The Effects of Glyphosate on Deuterium Levels and Immunity:
A Special Interview With Stephanie Seneff, Ph.D.,
By Dr. Joseph Mercola

Dr. Mercola:

Welcome everyone. This is Dr. Mercola helping you take control of your health, and today we are joined by a repeat guest, the eminent Stephanie Seneff, Ph.D., who you probably recognize as a senior research scientist at MIT (Massachusetts Institute of Technology). She has expertise in computer science and artificial intelligence laboratory, and she also has a degree in biophysics, all from MIT. And actually electrical engineering too.

Stephanie Seneff:

Right.

Dr. Mercola:

You have quite the breadth of training. And obviously at MIT, it's one of the most prestigious universities in the world. Unfortunately, they, especially 20 to 30 years ago when you were getting your training, but they somewhat have degenerated into progressivism and I think deteriorated relatively speaking. But nevertheless, your training is impeccable and your mind is phenomenal. And you committed much of this brain power to helping understand some of the challenges we have in biology, which is a bit far, a bit unrelated to some of your initial training, fields of expertise, but nevertheless, once you learn how to learn as you clearly did, you can easily apply this. I mean, that's the beauty. We're all on this lifelong journey of understanding our reality, and you're really facilitating the journey for many of us by helping us uncover some of the deep science at a molecular biology level.

Dr. Mercola:

Today, we're going to be looking at the influence of glyphosate and a molecule called deuterium, which is an isotope of hydrogen. And we'll talk more about that. But before we go deep into that, I'd like to get an – you're pretty well-known for your science on glyphosate. So I think we could maybe start with getting an update on what glyphosate is, especially with the changes in Monsanto being bought by Bayer and shifting all that and the lawsuits that have been involved. So there's a lot happened since we last talked about this. I'm wondering if you can just provide us from your perspective with a brief update on where we stand with glyphosate.

Stephanie Seneff:

Right. I'm actually quite excited because I've seen many papers coming out in the last few years, even the last two years studying glyphosate and even very low levels of glyphosate and finding toxicity. Where before, they hadn't bothered to look because we were assured it was safe and it was wasting your money studying something that's safe. I think people were not studying it, and that's why they weren't finding things. So there’s really papers coming out left and right lately.

Stephanie Seneff:

So there was a recent paper on endocrine disruption, a review paper of glyphosate linking it to endocrine disruption, which can lead to things like breast cancer and reproductive issues and obesity and thyroid issues, all of these things are connected to endocrine problems. There was just a huge list of references and a huge list of reasons, ways in which glyphosate is shown to be an endocrine disruptor in that paper.

Stephanie Seneff:

And of course there's all these lawsuits that have come up recently, thousands of them.

Dr. Mercola:

I think they settled it.

Stephanie Seneff:

Yeah, it's hard to figure out. [crosstalk 00:03:13].

Dr. Mercola:

It wasn't that much. The liability was in the hundreds of billions.

Stephanie Seneff:

I know, I know. If they did settle it, it was a total rip off of the people who were [crosstalk 00:03:22]-

Dr. Mercola:

Yeah, absolutely. The only one who win ar2e the lawyers.

Stephanie Seneff:

Right.

Dr. Mercola:

I think it was a $2 billion award, a jury award, one of the first few.

Stephanie Seneff:

There was $2 billion for one. There were three of them who huge amounts in the first award, and then of course they got shrunk and shrunk and shrunk, and they had various higher court appeals. It's still going on I think. The very first one, I'm not sure he's even gotten his money yet, and of course the money he's getting is a lot less than what was originally awarded from the jury, which is what always happens apparently with these cases. It's such a huge effort to be the first person, the pioneer who finally breaks that barrier. But I'm so in admiration of Dewayne Johnson who had got non-Hodgkin lymphoma in his 40s, and I met him in person. He's such a great person. He was just willing to go through all of this.

Dr. Mercola:

Is he still alive?

Stephanie Seneff:

He is. Yes, and he's gotten young kids. I think he's still waiting for his money, and the money keep shrinking as they go through the process. But it's really frustrating. So the cancer thing, too, there's a new paper that came out that showed that glyphosate sensitizes the cells to be more receptive to cancer in exposure to other chemicals, and that's what I'm seeing with glyphosate in a lot of cases. Glyphosate almost makes everything else more toxic than it would otherwise be. It disrupts your defense system against toxic chemicals.

