Danny Lennon: Hello and welcome to Sigma Nutrition Radio, the podcast that brings you evidence-based discussions with the world's leading researchers in fields related to nutrition and health. I am your host, Danny Lennon, and you are listening to Episode 120. And today, we're going to tackle an issue that carries a lot of controversy with it when it's brought up in nutrition discussions, and that's around genetically modified foods or genetic engineering, how that relates to food produce. Now, there's no shortage of places online that you can find people talking about this issue, often with quite a lot of emotion, and certainly it's quite a loaded topic. You hear about how evil Monsanto is and these other companies and how they're conspiring to make billions at the expense of all our health, and certainly I think we can't be naïve and think that big corporations are out there to look after our health. And I think it's pretty clear certain companies, people typically think of Monsanto, many of those may get up to some questionable stuff.

But what I think often that gets lost when you go down that rabbit hole is that it's easy to forget that genetic modification and genetic engineering technologies are not synonymous with those companies. They're two different things that you have to consider. And it's an area where there is so much fear perhaps due to fear of the unknown or something we may have been told by someone or read somewhere that sounds pretty dramatic, and particularly when we hear about messing around with

certain genes or whatever terminology people tend to use. And so to get an accurate understanding of the safety and usefulness of genetic modification, we need to remove our thought process away from this discussion on the actions of certain companies and instead we need to objectively look at the science of these particular technologies, where they're being used, where their applications are, and then what the actual state of the safety is on this whole arena.

So with that in mind, today's guest is Dr. Kevin Folta from the University of Florida where he is a professor and Chairman of the Horticultural Sciences Department. And in the lab, he researches photomorphogenesis in plants, but he also spends a considerable amount of time trying to communicate what good science is to the wider public and spread some evidence-based messages, particularly in this area of genetic engineering where there is so much confusion and fear.

So before we get into the interview, the show notes of this episode will be over at SigmaNutrition.com/episode120, and there I'm going to link to all the resources that may get mentioned in this particular episode, where you can contact Dr. Folta. And also, if you have not done so already, you can sign up to receive the transcripts of each podcast episode as soon as they're ready every week and we'll deliver that direct to your inbox as a PDF completely for free. So without further ado, let's get into the show with Dr. Kevin Folta.

Dr. Kevin Folta, welcome to the show. Thank you so much for coming on today.

Kevin Folta: Thank you, Danny. This is great.

Danny Lennon: Yeah, it's my absolute pleasure to have you on and I'm really interested to dive into a lot of the research we're going to talk about, particularly on this area that surrounds genetic modification, genetic engineering in particular, because it's not something that we've directly addressed on the show before in any great detail but is probably one of the most important topics in human health discussions right now, particularly when it comes to nutrition and kind of bigger messages that people are hearing. But before we get into any of that specific stuff, maybe can you just give us the Cliff's Notes of who Kevin Folta is and what your research is all about and what your day-to-day work in the university looks like?

Kevin Folta: Well, I basically wear three different hats. I have three full-time jobs, I like to say. My primary job is a researcher. I'm a professor who works on

how you can use light to change the way plants behave and we use light to modulate quality, we change gene expression, we do all the things that you can do to a plant using narrow-bandwidth light to kind of talk to the plant and get it to do what we want it to do. So we can change all the stuff about nutrition, flavors, maybe the way plants decay after you harvest them. Really cool stuff. My other job is a department chairman where I work to oversee and kind of guide and do the administrative functions for our 50-some faculty across seven centers here in the State of Florida, seven locations, and we do everything from plants on the space station to citrus to organic and sustainable to just about everything. And my last hat is in science communication where about at least maybe once or twice, well, a month, three times a month, four times a month, I'm traveling and talking about to people about how to talk about science, especially genetic engineering.

