are in a feed yard, they tend to be more efficient at getting. And part of that is because they're losing less energy as methane, right. So it kind of comes down to the rumen fermentation pathways. So again, cattle, we feed cattle, but really, we're feeding microbes when we feed them. And when we feed more grain, we tend to get more of the fermentation and product that's called appropriately appropriate onic acid. It's a three carbon fatty acid. And that particular pathway within the rumen uses more hydrogen gas for more electrons, basically. And that's important because that hydrogen sync aspect appropriately creates a competition between proper day production and methane production, because that's an alternative outlet is if there's not as much propriate being produced, and that hydrogen can go towards methane agenesis or methane production. So that's where it's fairly well known, well known and understood, we feed more grain, we get more appropriate for these animals, we increase their energetic efficiency because of that. And as a byproduct of that we didn't produce as much methane because more of the actual energy potential in the rumen is going to things that the animal can use, rather than being blown off to the atmosphere. Right. So sometimes counter to what people think. They assume. You know, animals grazing must must produce less methane, but that's not necessarily true.

DJ May 09:48
Yeah. Yeah, I know. That was something that kind of surprised me when I started learning more about this. Yeah, yeah. But that efficiency, it just seems to kind of come back to it. efficiency when you're talking about emissions.

Sara Place 10:02
Yes, yeah, it's very important, and how we how we define efficiency, right? Because there's there's bigger than methane. There's lots of other inputs and outputs to consider in that whole scheme. But when we just think about methane, it's pretty clear, right? That if we feed more concentrate feeds, we do lower methane emissions from animals, that's for sure. Yeah,

DJ May 10:21
from an economic perspective, is it? Also I mean, I feel like that's kind of a fun byproduct, you also end up being more economical with feed toward the end.

Sara Place 10:31

Yeah, yeah. So there's a reason why like, if you go to the grocery store, and if you were to buy grass fed, or grass finished, all all beef is mostly grass fed, right? But if we buy grass finished beef, relative to grain finished, it tends to be more expensive, because it takes longer for those animals to get to harvest, right, just because they're not growing as fast. And so there's for the producer of that product, it there's more cost for them, right? So it makes sense that they need to command a higher price for them to, to make it right, make it make sense for them economically. So it's not that one's better or worse, or whatever. It's all about consumer preference there. But it is, those fundamentals are pretty clear in terms of it will make the animals more efficient. And it will lower costs for the whole system and lower methane emissions when we do great finishing.

DJ May 11:17
Perfect. Okay. Just around out here, I kinda want to do sort of like a, like a pros and cons. What are the challenges right now to reducing enteric emissions?

Sara Place 11:28
Yeah, so a few different things, right? One is just finding technical solutions that work. So there are some products that are promising out there that target some of the enzymes in that methane production process and can lower methane emissions. So it's not yet approved in the United States. But there's a compound called 3-hydroxy propanol, or the commercial name will be built there. And that consistently shows reductions in methane emissions. But the challenge there is finding more solutions like that, that work across many different diet types of animals. And then from there, there's a whole host of other challenges. One is trying to think about, how do we deliver these technical solutions on farm. So that product I just mentioned, both air works pretty well. And it's a complete mixed feed for animals. So when we're feeding animals every day and feeding their ration to them or their diet to them, but most of them I find in the United States comes from grazing animals that are not being fed feed. Right? They're grazing. So how do we deliver methane inhibition solutions to grazing animals? Right? That's a key question. And another big part of it is the economics of it. Right? So maybe we find a great solution that works, but the cost of the producer is so high that it makes no economic sense for them to use it. Right. So how do we technically, you know, deliver a solution but then also economically incentivize? And so it can scale and actually make a difference, right, in terms of total methane, coming from the cattle industry. So if we're sitting here today, and enteric, methane is 3% of us greenhouse gas emissions, how do we get it down to say, 2%? Right, what would it take to cut it by a third? would take a lot of effort. Right? And a lot of funding and technical hurdles need to be overcome to get there. Yeah.

DJ May 13:18
Yeah. On the flip side, I guess you mentioned 3NOP, you're both there. Are there other opportunities you see coming up, or areas of research people should keep an eye on?

Sara Place 13:29
Yeah, so we're, we, of course, are doing research at Colorado State one is just collecting a lot of baseline information from animals on different diet types, different genetics of animals. So we see one promising more long term solution is genetic selection for less methane production. So we see animals that are fairly similar in animal performance, meaning they gain similarly in terms of body weight per day. They're similar body size. And yet, there's animals that make, you know, 30%, more methane than expected, given those production parameters, right, or vice versa, produce 30%, less right relative to their peers. And so that variation, for us, it's an exciting opportunity, because if we can create genetic selection opportunities, then we don't have to worry about delivering a feed additive right out on the range, we can just over the course of several generations, right selecting animals that naturally produce less methane. So that's, that's a big opportunity. And then on the feed additive and feed manipulation side, there's just many other opportunities to really investigate the math antigens that are there, the methane producing bugs, understand their metabolism, and then come up with

solutions that really target some of the species and effective ways. Right. So ultimately, I just say we're just early days on this and part of the limitation is there hasn't been that much funding in the space and the research scale limitations of being able to test things at scale, like facility that we have at CSU AgNext To do that. Out is is kind of been lacking, right. So hopefully over the next several years, we'll be able to accelerate that technology curve.

DJ May 15:06
Great. Yeah. And then my last question for you, Sarah, what, what keeps you going with this research? What excites you the most?

Sara Place 15:15
Yeah, I think the key thing there is the ability to do this now at scale, right. So for me, that was a big driver to come back to academia is the ability to test these things out in a way that is relevant to production systems that are out there in the world. And think about it more holistically, if not just a technical solution. But thinking about the economics, thinking about the practical delivery of solutions to producers, making sure it always makes economic sense. So for me, that's always been a passion. And so that's, that's really what should go on in this space.

DJ May 15:48
Great. Well, thank you so much for your time. Thank you. Thanks for having me. Thanks for tuning in. That was today's show. If you want to learn more about enteric methane or Sarah's research, check out the show notes. And if you have questions about carbon and ecosystem services you want to see answered drop us a line at info@decode6.org That's Decode 6 with the number six. Finally, come visit us at decode6.org to see a whole new suite of content about sustainable dairy production. Thank you so much to Dairy Management, Incorporated. their generous support has made this podcast possible