Stephanie Seneff:

And then there were several papers that, just remarkable papers where they exposed rats to low-dose glyphosate when they were pregnant and low dose of rats that didn't even notice it. I mean, there wasn't any obvious damage to the rats, and there wasn't any obvious damage from the offspring from that pregnancy. But when those offspring grew up and then they had pups and then they grew up and had – so it got into the grandchildren. The grand pups started to have really big problems as a consequence of that exposure of their grandmother or even their great-grandmother. So it's this epigenetic effect that goes through generations with the [inaudible 00:05:19] is especially susceptible to damage that's going to show up in later generations. That is so remarkable.

Dr. Mercola:

Yeah. So I was actually looking more for an update on the use and the sale of it and some of those. But before you answer that, I just wanted to comment on your attire because we're recording this in the middle of winter, and they're wondering, "Whoa, what is [crosstalk 00:05:39] shirt there." Well, you are in Hawaii.

Stephanie Seneff:

Yes.

Dr. Mercola:

And actually, you mentioned to me earlier before we started, that this is now your full-time residence.

Stephanie Seneff:

Yes, I'm now a-

Dr. Mercola:

You're not there the entire year, but most of the year, you've officially shifted. So congratulations because you're getting vitamin D on steroids out there.

Stephanie Seneff:

Yeah, that's right. I certainly am, and I'm so grateful for that because fourfold increase risk of dying from COVID if you've got low vitamin D.

Dr. Mercola:

Yeah, yeah. I actually had my first paper published and went over all that.

Stephanie Seneff:

Congratulations.

Dr. Mercola:

Yeah. I mean, first paper published this century. I published a bunch the last century. But you've published 30 papers since 2011 or 2012.

Stephanie Seneff:

Yeah. More than 30 now.

Dr. Mercola:

Oh, more than 30. That's great.

Stephanie Seneff:

But I'm kind of slowing down on the publishing because I think I'm going more towards the idea of writing directly to the public, webpage articles. I think that's more productive actually.

Dr. Mercola:

Yeah. When you submit your journals, your studies to the journals for review, how many times do you get kicked back for rejections?

Stephanie Seneff:

I get kicked back without review. They'll say that the topic of the paper is inappropriate. It's shocking really, and of course the topic is inappropriate because they've got funding from people who would be very upset if they published that paper. They won't even let it go under review. So it's been very frustrating actually. I was quite surprised when I first got into this area, I should've known better. But the vaccines are such a hot button. There's tremendous frustration and censorship involved in trying to get something – that's why the papers that show the evidence that vaccines cause harm are typically in open access journals because the mainstream journals won't go near it.

Dr. Mercola:

Contradict the mainstream narrative. So when you've written a paper and it's rejected without even reviewing it, what's the process for you? Do you submit it to other journals?

Stephanie Seneff:

Yes. In fact, I had one that was extremely interesting. Really, really obvious evidence of me being censored because I had been solicited to write a paper, and my friend had also been solicited. So we buddied up and we wrote a paper. We thought it was really good. So we submitted the paper, and then it was shortly after we submitted it, it got rejected. We were

shocked. I think it was without review, rejected without review. We were really shocked. We approached the guy. It was a special issue, and we approached the guy to say, "Well, what happened here? We thought you wanted this paper. We thought it was exactly what you had in mind." And he said, "I didn't know it was rejected. I didn't know it." So it got rejected upstairs, I think. That's the only thing we can figure out.

Dr. Mercola:

Yeah.

Stephanie Seneff:

He couldn't fight for us. So we submitted it to another journal. We got it published, and it was well-received. So it was a good paper. It is a good paper.

Dr. Mercola:

So eventually all of your papers get published. It's just a matter of which journal it is.

Stephanie Seneff:

Not necessarily. I had another one that was total torture. This was many years ago, and it was on statin drugs, and I was linking statin drugs to the defects, to the problems we were seeing in middle-aged men, actually, because I think that we did a study on statin drug side effects. Again, I thought it was a really interesting what we found in the evidence from the data, and it was going through process pretty well. We had three reviews. It looked like we were going to be able to deal with it, and then we submitted our response to those reviews. And then a fourth reviewer appeared out of nowhere and hated the paper. Absolutely refused to give us any chance to – we finally even answered to all his complaints. He had a huge response. We dealt with all of that. We tried, and then ultimately they rejected it. So this person, whoever it was, I think, brought in because they couldn't allow a paper damaging to statin drugs to be published.