Danny Lennon: Yeah, and I think that's really such an important point and people have hardly mentioned this on the show before. Essentially, the role that this show is trying to fill as well is trying to get that good-quality information we're seeing in the scientific literature and coming directly from the people who are looking at this stuff into people's hands as opposed to them hearing it through a medium that may have misinterpreted what's actually out there, so I think it's a really crucial role. To frame this conversation, like I mentioned at the outset, a couple of things I did want to touch on was this whole thing around genetically modified foods and genetic engineering, so maybe the most important thing is to start with some clear definitions so that everyone is singing off the same hymn sheet here. So what exactly is the correct definition for genetically modified foods and do we mean by this term genetic engineering?

Kevin Folta: Yeah, so let's really clear and we really need to fix that. The idea of genetically modified organisms is a term I like to avoid because we can genetically modify or genetically improve a plant or genetically change a plant—we don't always improve it—genetically change a plant through a variety of mechanisms, and they can be everything from traditional breeding where we're just crossing plants that maybe could never cross in nature, where we're crossing plants with other plants with specific genetic backgrounds, maybe we're increasing the number of chromosomes through processes of polyploidy or maybe using chemicals or radiation to damage DNA to create variation. That's all genetic modification in my book. And most people, when we're talking about genetic modification, we really are doing genetic engineering. We're changing genes that we

understand and the genes that we know what they do. And this is a case here you may take a laboratory approach by taking a very good plant, like say a corn line that has many good qualities, but then you add one thing that maybe you can't add by traditional breeding very easily or take a plant that's very difficult to add a gene to or to breed something like chestnuts and be able to add one gene rather than trying to breed them, and adding that one gene maybe you can do in 10 years rather than in 150 years to breed the gene in. So it's the idea of adding a gene through a laboratory.

Danny Lennon: Yeah, and I think that's probably what most people kind of conflate with a lot of the terms that get thrown around and even with some of the umbrella terms. So if we're talking about, say, specifically that gene transfer or process of transgenesis, are we simply talking about like an exogenous gene and putting it into some organism in order to change or modify a certain trait?

Kevin Folta: That's generally the idea, is trying to add a trait that's not there or maybe take out a trait that is there. A good example of each might be sometimes you can—right now we're having a tremendous citrus crisis in the State of Florida and different citrus genes have been added back to citrus, defense genes, which look like they have a good effect on curbing the disease. That's a really cool idea because you couldn't do this by breeding very easily. It would take many years. The other example is where you take something out, and that's a good example of this White Russet potato that's coming out and also this non-browning Arctic apple. Here a gene that's responsible for causing the oxidative browning that apples and potatoes experience, the gene has been silenced. And so you're able to turn off the gene so that you don't have this deleterious coloration of the fresh fruit product.

Danny Lennon: So if we're talking about something as specific as either inserting or turning off one specific gene, then that would probably indicate to us that we have a great degree of control of what's going on here and it's a kind of very well-known process ahead of time of what's being done as opposed to maybe this misconception of scientists just playing around with something here hoping for a good outcome, right?

Kevin Folta: That's true, at least in terms of commercialization. We're very—I shouldn't say we're. The people who are commercializing these, the small companies that do this and large companies that do this, they are very certain about the gene, what it does, how it functions, and understand that before you ever even begin the laboratory exercise, you want to do

something that is going to be effective, that'll be safe, and the last thing that company wants to do is enter something into a plant product that'll be deleterious. In university laboratories, we're the ones who get the latitude to play around a little bit and maybe try some things that are a little off the beaten path and try to do something a little bit novel or unusual. That's really a cool thing for us to do, but we're not commercializing food products. We're just trying to understand basic biology.

Danny Lennon: Sure, and I really want to get into some of the really cool work that you've been involved in and some of the really exciting technology that's out there in terms of using these different technologies to enhance people's lives, but first I think maybe we address the other side of the coin and look at some of the typical objections that get thrown about when people discuss this idea of a genetic modification in foods and foodstuffs. Now, there are obviously different branches we could look at, one being maybe like environmental and economic impacts, but then there's the actual effect on human health when someone consumes a genetically modified crop and, seeing as this is a nutrition podcast, we'll maybe examine that latter one in a bit more detail. What are the most common objections that you hear from anti-GMO activists that are in relation to putting out information of how these actually affect human health on consumption?

