**Mycotoxin Matters Podcast ep 6 V1**

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Announcer: Welcome to the Mycotoxin Matters Podcast from Alltech Mycotoxin Management. As mycotoxins present an ever-increasing threat to livestock production, join us as we discuss these impacts and potential solutions, sustainable farming, and our vision for a planet of plenty.

Nick: Hi. My name is Nick Adams, Global Director for Alltech's Mycotoxin Management platform. You're very welcome to this episode of Mycotoxin Matters where we're joined by Dr. Alexandra Weaver, who has been working on the topic of mycotoxins now for over 12 years while obtaining both MS and PhD in the field of animal science and nutrition. Alexandra works specifically with mycotoxins in swine. Alexandra works in many areas of Mycotoxin Management now, but with a particular interest in developing computer programs to track mycotoxin risk and assess the physical and financial impact of mycotoxins. She currently works with Alltech and supports the global team and customers in any questions and topics related to mycotoxins. Alexandra, welcome to you. Great to have you with us.

Alexandra: Great. Thank you. It's nice to be here.

Nick: Today, we're going to delve into the topic of mycotoxins and gut health. Clearly, this area is one that has many different elements to it, Alexandra. So perhaps you could start by just giving us an overview of some of the different ways in which mycotoxins can affect gut health and why this is so important to animal health and performance.

Alexandra: Yes. Mycotoxins certainly can play a very important role in gut health. Most of the time, the animals are consuming mycotoxins through their feed, and of course, that feed is coming into the intestinal system. The intestinal system is the first area that mycotoxins can be influencing the animal, causing damage to that intestinal lining. And of course, that has many downstream effects on how that animal is perhaps getting their nutrients, maybe how they're going to have their growth performance changing because of these mycotoxins, and the relationship to the gut health. Certainly, that intestinal system is very important and mycotoxins do play a role.

Nick: So if we build on that, and you've talked about the gut being the first organ as it were that sees the mycotoxins, what are some of the different elements then that are affected by mycotoxins when we think about the gut?

Alexandra: Yes. The gut, again, it's a very complex system. Actually, it does do a very good job in protecting the body. There are many things that come into that gut system, not just mycotoxins, but other pathogens and other toxins that we consume, as well as all the beneficial components, all the nutrients in the food we're consuming. The gut does have a natural level of protection.

 Actually, we can look at these in four different layers of protection to that intestinal system. First, we have a physical barrier, which is composed of the intestinal cells themselves. These cells are actually held together tightly with what we call tight junctions, which is basically a collection of different proteins. These cells are held together tightly and they provide this level, this physical barrier of that intestinal lining.

 There's also a second level with a chemical barrier. This is actually, for example, the mucus that's produced by the goblet cells. That mucus layer covers those cells and actually helps protect from any problems that are going to come along such as toxins or pathogenic organisms.

 The third layer is the immune system at the gut level. This would be the immune cells and the secreted products of the immune system such as immunoglobulins and cytokines. Those help regulate again that gut level immunity and the interaction with any challenges such as pathogens.

 The final level, the fourth level, is actually the microbial barrier. This is where we would have commensal bacteria, the good bacteria that help promote good gut health and help reduce the chances or deal with problematic bacteria as well.

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 That helps really give a good overall balanced system if we think about the bacteria that are there, the immune system playing a role, and then your physical and chemical barriers of that actual structure of the intestinal cell. So with all these levels, you do get a very good protection. But of course, there are challenges that can get through those levels of protection, and of course then you can have downstream negative effects on the animal.

Nick: That's a really nice way to break it down actually, Alexandra, is there are four different key areas because when you step back and you look at the complexity of the whole system, sometimes it's difficult to see what are we affecting and how. So maybe let's start with that physical barrier, the actual cell lining itself so to speak of the epithelium. What are mycotoxins doing specifically to the cells, to those tight junctions that negatively impact the animal?

Alexandra: Yes. There are actually several different things that mycotoxins can do to that physical lining. First of all, they can change the cell cycle of those epithelial cells. Maybe that changes how those cells are replicating and growing. And because of that, we might get damages to the intestinal villi structure. There may be lesions that are observed. That, of course, has negative effects on the function of the gut. There can also be a cell death occurring, so not just changes in that cell cycle of growth, but actually the death leading to those lesions. Then finally, changes to those tight junctions which are holding those cells together. If you have that weakening of the junctions between the cells because of changes in the way those tight junction proteins are produced then you can actually get an opening in that intestinal cell. That actually allows changes to nutrient digestion, absorption. It allows bacteria to potentially actually penetrate through that intestinal cell lining. You certainly can have a variety of ways that mycotoxins are impacting that physical barrier and certainly some negative effects associated with that.

Nick: Thanks for that, Alexandra. Maybe we're going to circle back round to some comments around the points you just made in a moment. If we pick up on that chemical barrier -- you mentioned mucus -- do we see changes in mucus production because of the changes to the physical barrier, the impact of mycotoxins on some of those cells or is it because of some other impact of mycotoxins directly on the mucus?

