Mycotoxin Matters podcast episode #27

**SPEAKERS**

Announcer, Nick Adams, Dr. Alexandra Weaver, Dr. Alexandros Yiannikouris

**Announcer** 00:02

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 Adams** 00:21

Hello, and welcome to the latest edition of our mycotoxin matters podcast. My name is Nick Adams, Global Director for Alltech's mycotoxin management platform. And I'm delighted to be joined today by two guest contributors. Dr. Alex Yiannikouris and Dr. Alexandra Weaver. Today we are going to be talking about the topic of emerging mycotoxins. It's one that has gained a lot of press coverage over the past probably three to five years, and it's something that we increasingly see covered in various media articles. And so, with Alex and Alexandra, we have two guests who are very capable of talking us through this topic. Alex has been working in the area of mycotoxins for over 20 years and is currently the group research director for mycotoxins and analytical chemistry within Alltech. And Alexandra, since completing her PhD, in the subject of mycotoxins and their impact on swine, has been working for Alltech within the technical support side of the business. So, Alexandra, maybe if we can start with you, as we think about this topic of emerging mycotoxins, you could give a little bit of an introduction, tell us exactly what the emerging mycotoxins are, and why are we getting more and more interested in them?

**Dr. Alexandra Weaver** 01:59

Yes, so the emerging mycotoxins category is definitely a category of mycotoxins that's growing. These are technically defined as mycotoxins that really are not always measured, especially by more simple testing methods like rapid test kits, and they're also not at the moment legislatively regulated globally. They are different than what we could call our modified or masked mycotoxins, which are those that are derivatives of the common mycotoxins we look at, like 15-acetyl DON, or these other that are components of our common mycotoxin family. So, these are separate mycotoxins, and they are becoming more common as we are able to detect them with more advanced technology. We do realize that they are very frequent. And I think in the future, we won't really call them emerging mycotoxins anymore, we may actually have them as their own mycotoxin group.

**Nick Adams** 03:01

Thanks, Alexandra. So, Alex, then that brings us on naturally to yourself. When you think you know, your background on the analytical side of things, talk to us about the detection of emerging mycotoxins what has changed in that domain to allow us now to be able to analyze them and detect their presence.

**Dr. Alexandros Yiannikouris** 03:26

Certainly, Nick. Yeah, I mean, it is, again, the advent that has happened in the field of analytical chemistry in the last 15 years where we've seen tools that are quite powerful, such as mass spectrometry becoming more and more available to labs that are investigating mycotoxins. So, I think that it is really that particular technique that has enabled us to identify those new or emerging mycotoxins and being a little bit more refined in terms of defining exactly their occurrences and their presence in different types of foods and feed matrixes. So, again, mass spectrometry is a technique of choice there, because we can selectively separate those compounds according to their molecular weight and their charge. So, it is really something that has enabled us to focus on those particular kinds of compounds there. The technologies and the different methods that are now available are enabling to do this type of identification at the same time as we do identifications for other types of mycotoxins. So again, it is very powerful there, because in one sample we can as well investigate classical types of mycotoxins such as deoxynivalenol, ochratoxins, zearalenone, aflatoxins, etc, etc. And have an information about those emerging mycotoxins that can be detected using the same type of mobile phases using the same type of static phases when we're talking about chromatographic columns and other responses inside the detectors, the detector of the mass spec detector basically.

**Nick Adams** 05:24

Excellent. Alex, thanks for that. Alexandra, coming back to yourself, maybe give us some insight based on the latest harvest analysis work that you've been undertaking with the group on the prevalence of the emerging mycotoxins and, and why is it that we see these at the type of levels that we see them?

**Dr. Alexandra Weaver** 05:50

Yes, so interestingly, we actually find that the emerging mycotoxins category are actually some of the most frequently detected mycotoxins globally. More so than say your type B trichothecene, your DON group, which is very high, but these emerging mycotoxins are generally the most frequently detected. Now, for example, if we look at samples that were analyzed by the Alltech, 37 plus laboratory in 2022, we actually see that over 96% of the samples have these emerging mycotoxins, and then if we break that down into some of these different types of mycotoxins, we can actually see that for example, fusaric acid is generally the most frequently occurring in at least 77% of samples. We also see that enniatin A and B, they also are very frequent. Moniliformin, these are all very frequent over 50% of samples or more containing these emerging mycotoxins. Now I will say that although the occurrence rates are very high, very frequent, generally, we're seeing lower levels in terms of risk to an animal. So, we're really looking with emerging mycotoxins at more the chronic intake of these mycotoxins rather than acute effects and acute consumption of these mycotoxins by the animal.