Kevin Folta: Well, you hear everything. The people who object to this and the people who are leading those discussions in the public space are saying that they cause everything from cancer to Alzheimer's to arthritis to autism to Morgellons disease to…and I could go on all day. They have quite a litany of claims that they make yet none of them have been substantiated very well by the literature. The central objections are that they cause these problems and then if they do concede that, "Okay, we haven't seen any evidence of any of this, but how do you know it's not going to happen a hundred years from now?"

The other big objection, and this is a very interesting part of this, is that the objections you hear depend on where you live. So in the United States they will tell you that it's autism, cancer, Parkinson's, Alzheimer's, cancer, the long-term developmental diseases and disorders that we see. In places like China or Africa where the central thrust is to have children, they'll tell you it'll make you sterile. So they adjust the fear based upon where you live.

Danny Lennon: Yeah, that's a really interesting piece to this. And so when it comes to just how widespread perhaps some of these fears are, do you think that's more

a product of people just pushing really bad information like we see quite aggressive people blogging about stuff or creating documentaries in quite an aggressive tone that tries to set out in quite a scaremongering fashion, I would say? Do you think it's simply a product of so much of that information being out there or is it kind of this maybe intrinsic thing in people's mind of just being scared of playing around with genetics?

Kevin Folta: Oh, I think it's both, and I think it's one more problem that exacerbates it, is that the people who are most nervous about this are people who have plenty of calories and plenty of dollars or pounds or whatever you're using, euros, they have plenty of money and they don't have to worry about where their next meal is coming from, and they're making decisions for…and then they're the ones who propagate a lot of the fearful information. The fear information comes from documentaries, it comes from people selling books, people who have websites, people who have institutes that really are just a broom closet with a website attached to it. It's a lot of money to be made in scaring people and selling them antidotes. The problem is that the good technology really needs to be put to use in places where people need it, and that's the problem with having this fear-based discussion about health.

Danny Lennon: Sure, and I think when you look at the kind of safety measures that are put in place in terms of assessing foods that have gone through some sort of genetic engineering, it's pretty stringent and I suppose way ahead of what's there for any conventional production. So could you maybe just touch on it for people that maybe are unfamiliar, what does that process look like of assessing safety and just how far does that go?

Kevin Folta: Well, safety is an interesting question because it depends on what you're trying to test.

Danny Lennon: Mm-hmm.

Kevin Folta: As I mentioned before, we sometimes are adding a citrus gene to citrus, and that means I have to have the same sort of standards for safety that maybe adding a gene from bacteria to citrus would have. And so each one's dealt with at least at this point as an individual basis and each one undergoes evaluation by FDA in the United States, the Food and Drug Administration, or the EPA for environmental potential effects, and then is examined by USDA APHIS for how it may grow on the farm and how invasive are those types of cultural characteristics. And each step is monitored by these different agencies and they go from one to the next. It

isn't all done at the same time. And each agency defines what are the tests that a company or university or whoever's releasing the product, they define the hoops they have to jump through and they have to see data that satisfies their inquiries, and most of it is how you show that something is or is not the same. So if you have a plant that is the foundational variety and then you add a gene to it, are the products that come from the foundational variety the same as those that have the gene added, and if they are, that's great, and if they're not, that's great, what are the differences? That's really the major test.

Danny Lennon: Sure, and I think one of the major concerns that I've seen at least some people kind of promote is that this issue of allergenicity, and so by transferring genes from one thing to another that people are maybe having allergy to something, now you're causing them to have issues with something else because you're playing around with genes from different things. Is there any valid basis to these concerns?

Kevin Folta: Well, sure, it's always a potential. It's plausible. Allergies are caused by specific sequences in peptides that trigger an immune response in the animals that choose it or consume it, humans or animals, which we're animals – I always lump us in there, some of us more than others. But it could happen because you're setting a transgene, you're adding a gene that's setting down in the genome and maybe you could excite a sequence to be expressed that normally wouldn't be or a latent gene that never is turned on that now is turned on. That was always the concern, but that's testable, and even though it's a plausible idea it's highly improbable, and then nowadays where every plant that's produced with genetic engineering is highly tested and highly vetted for collateral effects where it's just not something that I would be concerned with.