Alexandra: Both actually. Mucus production can be impacted because there is a change in the cells, either the cells that are producing the mucus, those goblet cells, can negatively impact. And so they're producing less mucus and then you get a thinner mucus layer. Other times, actually there's research with certain toxins, certain mycotoxins showing that actually the goblet cells start to produce more of that mucus. But then because they're producing more, the cells aren't maintaining a nice balance, and actually at a certain point, you don't get enough cells. You don't get enough mucus. It actually starts to hinder itself because it's trying to produce too much mucus. So then you're actually reducing your cell numbers in over a long chronic period of time, which then finally leads to a lesser mucus. So the end result is the lesser mucus due to the presence of mycotoxins. And in that chronic situation, that lesser mucus barrier, that thinner barrier then can lead to damages coming directly to those cells of the intestinal system.

Nick: Interesting. So then if we pick up on the immune side of things, clearly the gut houses a huge amount of the immune infrastructure, if you like, of the body for all the reasons that you've been talking about in terms of it being that first line of defense. So what are some of the things then that mycotoxins are doing to that local immunity and what's the impact of that?

Alexandra: Yes, the immune system certainly can have an impact for mycotoxins. Really again, there can be multiple ways that the mycotoxins are playing a role. They can lead to an overproduction of materials that are from those immune cells like the immunoglobulins and cytokines.

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 This then leads to inflammation. So if you get this overproduction of these cytokines, they are promoting inflammation. That inflammation then, of course, can lead to tissue damage and other negative effects. Also, with the presence of these mycotoxins and the production of these immune cell products, these immunoglobulins and cytokines, you'll get this imbalance in the immunity. That can lead to changes to the maintenance requirements, the animals' natural maintenance requirements. Actually, they have to put more energy into the immune system. You get the damage, as I said, from those immune products.

 In general, you just get an activation of not just the local immunity, but actually, it can be a whole body immune response that even starts just at that gut level, but it turns into a systemic immune response. That can cause some significant changes in the way that animal is maybe then later able to deal with pathogens that come along or other changes to how they're dealing with any challenge from an immune-related format.

Nick: Thanks for that, Alexandra. If we then think about the microbes, and maybe this is the newest area in the fore, as it were, in terms of what's the impact of mycotoxins on the microbial population, is that an indirect impact? Because we're affecting those other things that you talked about, and therefore, changing nutrient flows. You're changing the populations in that direction. Or is it a direct impact of mycotoxins on some of the microbes within the gut? Maybe just chat with us a little bit about that.

Alexandra: Yes. Again, it's both ways. There are two thoughts or two ways right now that we're seeing that mycotoxins can actually impact those microbial populations. As you mentioned, this is a very new area compared to some of these other areas that we've talked about. Of course, the bacteria in the gut play a very important role in many different aspects of health and performance.

 When we think about the role of mycotoxins, we can see that in some cases, they actually have direct impacts on those microbial populations. Maybe they are toxic to those microbes, your beneficial microbes maybe, and so you get a lesser population of those beneficial bacteria. That has been shown in recent research that you can actually get these reductions in beneficial bacteria. At the same time, there's also been shown to be an increase in bacterial counts of negative or disease-causing bacteria. Organisms like E. coli and salmonella have actually been shown to increase in their colonization of the intestinal tract. Overall, you get an imbalance between your beneficial bacteria and your disease or your negative bacteria.

 Also, there's research that shows that not just are you getting this imbalance, but there's actually an overall decrease in the microbial diversity in the intestinal system. So you're just getting an overall change to that intestinal system with the presence of these bacteria. That obviously can change the digestion of nutrients and the way that that animal's gut is trying to interact with really the whole systemic system of that animal.

 I would also add to this, too, I mentioned that there were the direct impacts on changing maybe toxicity to positive, beneficial bacteria. Maybe there are effects that reduce their growth rate. But as you mentioned in your question there, there's also potentially secondary effects on those bacterial populations because of changes to the nutrient digestion and absorption or the immune system, which then play a role on either the positive growth or negative growth of certain organisms.

Nick: Alexandra, it's a fascinating subject and one clearly that we could then spend hours talking about, I think. For the moment, I'd say thanks very much for those insights from you. What maybe would be some of the last thoughts that you would leave our listeners with perhaps around the importance of managing, understanding some of these mycotoxins so that we can minimize the impact on gut health?

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Alexandra: Yes. I think, of course, knowing your mycotoxin risk is very important, knowing what mycotoxins are out there in the diet of the animals, knowing if you have multiple mycotoxins present because multiple toxins have actually shown to increase these reactions within the intestinal tract whether it'd be the damage on the intestinal system or the response to the immune system, so knowing your risk is very important.

 Also, understanding that if you're seeing a gut health challenge, mycotoxins could be playing an underlying role in that problem that you're seeing. You might think it's just an E. coli problem or a salmonella problem or some change that's occurring that you're thinking as a different challenge. But maybe mycotoxins are actually changing this gut environment and either causing the problem or increasing your risk certainly. So thinking about mycotoxins as a component of a problem that you're seeing and a component of your whole feeding program is certainly very important.

Nick: Thanks very much, Alexandra. I really appreciate all of those insights.

Alexandra: Yes. Thank you for having me.

Nick: Thanks for joining us today on Mycotoxin Matters. My name is Nick Adams. Today, we spoke with Dr. Alexandra Weaver. If you've enjoyed this episode, please be sure to leave us a review.

Announcer: We hope you enjoyed listening today and we look forward to you joining us next time on the Mycotoxin Matters Podcast. For more information on the topics discussed, please visit knowmycotoxins.com. That's knowmycotoxins.com.

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