

Mycotoxin matters - Episode 22 transcript

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SPEAKERS

Announcer, Dr. Manoj Kudupoje, Nick Adams, 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 00:22

Hi and welcome to this edition of the mycotoxin matters podcast. My name is Nick Adams, Global Director of Alltech's mycotoxin management team. And today we're going to take a look at some of the key elements and areas that have been the focus of research in recent decades. What is on the table today? And where things may go in the future when we think about what's really helped us to understand mycotoxins and their impact on animals in more detail. Joining me today for the conversation is Dr. Alex Yiannikouris, and Dr. Manoj Kudupoje, both of whom work with Alltech's research group. Alex directing the research within the toxicology division, including mycotoxins and Manoj working within that division alongside Alex. Manoj, Alex, you're very welcome to the podcast today.

Dr. Alexandros Yiannikouris 01:31

Hello, Nick.

Dr. Manoj Kudupoje 01:32

Hi Nick.

Nick Adams 01:34

Alex, maybe we could start with yourself. And, you know, when we think about mycotoxin research, it's been something that you have been synonymous with for the past couple of decades or so. And I wonder if you can just give us a quick overview of what you've seen during that time.

Dr. Alexandros Yiannikouris 01:55

Yes, absolutely. Nick, I think that yeah, it is almost a passion for me, as I've started with a PhD on mycotoxins, and kept on going in the same topic for more than 20 years now. So yeah, I would describe it really as a passion right now. That's very interesting, because we've seen things evolving quite a bit.

But there have been always many areas of investigation. And I think that we tried along those 20 years to touch on those different areas. Will it be on the animal side that has been for years the core and the emphasis of our research, try to really understand the impact of mycotoxins on animal performances, but also within that in vivo work starting to develop models within in order to better understand either, what was the impact on the technical what are the consequences of those toxins on the technical side, but also what is the trafficking, the distribution of those mycotoxins and going more in depth into pharmacokinetics, ADME types of investigation in order again, to understand that a little bit better, and to investigate also appropriate mitigation types of solutions. These models were quite interesting, but they were also using some of the advancements that have been made in terms of in vitro, ex vivo models that were done along the years. And that's also an area that has been quite interesting in order to understand truly the mode of action of those mycotoxins as well as to tag along those the mode of action of potential mitigation strategies. So, to name a few, we have cell culture systems that have been used, which are quite interesting, because you can actually increase your statistical output and keep the experiment quite small, without having to go into very large animal experimentation. So, it saves a bit in the use of the animals. And it really enables you to tackle a very precise type of mechanism. So, we're still using this type of model. But I think that we're making them evolve a little bit into something that tries to be a little bit more realistic. And that's why also we focused our attention on ex vivo models, which means that we are either taking a tissue from a specific compartment of the animal and trying to subject it to toxins and try to also understand what we can do on the mitigation side. Finally, we also looked at computational types of approach. So, things that are done in a computer in order to further screen the conformation of those mycotoxins and how well we can also interact with those particular toxins. So, merging those different areas, merging also with the classical individual biochemical assays we can start understanding better what mycotoxins are doing, but also starting to understand better and develop the models that are appropriate to investigate further their mitigations.

Nick Adams 05:26

Thanks, Alex, it is interesting you talk about some of those different approaches. Do you think that any of those approaches or sort of particular models within them stand out in terms of being key advancements so more important in allowing us to get to our level of understanding as it is today?

Dr. Alexandros Yiannikouris 05:47

Yeah, I mean, we cannot talk about those models if we hadn't seen a fantastic breakthrough in analytics, I mean, really the analytical side of things, being able to measure to quantify those toxins and especially mycotoxins to be able to go into the quantification of hundreds of different types of mycotoxins has really been the key in order to really progress on those areas. I mean, it is valid for the in vitro side as much as it is valid for the in vivo side being able to do the proper quantification when you're performing, for example, by chemical assay in order to evaluate binding properties of mitigation solutions to the toxins has been fundamental in our understanding and in our advancements in terms of being able to provide solutions that will be that will be able to interact with that variety of mycotoxins that we're encountering. So, I think that, to add to that another layer has been also to try to better understand the occurrence of those mycotoxins and as such, developing methods that are enabling us to track those and efficient methods that are enabling us to perform an absolute quantification has really been a key to those advancements. To name some of those, the 37 + method that we put together more than 10 years ago that has now been adapted across several of our own laboratories

that are investigating now more than 50 different mycotoxins in feed, will it be ingredients or complete feed is really something that has enabled us to better understand what are the mycotoxins that are important? What are the ones that we need to investigate? And that makes sense in the specific field of agriculture? And what are those that we should pay more attention in terms of either mitigating or in terms of adding an impact in or animal production systems?