Danny Lennon: Sure, and one thing that I found particularly interesting when I've seen some of your work and some of your discussions around this was if we take potential things that can have an allergic reaction with people or some sort of degree of intolerance, so for example we know foods like peanuts, one of the ones you mentioned is that it is possible through the technologies we're talking about here with genetic engineering to produce things that potentially don't have that response in people that usually experience problems with those. Could you maybe talk a bit more in detail about that?

Kevin Folta: Oh, I'd love to. That's a really exciting application in my book and it's already been done. You can take something that has high allergenicity like

peanuts, soy, wheat, and you can engineer out the proteins that lead to that allergenicity, and that's done in a couple of different ways. You can use this process of RNA interference, this process of essentially putting a gene in backwards so you're just adding the native sequence that's there to essentially cancel out the sequence that's being expressed. And that works okay. It does have a possibility to change the quality of the peanut product or the wheat, so that's not as preferred an approach. It's been done and it works.

The newer method is this thing called CRISPR-Cas 9 and your audience should become very familiar with this term because this is the new surgical technique that allows scientists to change very precisely individual letters in the DNA of the genome. You can change one specific base pair change or a small base pair set of changes that you can essentially edit that sequence which is causing the allergenicity and make very small tweaks to make it no longer trigger an immune response yet still perform well as an overall protein in its roles in, say, baking or in a food product. So that's a really exciting breakthrough and I think that's going to be something front and center for everybody going forward.

Danny Lennon: And how far are we away from actually getting this into the actual wider market for people to actually be able to take advantage of or what stage are we at with this sort of technology?

Kevin Folta: That's a very good question. These things could be deployed tomorrow if the regulatory pipeline was different. Peanuts, it's not a large enough crop to be able to afford to be able to do this deregulation, and then the fear is, “Well, we deregulate this and now people don’t want it or they boycott it or they object to it.” That's the big fear. So let's just roll the dice with somebody having allergenicity to the peanut product. It's crazy. Wheat, there's all kinds of problems with export markets if you have genetically engineered wheat, and the kind of segregation that would have to be done to separate genetically engineered from non-genetically engineered even if it was a safer wheat, would be a tremendous hassle. At this point, it doesn’t look like any of these technologies are going to be happening in the next immediate time, but it's really nice to know that we could do it if all of the sudden the world had the courage to accept technology and allow this stuff to roll out.

Danny Lennon: Yeah. So essentially we have, due to the kind of regulations we have in place and the difficulties in deregulating that stuff, we have a situation where we have the potential to maybe have these huge benefits for a broad

number of people but it's just been held back maybe for whatever reasons that current regulations are in place.

Kevin Folta: That's exactly right, and that's what we see across many different areas. It's the kind of plants where the allergens have been suppressed. That would be a huge help here in the industrialized world. But I think more about the people who could benefit from slight tweaks in micronutrients like vitamin A or vitamin B6, iron. Those products exist as well and just are not being deployed. We can solve problems that allow plants to grow through disease or grow in droughts and at least survive better in droughts. There are so many technologies that could be planted tomorrow anywhere in the world and solve some of our most pressing problems, but it's just they're stuck in university shelves because they just can't be deregulated.

Danny Lennon: And how much of that is down to simply this maybe unfounded fear? Or maybe is it just because of the degree of anti-GMO movement or whatever the case may be or is it simply a system issue? Or what is the biggest thing holding up that deregulation?

Kevin Folta: I think it is the fear issue that clearly if a company wants to deregulate something they can do it and they deregulate corn, cotton, soy, sugar beets, but those are all big-acreage ag crops. Things like strawberries, tomatoes, that could benefit from these technologies, there's just not enough acres to justify it, at least in the industrialized world. In the developing world, things like cassava and banana could have tremendous benefit. Again, this is being done. It's being done by folks like Gates and by Gates Foundation and by local governments in Uganda, Kenya, Nigeria. These countries are doing this without the involvement of US entities other than Gates with some of their money. Over there though, they still have fear and there are still people going around polluting the public opinion environment saying that these are dangerous technologies that'll render you sterile if you consume them. So it's not as bad as it is here—I think it'll be overcome pretty quick—but those kinds of forces are still at work.

