



Curbing Enteric Methane with Feed Additives: Opportunities & Costs for On-Farm Use

Featuring Ermias Kebreab

Professor & Director of World Food Center, UC-Davis

DJ May 00:02

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. Last episode, we talked all about enteric emissions from cattle. You know, the front-end methane the cows give off through burps as they digest their food. One promising way we can reduce greenhouse gas emissions from dairy and beef production is through feed additives that help reduce these methane emissions. So today, we're asking the question, what are feed additives? How do they work? And what can they do to decrease the overall greenhouse gas emissions of dairy and beef production? Our expert with the answers is Dr. Ermias Kebreab, a professor at the University of California Davis. Ermias conducts research in animal nutrition, mathematical modeling of biological systems, and the impact of livestock on the environment. He was a contributing author to the 2019 Intergovernmental Panel on Climate Change update on enteric methane emissions. He is also co-chair of the feed additive and methane committees of the Food and Agriculture Organization of the United Nations. He's a fantastic person to talk us through the ins and outs of feed additives. Ermias, welcome! It's great to have you here.

Ermias Kebreab 01:22

Thank you for having me,

DJ May 01:24

We're gonna dive right in. So what are feed additives for livestock?

Ermias Kebreab 01:29

Feed additives, they come in different forms. We have feed additives to enhance productivity in dairy, which will be more milk yields, or it could also be feed additives that maybe have influence on the color of the product and the smell of products and enrich some nutrients. For example, Omega three, and if you if you use some additives that are higher in Omega three, you might get into a product as well. And then we have specific ones that are anti methanogenic. So basically try to reduce methane emissions from animals as well. So they come in in different shapes and forms.

DJ May 02:09

Perfect. So I definitely think we want to focus on the anti methanogenic--that's a mouthful--feed additives. Tell me, how do those work? And what do they have to do with like the gut microbiome and cows.

Ermias Kebreab 02:23

So the cows mostly they form methane in the gut, and it's really actually the microbes in the gut that are responsible for making methane. So, there is a process called methanogenesis in which, as the food that the animals consume is digested and fermented, they produce by-products like hydrogen, and there are microbes in there some of them help in digesting and fermentation and some of them utilize what has been produced by by those other microbes. So, there are methanogens, that are not bacteria, they are actually in a different kingdom altogether and that here and they have been specialized for a long time to utilize hydrogen as a source of energy. So they use hydrogen that's that's a byproduct of fermentation. And as they use it for source of energy with carbon dioxide in the process, they produce methane and methane is then need to be taken out of the of the animal and the way that the animal does it is basically through a lactation or burping most of the methane will come out some of the methane is formed in the in their, in their intestines later on. But that's also

a lot of it is absorbed and is exhaled through the nostril. So through the mouth and through nostrils, you will get over 95% of the methane that's been formed in the animal will be taken out that way

DJ May 03:55

Okay. So, when you use feed additives, what are they doing in this process to decrease those emissions?

04:02

Alright. So, when you use feed additives, there are two ways in which they can influence this natural process. One is by directly targeting the methanogens themselves. So, they will affect them intelligence, they will interfere with their ability to produce methane. So these are called inhibitors, methane inhibitors, where they will through some actions, particularly through their enzymes, you know, they have they have they mimic some enzymes. And so they basically inhibit the methanogens from forming methane. And then we have another group of feed additives, they would reduce the amount of hydrogen that's available for the methanogen. So, as I said earlier, that if you have hydrogen in the, in the guts, these archaea, they will use that hydrogen for and then the byproduct is methane. So if you basically take away the hydrogen, or minimize the amount of hydrogen in the rumen, then they don't have as much substrate to work with and convert it into into methane. So those are what we call sort of rumen modifiers. And they work in different ways. Some of them, like nitrate, for example, it will take up hydrogen, it will be converted from nitrate to ammonia, which means that it will take up hydrogen in that process, so that there's less amount of hydrogen happening there. So less methane coming in there. Others, they change the fermentation by-products, the fermentation by-products, some of them are called acetate propionate. Some of those processes, they produce hydrogen, some processes, they take up hydrogen. And so if those fermentation byproducts are more into the propionate, or the ones that are taking hydrogen, from the, from the gut, then you will have less amount of hydrogen available for the methanogens as well. So work in two ways. Either you inhibit directly, or you change the rumen environment, so that you have less hydrogen available for them at antigens.