Nick Adams 08:12

Excellent, Alex. Manoj maybe if we can bring you into the conversation now. You also did your postgraduate work in the area of mycotoxins, and you use some interesting approaches during that work. I wonder if you can touch on those and some of the learnings that we found from them.

Dr. Manoj Kudupoje 08:33

Yeah, thank you, Nick. Thank you. I worked under Alex. My PhD work was mainly characterising this polymer. Initially, the work was started, how does it work? We have the data, in vitro data, and we evaluate this product using the isotherms. Can we extend this approach and really see this effect at a different level? So, in my PhD work, I looked at the different aspects of this polymer looking at the polymer size, polymer functional groups, its morphology, surface area or the surface and porous properties of those products. I use the light scattering this meant to determine the molecular size of those polymers and the functional groups were determined by the FTIR. It's one of the fantastic instruments, FTIR stands for Fourier transform infrared, what we get from this is the functional growths present, and that is a label for interaction with different mycotoxins. So, for the morphology of the product, we use the tandem electron microscopy and scanning electron microscopy, we can really see at the minute level how the structure relates with adsorption properties of those product and even we use the nitrogen adsorption porosity metre, where we can determine the pores in in those products and this really helped, to convey the message that this product is something different from other products. And to extend that we did some physiological implication of those in vitro studies using the myography. And this is one I was really interested in, because we all know that Ergot alkaloids are one of the mycotoxins that cause muscle contraction. So, when we add the product in the diet, that we say that it reduced the bioavailability, we want to know does it really do that? So, when we add this ergot alkaloid to muscles, we saw that there is a muscle contraction, but in the presence of this product, the muscle contraction was dramatically reduced. And that we used for modelling to determine how much of product is required to reduce the absorption reduce the toxic property by 50%. It is a fantastic work in my PhD work, Nick. interesting there Manoj, how you use the different techniques, I suppose to understand the challenge from lots of different angles to try and bring them the whole project together. Yeah. I think that's one of the best ways to even going before into the in vivo study. We are showing what it exactly does at ex vivo levels.

Nick Adams 11:34

Yeah. So, using the different steps of the models and the research tools available to us. Before moving into those, those final studies with the animals, Alex, maybe then coming back to you. What do you see then might be some of the key areas of focus for the next 10 years?

Dr. Alexandros Yiannikouris 11:59

Yeah, that's, that's an important question. I think that's, we can go for a couple of hours on that particular one. I think that there are still some questions that we hadn't been able to answer along the years. Some of those questions were there from the beginning. I remember, during the early days of the world, mycotoxin forum, I think that was the first or the second edition. We were still talking about finding specific biomarkers of mycotoxins and we still don't have those biomarkers. So, I think that there is more work to do on that side. The other thing that we were talking about what synergies and again, this is an area where we haven't seen that much investigation, I think that that's an area where we are starting to progress quite a bit, we see more work. And we are also personally doing more studies that are involving multiple contamination, that are changing a little bit the way that we are approaching the toxic impact because it enables us also to study more chronic types of contamination, lower concentrations that are more realistic, actually, with what we are encountering in the field. So, on that side, it is already something that is being done, but we need more in order to try to understand better. What's the impact of those synergies? What are the consequences of having multiple mycotoxins present at the same time in the diet of those animals? I think we are seeing some work coming also on the site of emerging mycotoxins, of course, the denomination emerging is only good until there is enough work that studies those mycotoxins. But I think that that's an area that we're seeing in that we've seen in the last five years progress with their characterization, first using analytical tools such as mass spectrometry, but now trying to understand what those toxins that we didn't pay attention before are doing to the animal and can they explain sometimes the issues and the consequences that we're seeing at the animal level. So again, a lot of work that has been done on that side and more work to becoming on that particular area. There is also I think, if we're looking at some of the recent presentations that were done, again at the word mycotoxin forum in Parma, we see also some old mycotoxins that are being revived I mean, some of those can be part of metabolic pathways of toxins that be focused for years such as a toxin for example, and they can be present in quite relevant announced actually and can also have an impact and again, it goes back to studying also the interactions between those mycotoxins. So other areas that are of interest, of course, it's the big data site. I mean, we've generated not only Alltech, but the scientific community at large, and also the industry, a huge amount of data that is really helping us in understanding better the occurrence of mycotoxin. I think the next step is really to use this type of data into machine learning system in order to be able to start forecasting actually, the mycotoxin occurrence, which will enable us to be a little bit more in advance in order to try to find appropriate mitigation and appropriate solutions. And not just being retroactively trying to cope with the consequences of those contaminations. Another area that I see that is coming also is the area of course of sustainability, we need to talk about the impact of mycotoxins on the animal production system. And indirectly, what those mycotoxins are doing in terms of the performances, and the impact of those animal production will ultimately have consequences on carbon emission, on methane emission, etc., etc. So, this is an area that we've started investigating, using the entire set of studies that we've produced along the years. And just as a reminder, I think that we have close to 200 studies almost published work that now we are using in order to build those meta-analysis in order to further understand globally to bring that statistical level to another level and be able to further extend our analysis to the impact of those mycotoxins, on the sustainability side. Finally, I think that if we have done also quite a bit of work on those areas, if we've seen quite a number of investigations, that are happening. There is also quite a number of all mix approaches that are being used now that are enabling us to further understand that mode of action of mycotoxins and in turn mode of actions of mitigation strategies to name a few genomics, nutrigenomics and metabolomics,