Danny Lennon: Yeah, and maybe we can turn to a specific…you mentioned a couple of things in the developing world. I know you mentioned vitamin A and then obviously the use of, say, something like bananas, and I think only recently I read a piece that I think went pretty mainstream. I think it was on Vox.com or somewhere that talked about this issue of these bananas with the addition of vitamin A, and obviously vitamin A deficiency is such a huge issue in the developing world and this is one area, like you

mentioned, that could have such a greater good that's being held back on. Could you maybe outline for people, number one, just what a big issue vitamin A deficiency is in some of these countries in the developing world, and then what role we can play with some of the production of, say, these bananas in this case?

Kevin Folta: No, I think it's an absolutely huge issue that everyone should know about. Vitamin A deficiency comes from a lack of this micronutrient that's found in so many of our foods, and in the West we don't have a problem because we have leafy green vegetables, we have carrots. Vitamin A comes from the metabolism of something called beta-carotene, so that orange stuff that's in carrots or squash. It's carotenoid pigment that when cleaved in half makes a pro-vitamin-A molecule. That's all done inside the body once you've consumed beta-carotene. But many of the world food staples, so let me start with deficiency, if you're deficient in vitamin A, which there's one million children a year that are, it leads to progressive blindness, loss of vision and eventually death, and for about half of those that suffer from it. And the reason this is such a sad situation is because we can fix it with addition of a micronutrient. And the Vox article was beautiful because they show, there's a picture of a child in Yemen who's being given drops of oil containing beta-carotene onto his tongue and just those few drops will sustain him for six months. It's amazing. But how are you getting every child and why do you have to have someone go there and do it? And are you sure you're getting everybody? Many people see these kinds of treatments as, "Well, here's comes the West to give us their poison," or whatever. Many people are against it.

What if you could grow the crop you've always grown, the thing your grandparents have grown, the thing that generations have sustained the people of your nation, that part of your culture, part of your social norms, only it has this addition of this micronutrient? And that's been done. You can get vitamin A, high-vitamin-A or high-beta-carotene cassava, high-beta-carotene bananas, high-beta-carotene rice. These have all been made. Now there's high-beta-carotene soybeans where just handful of soybeans are more than enough for someone for a few days. All of this technology exists. It's been around for a long time and maybe is starting to get close to deployment.

Danny Lennon: Yeah, that really is amazing. I think that sort of stuff puts so much of this conversation in perspective of why it actually matters, and I think it really hammers home the point of so much of what you and your colleagues and other independent labs are looking at, essentially what [00:27:50] trying to

do is play this problem-solving role of seeing what big areas we can address, looking at ways to deploy these technologies, to do that, and then creating a situation where we can essentially tackle these. Are there other any good examples of what you've been working on or other groups have been working on that show this kind of idea of trying to look at problems we have and where the genetic engineering and these other technologies can play a role?

Kevin Folta: Oh sure, there's lots of them. The laboratory next door to mine has reengineered the folate biosynthesis pathway. So this micronutrient that's responsible for proper neural tube formation, they can make fruits and vegetables which have much higher levels of folate. Vitamin B6, which is important for neural development and proper physiology, has also been reengineered into plants especially cassava. Iron sequestration, which iron deficiency is a problem. Those are just like kind of the nutrient tweaks that have been done and there's a lot more that are possible, just not being done. Vitamin A is the big emergency.

In my lab, we take it to the other end of the spectrum. We're understanding the genes that are responsible for flavors in small fruits and maybe can eventually engineer a better-tasting strawberry or a better-tasting tomato. That's really easy. Other things that we do are try to develop plants that use native genes, so strawberry genes in strawberries, citrus genes in citrus, to confer resistance to disease, and that's a really important one these days because newly emerging diseases are really gaining a traction and foothold.