**Nick Adams** 07:18

Which leads us on to the next natural question I think Alexandra in terms of when you think about the levels that we see commercially, and with the research that's been done thus far, what are some of the things that we feel emerging mycotoxins can do to the animal? What sort of effects can we potentially see on the animal from these mycotoxins?

**Dr. Alexandra Weaver** 07:46

Yes, so it is a little difficult, I would say to give a whole lot of negative effects or a lot of information because there is really just a lack of animal trials with these mycotoxins as they are considered emerging. There has been research, you know, historically, but not nearly the same level of research and detailed research as we would say, with some of the very notable family, mycotoxins like aflatoxins or DON. But we do have some basic information on these mycotoxins, and we do have some knowledge of what they can be doing. So, for example, the Alternaria mycotoxins they have been shown to act as endocrine disruptors, so they can alter estrogen progesterone, progesterone synthesis. In pigs, it's been shown to have synergistic properties with zearalenone, so that could actually increase the effects of zearalenone on the reproductive performance of the animal. There's other ones like aurofusarin, that has been shown to actually have some negative impacts on egg production and egg quality, particularly the fatty acid composition of egg yolks. We could look at beauvericin, that one is interesting. And that actually seems to have some effects on pathogens that could be both positive or negative, depending on the way you're looking at it. But some research has actually shown that it could actually be negative or have negative effects on pathogens such as Clostridium. So actually, that could maybe be beneficial for the animal. But there's a lot of other negative effects. So, I don't know how that outweighs. So, you might have a little benefit, but you may have many negative effects as well. Then we could look at for instance of moniliformin. That one seems to have a very strong impact on the heart and causes myocardial lesions particularly in poultry. They seem to be quite sensitive to moniliformin, and then the enniatins there's a lot of new research being conducted with these. It's been shown that they may actually increase the effect of DON in pigs. So when the pigs are consuming deoxynivalenol the effects of that DON mycotoxin could be greater if there's this combination of toxins. And there's also some research suggesting that enniatins can actually pass through on the ruminant side pass through the rumen on affected so that means that they get into that intestinal tract unchanged, and they may then still have the negative effect. And the rumen isn't really helping that animal at that point. So, a lot of different effects. Overall, we want to still remember that these mycotoxins really like any mycotoxins are impacting gut health and immune system, and then overall performance can be impacted too.

**Nick Adams** 10:36

It's clearly not a straightforward picture. And I think that's probably adds to the complexity of the mycotoxin story, where we're already sort of dealing with a lot of mycotoxins that we were measuring. And these are coming in and sort of further complicating that picture. And, but certainly, it's important that we continue to understand them because it's obvious that they can have some sort of impact on the animal and like you say, Alexandra, particularly in those important areas of things like gut health and immunity. Alex, maybe we can come back to you to sort of wrap things up. Based on what Alexandra is saying, what sort of things have Alltech been doing, maybe to look at the impact of some of these newer mycotoxins that we are, we're detecting?