proteomics and evaluating also the environmental impact the exposome, have been key words in the last few years for the next step of investigations that are being conducted. If I can add to that, I think that it is also time for us now to explore more and understand more the relationships between mycotoxin and gut health. Those are two areas that are connected. And, as such, also the impact of mycotoxins on the pathogenesis of viruses or bacterial diseases. And, for example, try to also understand why vaccination campaigns and therapy are failing because we have this type of issue happening in the field. So I think in a nutshell, these are some of the directions that we are seeing the scientific community focusing on and as we are part of this community, Alltech is also quite involved in those different areas. I think the only thing that we do remember is how much of food safety, we can have versus food insecurity. It's always a balance between those two, we cannot eradicate mycotoxin issue. There are levels that are safe, or levels that have consequences, but I think that we can manage all those if we have a correct risk assessment approach for those mycotoxins.

Nick Adams 19:16

I think, Alex in a nutshell, what I take from that is that there's still plenty of work to do. It's, really interesting to see how all of those you know, the concept ultimately, as you said, is that mycotoxins are not going anywhere. And yet, the tools we have now are allowing us to dive a lot deeper in understanding them and their consequences. We've always talked about mycotoxins as being predisposing factors for many things and what you're saying there with the different approaches that we have available to us is that we can start to understand those things in a lot more detail. So, you know there's a lot of, I suppose, exciting opportunities in this area moving forward. Manoj maybe sort of coming back to you for the last question then as somebody who is involved in mycotoxin research, you know, on a daily basis, how do you think some of these things will change or will change what you're doing on a daily basis.

Dr. Manoj Kudupoje 20:24

Yeah Nick, in India, we have a lot of going on in mycotoxin work, especially on the animal side. What we do is we try to grow these fungal cultures in the lab, especially the fusarium culmorum and fusarium graminearum in the rice media, and we analyse this using 37+. When we analyse we have noticed there is a lot of different mycotoxin present in that media. When the birds are exposed to this media, we have observed the compromise in the gut health. And when we add in Mycosorb A+ in the diet, this ill health the toxic effects has been reversed. When the diet was supplemented with yeast cell wall, the inclusion of point two kg per tonne, supported the animal health, which is indicated by the integrity of the mucosal morphology in the small intestine. It also supported greater goblet cell concentration, it improved the liver function and also increased the butyrate level in the high gut supporting the better productivity. In addition, when that fortified with the additional biotic compounds, additional composite nutrition, nutritional attributes, some plasma parameters and gut physiology was also input. Actually, we are working on strategic formulation of yeast cell wall extract that could be applied to the diet of broiler chickens to optimise the performance when the birds are exposed to naturally occurring contaminated fusarium mycotoxin challenge.

Nick Adams 21:53

Manoj, Thanks for that. It's interesting to see then how you you're building on some of those models. Alex, Manoj really appreciate your time today. There's a lot of useful information there as we've sort of

taken that journey through the past, the present and a little look into the future when it comes to mycotoxin research and clearly, you know, we're really probably only the tip of the iceberg as we get to understand more about the different types of mycotoxins that we're seeing because of the breakthroughs in analysis. Now it opens up that door about saying, 'well okay, how do we now understand the impacts of all these different mycotoxins?' So, really appreciate your time, and hope to have you back on mycotoxin matters in the future.

Dr. Alexandros Yiannikouris 22:42

Thank you, Nick.

Dr. Manoj Kudupoje 22:43

Thank you, Nick.

Announcer 22:47

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 [know mycotoxins.com](http://knowmycotoxins.com)
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