Danny Lennon: Yeah. One of the things that really hits me is when you just hear about some of the objectives that you in the research area look out to to try and address and the kind of drive behind all this stuff. When you hear kind of this talk that come from some of these activist areas of scientists in this are all in bed with big evil companies and all of this kind of nonsense, what is the overriding emotion that you must feel? Is it one of like anger or frustration or just dismay at where's this stuff coming from?

Kevin Folta: Yeah, it kills me because my job as a public scientist is to at least some degree interact with companies and to know what they're selling and who they're selling it to and how it works. That's part of my job. Yet, that's looked at as extremely negative by people who see that interaction as some sort of deep collusion. You can read about me online and I read it now and then just to really remind myself. They'll tell you that I'm on the inner circle of Monsanto's strategic team, that my job is to lie about

science and to promote genetic engineering, and that's not true. My job is a scientist in the public domain who's spent his entire career here and what I want to do is bring whatever technology works best for farmers to help them be profitable, bring solutions to the developing world, and find ways to do it where we make less environmental impact. Those are my goals and that's what gets me so excited, yet when you talk about a technology to do it it really does rub activists the wrong way. They don't want you to talk about environmental sustainability or how these technologies could be good. Instead, they want to focus on nonissues and then vilify the scientists. They don't want to show you why your research is bad or why your data are wrong. What they want to just say is, "Well, we don't believe you and you just work for the companies."

Danny Lennon: Right, and it's almost this synonymous use of these technologies with specific companies or I suppose this big idea of big company is going to destroy everything. And again, not to say that they are…like they obviously have their own agenda, but to try and conflate that with what is being done in research circles and throughout the scientific community is just complete nonsense. And it's interesting that you never see anyone within the kind of scientific community or even anyone that has an understanding of how research is working in this area coming to any of these crazy conclusions. It's always someone that probably doesn't have the understanding of what's going on. So it kind of shows a lot, I think.

One thing I did want to mention was already we talked about some of the regulations. Now, obviously that will depend on someone's geography and here in the EU there are slightly different regulations to you guys in the States. I know even some member states over here like Germany or Northern Ireland actually have bans in place as far as…for certain things. Are there anything with in terms of EU regulations, if you've seen anything on that that are either advantageous over what is currently employed in the States or, in the flipside, do you think that we could benefit from actually changing any particular regulations to mirror more of what's going on in the US, if that makes sense?

Kevin Folta: Oh sure. Well, probably the best example is—a good one—is the country of Romania, and Romania throughout the 1990s and, you know, it's an emerging economy and they're doing better with industrialization, they're doing better with agriculture, and they used the genetically engineered potato that was available in the late nineties and early 2000s. It made a protein that killed beetle larvae. So the protein would in essence be…so the plant would make its own protection against this pest called the

Colorado beetle and when they started to use this their potato exports went through the roof. They were able to export potatoes, grow a lot more and cut insecticide use down to nothing, much lower than they were using under conventional non-GMO potatoes. They also became net exporters of soy because of their use of genetically engineered soy. So this was in the early 2000s that they were seeing great benefit.

Then you come along to 2007 and they had to give up that technology because they joined the EU, and they became net importers of soy and potatoes. They began to use hundreds of times more pesticide than they used previously. So here they lost this idea of sustainability, they made more environmental impact and lost the revenue because they switched from that technology. And the EU could benefit very much from this, and they will eventually.

Danny Lennon: Yeah, I think that sort of stuff often gets lost in these conversations and it's always…kind of some people always tend to try and look at it on this internal feeling of what is right as opposed to either not only just the facts that are there but considering other things like the economic viability of things behind it as well.

One thing I did want to mention that often gets brought up to me when different types of discussions like this break out that is outside of actually genetic engineering itself is more to do with the use of, like we said, herbicides and pesticides, and in particular in recent times we've had a couple of papers talking about glyphosate in particular. I think the paper that particularly comes to mind was one by Anthony Samsel and Stephanie Seneff, which I think appeared in a toxicology journal a couple of years ago, and in that they linked glyphosate exposure to potentially causing health issues in those with celiac disease as well as hypothesizing a link with kidney issues. Has there been anything borne out in the data or any trials have validated anything along those lines? Or do you have any thoughts on those particular ideas or papers when it comes to glyphosate?