Stephanie Seneff:

So there's a huge amount going on. It's really frustrating to publish papers when you are going against the mainstream. It's just always impossible to publish papers.

Dr. Mercola:

Thanks for taking that tangent. It's not related to our primary discussion but I think the public would be interested in hearing the inside story of people who do write studies for peer-reviewed journals and the process of it, especially if you're contradicting the mainstream narrative. So kudos for persistence. I just got a taste of it recently late last year with – it wasn't rejected. We submitted it to Nutrients. It's a pretty decent journal. But we got four, not rejections I guess, feedbacks from the reviews that it was unacceptable unless you make these changes. We did that process four or five times before they finally accepted it.

Stephanie Seneff:

I mean, I had another paper that I wrote on Alzheimer's, and again, I linked it to statin drugs. They basically said, "Unless you take the part out about statins, we will not accept this paper."

So we took it out, and then they published it. I mean, thankfully they published it, but we didn't mention statin drugs. [crosstalk 00:10:26]. It's really an interesting world right now. I'll tell you.

Dr. Mercola:

Yeah, let's get back to glyphosate, and if you could briefly summarize where we're at. Are they selling as much glyphosate? Are we still using as much? Has the transition to Bayer being the owner of Monsanto, Monsanto not existing, sort of rebranding, has that changed the use? Has the PR from these cases had an impact on lowering the use of glyphosate?

Stephanie Seneff:

I think there's interesting things happening, and I'm really encouraged actually. And part of it, of course, is a lot of it is public awareness and then pressure from the public. And then you have companies that realize they might get sued if they sell glyphosate. So you have major marketing companies that sell lots of Roundup products who are deciding to stop selling it because they're afraid of lawsuits. So again, it's pressure from the consumer going back to the companies that sell it, and then as you get more and more consumer awareness, we're also getting a lot more availability of organic food. You're seeing certified organic more and more in the regular grocery stores. It doesn't have to be one of these expensive boutique grocery stores to get the certified organic. So that's really blossoming.

Stephanie Seneff:

Certified organic is selling like hotcakes. So again, it's public awareness I think is the key. And then you have all these lawsuits. I mean, those three lawsuits were just phenomenal to really bring, again, bring public awareness to the problems and also to get a whole bunch more people to try to do lawsuits. So we have like tens of thousands, I think, now, lawsuits on non-Hodgkin lymphoma.

Stephanie Seneff:

And then Bayer too being no longer in the United States, I think they have best control over what's happening in the United States. I think Monsanto was extremely good at fighting powerful lawyers to defend their product. Monsanto had assured Bayer that they had never lost a lawsuit on glyphosate, and then as soon as Bayer took over, they started losing. So I think there was something going on there that is no longer going on, which makes it more accessible to lawyers to take on a case and to feel emboldened that they might actually win.

Dr. Mercola:

Yeah. There were some really clever attorneys who were able to do some magnificent work and win those cases. And really put Bayer and Monsanto back on their heels. I mean, it looked like they might even stood the chance of going out of business. I mean, if the [inaudible 00:13:02] were successfully litigated. But it always seems to be the case, you have these atrocious, egregious behavior, corporate behaviors that they literally should go out of business for the damage that they did if they were awarded appropriately. And the first three lawsuits, as you suggested, they were huge victories. But then there's this massive travesty of justice, and the lawyers wind up negotiating this out. The class action contributors or constituents are minimized,

and they hardly get anything for the massive pain and suffering and loss of life as a result of using these products, which were fraudulently brought to the market.

Stephanie Seneff:

Right. And as I understood it, they were trying to put into that plan, that negotiation for that deal was that something about having a committee to decide forevermore that glyphosate, whether or not glyphosate causes cancer, to have a decisive study in which the committee would decide. And that was so dangerous because they could of course stack the committee with their friends and decide that it doesn't cause cancer forevermore. And then nobody can ever sue them for cancer and Roundup again, which would've been horrendous. But I think they fought that, and that didn't happen as far as I understand. It's a little bit hard to keep up on it. Not sure what to believe, but I think maybe that part got omitted in the final deal.