DJ May 06:11

Okay. So like, really generally, it's almost like you're either targeting the methanogens, or you're targeting the raw ingredients, they need to make the methane.

Ermias Kebreab 06:19

Exactly, yes.

DJ May 06:20

Okay. Perfect. So, when we talk about giving them to cattle, does it matter when or at what point or how does this work with the whole, you know, ration or diet of the cow?

Ermias Kebreab 06:32

Yeah, so it depends how they are working, if they are targeting the methanogens directly, so the inhibitors, then they need to be sort of supplemented at regular intervals. So that depends how long they stay in the rumen, you know, in the gut. So if they stay in the gut long enough, then you don't have to supplement it on a regular basis. But if they are washed out very quickly, then obviously, you have to take them on a regular basis. So, so far, the feed additives that we have, they have to be supplemented on a daily basis, or at least every three days or so, in order to see the benefits of reduction of emissions. That doesn't mean that in the future, we will have a way in which we can have this additive stay in the gut for a longer period of time, so that they can release it slowly. And then you know, you get that, that benefit for a longer period of time. So that's kind of where things are going in the future. We don't have that right now. What we have right now is that you have to give them on a daily basis. So this is fine, if you have a confined operation were like in a dairy system

where we have to see the the animals every day because they have to milk them. So we can give them this additives on a daily basis when they have been milked or you know when they when they're given their feed. So that works fine. But the issue is when you have extensive systems where you have beef cattle in the range, grazing, and you may not see them on a daily basis, particularly in the summer, when the when there is a lot of lush grass growing, you might not see them for some time. And that presents a challenge because then you're the you how you need a way is to provide this additives to them. So one of the ways that we are thinking about to overcome that challenge is to have this bolus where we put this additive and then slowly degrading that. The issue with ruminants is that you know, they're very active, and it moves very quickly. Which means that you have to have a way in which you protect the additives from being released too quickly. So you try to stay there in the rumen for a long period of time. And the other way is to have the additive be water soluble. So you can provide it in water form. Or we can also integrate it with our mineral blocks or even in raising cattle usually supplement them with with minerals. And the animals, they come in and they have a lick block, they just lick this mineral block as they need to. And you can integrate that within that as well. So those are the things that are we're working on right now. So they nothing like that is available at the moment. This is still at the research sort of phase. But the additives on a daily basis that is now available. There's at least one product that has been approved in Europe and 40 other countries and probably coming to the United States in the next year or so as well.

DJ May 09:46

Okay, so tell me more about the product that has been approved. You have to give it every day.

Ermias Kebreab 09:53

Yes

DJ May 09:53

I'm curious about any side effects, does it do anything negative to cows when you use it?

09:58

So the product has already been approved in Europe and a number of other countries is called 3NOP or Bovaer in Europe, and it has been tested very, very extensively, as a lot of work has been done. Well over 40, probably 50 or more experiments have been done all over the world, quite a few of them in the United States, Canada, Europe, New Zealand, Australia. So it's been tested quite extensively. And we've done some analysis where we look at all of the stuff that's been done over the last five to 10 years, we, we, we brought all the data together and try to analyze them try to figure out what is the efficacy, and we found out that it's about 30%, just over 30% reduction in dairy cattle that you can get from from this depending on the dose and how much you're giving them. And also the diet that you're using as well. So those are the main factors that will affect how effective it's going to be in reducing methane emissions. And so, in terms of side effects, we have not seen any side effects at all. So there is no impact on the animal health and there's no impact on yield, and there's no impact on the environment as well. So all of these have been well established number of experiments, both experiments based on research stations, or in real field in commercial operations have shown that that reduction level just over 30%, with no other effects on health, on productivity, as well as on the environment.

DJ May 10:54

Well, that's great. Tell me about the cost. You have to give this every day. Is it a pretty big chunk of change? What will this run somebody?

Ermias Kebreab 11:51

Yeah. So the cost could be high, if you're not getting anything out of the reducing methane emissions, right, because it's, as I said, there's no improvement in yields, that has been shown. So it's an additional cost of the farmers. But in a lot of cases, you can claim credit for carbon credit for reducing methane emissions. So I think the cost right now is kind of offsetting the the carbon credit that you would get. So in Europe, I believe it's been sold about one euro cent per litre of milk you're producing. So if the animals are producing 30, 40 litres of milk per day, then it will cost you about 30, 40 cents, euro cents per per day as well, per animal. So that's it's not a, an insignificant cost to the farmer. But then in Europe, we probably be able to sell carbon about 80 euros per tonne of carbon dioxide equivalent reduced. Which means it kind of offsets the cost that you're incurring for buying those additives by the cost of the carbon that you're selling. So I think in the future, it might come down so that farmers will actually benefit there will be some financial benefit for using those as well. But right now, at least in Europe, I mean, they they mentioned that the pricing is going to be different, depending on location. And this is just at the beginning as well, this new factory has been built so that when when we're productivity increases availability increases the cost by time down as well.