Kevin Folta: Absolutely. Well, Samsel and Seneff, she is a computer scientist at MIT, he I'm not sure what he does, but they don't have a research laboratory, they don't do clinical work. When they say that they've linked it, it means that when they did the Google search that they started to make associations. If you read those papers, they're not research papers. They typically are in a journal called Entropy, which is a theoretical physics journal that publishes reviews. They're comprehensive cherry-pickings, meaning they go into the literature and they find phrases or pieces of data

that support their hypothesis that glyphosate causes autism and Alzheimer's and everything else and then they produce this work. The sad part is that they never test the hypothesis, they never do an experiment, they never have any experimental evidence that shows what they're suggesting is true, yet they scare the hell out of people by saying that this chemical is poison, which it is if you're a plant. It's actually a very low-toxicity compound. It's not something that many, many agencies have decided is a very minimal risk. So it is very sad that we're seeing activists now going after the chemicals.

Danny Lennon: Yeah, I think the degree of scaremongering particularly off the back of that was actually quite interesting. I remember quite a number of people who had previously been talking about gluten being an issue for those that don't have celiac disease and then kind of shifted, "Well, even if it's not, now we think it might be glyphosate and here's something that kind of links this," and you have that immediately just out of a hypothesis and I think that's important. And I think particularly when you mentioned the cherry-picking, that's a huge problem in this area, right? I mean, I don't know how many times I've seen an article written where it'll be someone has picked a couple of rodent studies and they'll then say, "Look, some sort of genetic modified food did something bad here," without actually looking at it in any great detail what the study is actually saying, and that's enough to kind of get people worried, right?

Kevin Folta: Oh sure. Yeah, you show like the famous paper with the three lumpy rats that if you look at that they say one of them was genetically engineered, the other one was Roundup or glyphosate, and the other one was genetically engineered food with glyphosate, and the thing they forgot to show you was, where's the rat that just had regular rat chow? They don't show you the control, which also got tumors. So that shows you the deceptiveness just looking at that figure in that paper. That's the way it works though. This is a kind of predatory misinformation that keys off of fear, that plays into the biases of those who wish to vilify a technology. It's really unfortunate.

Danny Lennon: Okay, so maybe if we take the number of people listening to this that maybe want to delve into a bit more detail around this and get up to speed with more of the good-quality information, where would you refer them to to try and…that would be a reliable source of objective information they can actually trust as opposed to having to rely on these other kind of reports we see?

Kevin Folta: That's really a good question because it is difficult to find places where that's really obvious, but in the EU, Sense about Science has an excellent website and they're an independent broker of information that's very good. In the States, we have one that's called GMOAnswers. It's funded by the industry, by an industry consortium of 50 different companies, but the information comes from academics and company people but generally is very good information. And if I saw anything there that was bad, I would write about it on my blog, I would object to ever putting any information from me on that site. I don't want my credibility trashed. So I would watch that site pretty carefully and the data are very good. The answers are very good.

Biofortified covers lots of these informations, Biofortified.org, and if people are interested, I do a podcast called Talking Biotech where we interview people who are at the forefront of these innovations both in traditional breeding and in biotechnology, and it really is nice because you hear the stories behind the traits and behind the crops, and I think hearing it right from the experts is a really compelling way to learn more about the topic.

Danny Lennon: Awesome. And for everyone listening, I will link up to all that stuff that Dr. Folta just mentioned in the show notes to this episode, so please do go and check that out. Kevin, to kind of start rounding this thing off before we get to the final couple of questions, for people to take away a couple of big messages from this whole conversation, if there are just a couple of things that you think are the most important for people to go away with from this, what would you kind of list those as?