Dr. Mercola:

That's good. So thanks for the update on glyphosate and you ventured into investigating some of its associations with other areas that I mentioned. We were talking deuterium. So before we go into that, and maybe before we even do that, why don't we – you briefly reviewed the mechanism of action with glyphosate, which relates to glycine, and many people have heard this before. But I think it's always good to review it. And glycine of course is an amino acid. There are 20 of them. And the "gly" in glyphosate comes from glycine, and it's a really simple molecule. Just one amino acid, but it's got these phosphonates or what is-

Stephanie Seneff:

That's right. Methylphosphonate.

Dr. Mercola:

Methylphosphonate, that's what – methylphosphonate. It's just methyl I was leaving out. The methylphosphonates around there, which makes it poisonous, and you believe, and I think largely from initially catalyzed by Anthony Samsel, who I introduced you to.

Stephanie Seneff:

I know. I always tell people that. It all worked out. It's so neat to think back to that time because I heard that talk by Don Hubert just a few days. I went there, did my talk on statins. He did his talk on glyphosate, which I didn't know what glyphosate was at that time. This was like 2012. I listened to that talk, and I was like, "Wow. This is it." I mean, I was convinced this is what was causing the autism epidemic. I was so certain, and I'd been looking all over the vaccines. I think the vaccines are contributing, but I think the glyphosate's primary with the autism epidemic.

Stephanie Seneff:

Then I came to you shortly after that, and you introduced me to Anthony. And then we just wrote those six papers together. It's been quite an operation.

Dr. Mercola:

Yeah. So it's still not well-accepted and relatively controversial of the substitution of glycine as an amino acid for the real – glyphosate for the real amino acid, glycine into the machinery for creating proteins, and then obviously if you have a distorted analog of glycine, that constructive protein is not going to work like it's designed to. And the primary example of it is the shikimate pathway, which you so cleverly have exposed. So why don't you review that some more?

Stephanie Seneff:

Yeah, and I just want to say that I have a book now that I've pretty much finished. It's off to the publisher now, and they're preparing it. In the final process, should come out in June 2021.

Dr. Mercola:

Okay, good. We'll have you on for that too. Just send me a draft of that.

Stephanie Seneff:

Yeah, "Toxic Legacy" it's called, "How the Weedkiller Glyphosate Is Destroying Our Health and the Ecosystem." So I have a whole chapter there on the glycine analog story and then I follow it on a chapter on the specific set of proteins that are especially susceptible because of a particular, what I call "glyphosate-susceptible motif." So it's fascinating. Really fascinating biology and so terrifying when you think of the consequences, the potential consequences if I'm right. It matches so well with all the diseases that are going up so dramatically in our society that I really think I'm onto something huge here. And I hope that book will be well-received.

Stephanie Seneff:

I'm getting really strong pushback. People are saying it's not possible. But when I look at the evidence-

Dr. Mercola:

Who's giving you pushback?

Stephanie Seneff:

The chemists are saying-

Dr. Mercola:

Oh, okay.

Stephanie Seneff:

They don't tell me. I have friends who believe it. Obviously Anthony, but even chemists who believe it, a Harvard Ph.D. who believes it. I mean, it's not like nobody believes this, but there are few and far between. Most people are being told that it's not possible and therefore we don't even consider it. But when you look at the evidence, I think the evidence is overwhelming, and it's Monsanto's own evidence that's overwhelming. And particularly a striking part of that evidence has to do with EPSP synthase because that's the enzyme in the pathway.

Dr. Mercola:

Let me just interject a quick tangent because a lot of that evidence came directly from Samsel where I don't know how he did it, but he was able to capture like thousands of original correspondence.

Stephanie Seneff:

I know. Absolutely. [crosstalk 00:18:34].

Dr. Mercola:

-exposed that information from their own files.

Stephanie Seneff:

He's really something. I admire his tenacity, and he just won't give up. He managed to convince the EPA (Environmental Protection Agency). There was a nice story because he'd been pestering them. Freedom of Information Act. They finally said to Monsanto, "If you don't respond within three months, we're going to make you give him all this stuff." They waited three months and didn't respond, and that's how it ended up that he got it. But they made him sign something that said he couldn't show it to anybody. He could report what he found in it in papers, but he couldn't let anybody else see all those such stuff, which is quite remarkable. And also, it's not searchable. So it really requires sitting and poring over data. It's not searchable. So that's just amazing.