**Dr. Alexandros Yiannikouris** 11:29

Yes, certainly. I think we need to remember that those mycotoxins that we're talking about whether it be from fusaric acid, sterigmatocystin to Alternaria. And to beauvericin and enniatins, these are very different structurally and chemically, I mean, we are facing here, different mycotoxins that will have different effects, because they have those different chemistries that are going to have different impacts in the animal because of those differences in chemistries. I think that in the last five or six years our interest, because we were seeing some of those numbers coming from the surveys that showed how important some of those categories were, especially the enniatins, the beauvericin, the fusaric acids that are, that seems to be occurring in quite high frequency, we really wanted to emphasize a little bit more the research on that front in order to understand because we have those occurrences of those toxins, what eventually those toxins can have as an effect inside the animal. So, we developed a series of research. And one of particular interest has been a collaboration that we have with University of Guelph, and Dr. Neil Karrow. And we have actually a doctoral candidate that started to investigate a little bit more what those mycotoxins can do inside the animal. One of the comments that Alexandra made was that some of those toxins can go through the rumen whilst not being affected. And such they can also be absorbed by the animal. And in that perspective, what we wanted to do is to try to understand a little bit more. What happens if, for example, in a ruminant animal, those toxins are getting absorbed, and they're starting to reach the mammary glands, which is a very important organ and also can consequently have some impact on milk production and milk quality. So, in that particular context, Ran Xu who is the doctoral candidate working at a Dr. Neil Karrow's lab, has started investigating a little bit more in detail the impact of beauvericin, enniatins, specifically on cells that are associated with the mammary glands. So, we did quite a bit of in vitro cell culture modelling in order to try to understand the cytotoxicity of those different toxins and what we found is that we have different types of those responses that are associated with those particular types of toxins. And the behavior of some of the toxins, especially enniatins and beauvericin are quite different even if those two particular mycotoxins belong to the same kind of categories of mycotoxins there, ionophores, they seem to have some similarities and structures, but when we're looking at the cytotoxicity effects that they're able to do on the mammary cells they have kind of different behavior. One, for example beauvericin, is going to have a cytotoxic impact at a higher concentration. But that type of toxicity effect is pretty much a yes or no type of answers, you're gonna get close to 100% of cytotoxicity for that particular toxin, once you reach a specific concentration. Enniatins, for example, you're gonna get some kind of gradual decline of that, of that cell viability with an increased dose of that particular mycotoxin. So, despite some of the similarities that they have, they have an impact on viability of the cells. And because they have that impact, they can injure basically the efficacy of the mammary glands. The other aspects that we've seen that were involved are specifically some of the junction proteins that are responsible of maintaining together those epithelial cells of the mammary gland, we know that some of those toxins can have an impact on those tight junction protein and will decrease for example, the genetic expression of some of those. So, it might affect basically are those cells all going to respond, are going to be able to absorb and how they are going to be able to respond specifically pathogenic type of contamination. The other aspects that we've seen are being impacted by those toxins are immune factors. Specifically, chemokines and cytokines that can be negatively impacted by those different types of toxins, again, enduring the responses of the mammary gland to other types of pathogens than mycotoxin. So, they can be responsible of unbalanced basically, of that homeostasis of the mammary gland. And as such, affect that mammary gland response to other kinds of pathogens, as well as its capacity at getting the right nutrients and changing by search the composition of the milk. The other type of research that we've done is basically trying to evaluate if some of our mitigation approaches can be effective at reducing the levels of toxins and consequently, to reducing the impact or the level of those mammary cells. And what we've been able to establish using different types of mitigation products and composition, we were able to see a profound impact of a specifically yeast cell wall based types of products on the bioavailability of those different mycotoxins meanings that we are highly effective at binding specifically beauvericins and enniatins, and reducing their cytotoxicological effects that have been evaluated through again, modelling and cell viability types of evaluation. So I think that we are progressing also in our understanding of not only the impact of these toxins on some specific cell effectors, but how we can also be quite effective at reducing the impacts. Of course, there is much more that we don't know about those mycotoxins. Again, we've seen and Alexandra explained quite well, how they can have some beneficial effect by interacting positively with some pathogen inside the rumen. Or the digestive tract of the animal. And on the other side can have negative effects. So, we need to pass through those different effects what exactly those toxins, incidence is, but at the moment, we are starting to have a better comprehension of these types of mechanisms.

**Nick Adams** 19:19

Alex, it's fantastic and good to see how the work that you've talked through, sort of builds on some of the comments Alexandra made around the immune side of things and the gut health side of things. And perhaps and that take home that also looking at some of the remediation strategies and knowing that while these mycotoxins are frequently found in the diet, the mitigation strategies that we are employing are effective in dealing with those so I'm sure our listeners today have sort of taken a lot from that and have a better understanding and overview of the information we do have on the emerging mycotoxins. So, Alexandra and Alex, thanks very much for your input today.

**Dr. Alexandra Weaver** 20:09

Thanks.

**Dr. Alexandros Yiannikouris** 20:09

Thank you.

**Announcer** 20:11

We hope you enjoyed listening today and 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 k n o w mycotoxins.com.