DJ May 13:37

Yeah, totally. Do you know, I'm kind of throwing this at you? Do you know how many farmers use it? Now? Do we have any idea how widespread the use is?

Ermias Kebreab 13:46

So right now, I think it's about 200,000 or so cows on it, mostly in Europe. But I see that this could expand quite a bit, particularly when it's approved in the in the United States, we expect to be in less than a year. Once approved, then it becomes more available, then. And also the availability is an issue right now, because they need to scale up the production of the fidelity the self. But when the fidelity becomes more more available, and the demand also increases, then I see that there will be much more use of that and know that there are some legislations that require the reduction of methane. For example, in California, we need to reduce methane emissions by 40% by 2030. And right now, you're not on course to meet that target. I think we're going to be like half of what's been targeted right now without any enteric methane reduction. So enteric methane is very, very important to reduce it. And we don't have a lot of solutions. So this is going to be one of the solutions that's going to be approved at the federal level. So which means that I think they they use and the demand for it, at least in the state of California is going to be high.

DJ May 15:07

Yeah. Okay. So say I'm a farmer or maybe an advisor to a farmer. And I'm kind of keeping an eye on these feed additives, especially three NOP in the next year. What advice would you give for maybe some of these early adopters in the United States who want to use it?

Ermias Kebreab 15:24

Well, actually in California, in California in the year and good luck, because the research just approved \$25 million for early adopters. So if you're an early adopter, you can tap into that incentive, so that you can use those food additives, and you will get benefits on that. So definitely, if you're in California, then it's a no brainer. And there's already funding available for a farmer to take advantage of this. In the rest of the country. I think they have to watch, keep keep an eye on the carbon markets, there are now opportunities of creating opportunities for marketplace. And the marketplace basically is trying to match up farmers that are reducing emissions with organizations that want to buy those those credits. So there is a way to be able to cover your costs, hopefully a bit more than that they should just cover your costs to by using those to the fee that fidelities as well. So there is still developing is coming up this marketplace has been it's been developed right now. So with the development of the marketplace, and with incentives, like the one instead of California, I think the use of those food additives would substantially increase once they are approved by the federal government.

DJ May 16:46

Now, that's great news. That's great. One last thing, what excites you the most about the research that's going on maybe into those other types of additives? You mentioned earlier?

Ermias Kebreab 16:56

Yeah. So I think the the most exciting thing is that there is a lot of investment happening right now, I think there is a realization that this is something that needs to happen. This is something that we can do. And it helps the environment in the short term, because methane is a short lived climate pollutants. So we really need to address that. And we can get a kind of a quick win if we are able to reduce emissions and the majority of emissions from livestock is in the form of enteric methane around the world. So this is this is a solvable issue, and that that will help the climate as well. So I am very excited to see that there's a lot of work that's happening. We already have one that's been approved, we have one that is also approved for sale in California, from NASA, which needs to be approved by the federal government but and the legislation overall is being overhauled in a lot of countries in the US also there is a new bill that has been introduced to kind of streamline the process by which those kind of food additives will be approved. The Canadians have recently changed or improved or modified the way that food additives have been sort of processed as well. So I you know, this is all really exciting to see the pace of this changing is a lot and together with USC, UCSF and UC Berkeley, we received \$70 million to develop a new technology for reducing methane emissions as well. So we know that's extremely exciting time to be involved in this kind of

DJ May 18:40

work. Yeah, a good time for you for sure. Yeah. Excellent. Well, thank you so much. I really appreciate your time today.

Ermias Kebreab 18:47

Yeah. Thank you for having me.

DJ May 18:50

If you want to learn more about Dr. Kebreab's research or the options for feed additives, check out the show notes. And if you liked this episode, I hope you subscribe or better yet, share it with a friend or a colleague who might be interested. And if you want to learn more about carbon and ecosystem services and ways to improve agriculture, come visit us at decode6.org. We'll see you there!