Kevin Folta: Well, the number one message is that these technologies have been used in medicine for many, many years. All of our insulin comes from genetically engineered recombinant DNA technology, never a single health problem with respect to those technologies. Our cheese-making enzymes in 95% of cheese come from genetically engineered microbes. Our food, just little bits of ingredients from corn, soy, canola, and sugar beets, little bits of ingredients, those have been in food for 20 years without any sign of a health effect. Billions of animals consume this stuff on a daily basis, 100% of their diet or approaching 100% of their diet, and they don't have any changes in physiology. So safety is not something, in something that's released, that I'm concerned about. Certainly I am concerned everything being adequately tested—that's no question—but in the current slate, we got good food. This is safe.

The big take-home message is, how do we not stop technology because we don't like the companies that use it? So in other words, people saying, "Well, I hate the Monsanto [00:42:44] Bayer or whatever, BASF companies, so I don't like the way they run their business and I don't like the way they treat farmers," you know what? That's great. Do that. Don't like them. But be careful about trashing a technology that can help people because when you say that it's poison or that it makes a rat have tumors, you now take away the will to provide technology to the people who need it the most and the people who are losing their cassava farms to a virus that we can control, the people who are losing their banana plants to bacterial wilts that we can control. We can do so many good things for people in the developing world and so many good things to cut our environmental impact with farming. We just need people to stop vilifying the technology that can help us do it.

Danny Lennon: Right, I think that's such a huge point. Essentially, we're being frozen into inaction due to just some irrational fear or a fear of the unknown because we haven't come across the information that is out there, or at least it's being contaminated by this poor information that is so easy to throw around. I think that's a huge takeaway. Before we get to the final question, Kevin, where can people find out more about you and the work you do and track you down online?

Kevin Folta: Sure. Well, I'm reasonably visible on twitter and that's @kevinfolta. I have a professional Facebook page that's pretty interesting and I have a blog called Illumination that you can find pretty easily if you google my name. And the podcast, the Talking Biotech Podcast, is really a lot of fun and I have the best guests in the world and just really enjoy learning about the way in which we can use technology, and it doesn't necessarily have to be genetic engineering, okay? So whether we're talking traditional breeding or genetic engineering in animals or in plants or in medicine, those are the stories that we share on Talking Biotech.

Danny Lennon: Awesome, and like I said, I'll link to all that stuff in the show notes for everyone, so please do go and check that stuff out. With that, we're just up on time here and so that brings us to the final question that we always end this show on…

Kevin Folta: Alright.

Danny Lennon: …and it could be to do with anything outside of what we've talked about today and it's simply, if you could advise people to do one thing each day

that would have some beneficial impact on some aspect of their life, what would that one thing be?

Kevin Folta: Oh, that's easy. Get out and move. And I think that the idea of so many diseases are caused because of…or at least have a component that's dependent upon sedentary lifestyle. I think as somebody who's been a lifelong participant in martial arts, who enjoys being able to learn how to train himself to move in space quickly and with agility, your balance, your motion, your joints, you get funny strength in funny ways from that kind of stuff. So being able to practice moving around, climbing stairs, taking the long walk rather than the short walk, skipping to work, [chuckles] doing stuff that just makes you move in ways that you don't, that's really going to be a benefit.

Danny Lennon: Yeah, I think there's not too many other makers that you're doing really well at life if you're able to move effectively and pain-free and in different ranges of motion, so I think that's a really good piece of advice. Kevin, this has been a really, really fascinating discussion. Thank you so much for the great information. Hopefully it's given people an objective look at what is in the body of evidence and an evidence-based look at this topic, which is unfortunately quite rare to find. I really appreciate the information and I appreciate your time. Thank you so much.

Kevin Folta: I'll thank you for all you do too. This is really…I really appreciate this kind of forum. Thank you.

Danny Lennon: So there we go. That was Dr. Kevin Folta of the University of Florida. Hopefully this episode has given you an insight to an objective and evidence-based look at genetically modified foods and those surrounding technologies or at least some critical-thinking tools to go and look at this area a bit deeper and perhaps not to freak out and get scared when you see the BS that Dr. Mercola and friends will peddle to you. In the show notes, I will link up to all the resources that Dr. Folta mentioned and I'll put a link to his bio and a link for you to sign up to the full transcripts to the podcast episodes, again, for free, including this particular episode.

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