Dr. Mercola:

Was that like a software hack so they couldn't – I bet there's a workaround for that.

Stephanie Seneff:

Yeah, there could be. I actually don't even know whether it was physical documents or whether it's like you have a PDF that's like a picture. Yeah, there may be a way to [crosstalk 00:19:40]-

Dr. Mercola:

Yeah, I know it's probably an image. They gave him an image. [crosstalk 00:19:44]

Stephanie Seneff:

Yeah. It's probably images I suspect, which makes it hard. I mean, maybe you could run it through a character recognition. But anyway, he's just been rummaging through it and finding extraordinary stories from there, including the one about the bluegill sunfish, which we published. We described that in our paper. The bluegill sunfish was quite remarkable because they exposed these bluegill sunfish to radiolabeled glyphosate, so they could track it. They knew the glyphosate was there or at least something from the glyphosate was there because of the radiolabel. And then they looked at the tissues of the bluegill sunfish, and sure enough, the radiolabel was in the tissues. Now they've said that glyphosate doesn't accumulate in the tissues. Well, there it was in the tissues.

Stephanie Seneff:

So then they said, "Well, let's measure glyphosate in those same tissues," and they came up short. Like 20% of the radiolabel, up to 20% was accountable through the technique that you would use

to see if glyphosate's there. So 80% went missing. So then they got the brilliant idea of adding enzymes to break proteins down into individual amino acids. And once they did that, the yield increased to 80%. So they got another 60% of the glyphosate identified as a physical glyphosate molecule once they broke down the proteins into individual amino acids. And they said in the paper-

Dr. Mercola:

Which proteins were these?

Stephanie Seneff:

These were just proteins in the tissue. So they had the tissue [crosstalk 00:21:01]-

Dr. Mercola:

Oh wow. So that's evidence.

Stephanie Seneff:

Proteins-

Dr. Mercola:

That's important hypothesis that the actual glyphosate gets integrated into the protein structure.

Stephanie Seneff:

Well, that's what that sure looks like. And they even said that. They said, "Perhaps it was incorporated into the protein." That's their words.

Dr. Mercola:

Wow.

Stephanie Seneff:

It's Monsanto researchers. And this is like the 1980s. That's pretty damning I think. And then the EPSP synthase is also a remarkable story because there's a glycine residue at the place where EPSP synthase binds to phosphate in PEP, phosphoenolpyruvic. But basically [crosstalk 00:21:34]-

Dr. Mercola:

That's a long, complex biomedical term. So what does this enzyme do? Is this the one that it's responsible for making the – not the branched chain.

Stephanie Seneff:

Aromatic.

Dr. Mercola:

Aromatic amino acids. Okay.

Stephanie Seneff:

So that's a critical enzyme in the process. In the shikimate pathway, which is the pathway that produces aromatic amino acids, and those are aromatics essential to us because we don't have that pathway. The argument is we're not susceptible to glyphosate because we don't have that pathway. But our gut microbes do have that pathway, and they use it to make those essential amino acids for the host. So we become deficient when they can't do it, and they become damaged. They become killed, and then you get an imbalance in your gut microbiome. So lots of things happen that are bad in the gut because of glyphosate disrupting bad enzymes in the microbes. Right.

Dr. Mercola:

Yeah. So we'll probably go more depth when I interview you next for your new book coming out, which I'm excited to review. So why don't you tell me about your journey with integrating this passion of glyphosate into deuterium.

Stephanie Seneff:

That's an amazing story.

Dr. Mercola:

Before you do that, why don't you take another tangent and tell everyone [crosstalk 00:22:51]-

Stephanie Seneff:

Yeah. First of all, I would say that in fact that paper that I mentioned that I published together with Greg Nigh that got rejected in that weird way and then got later published, it was because of that paper that Laszlo Boros reached out to me. He found that paper. He liked it and he sent me a note and said, "Gee, great paper. By the way, deuterium." I'm like, "Oh, deuterium? Oh yeah. I know what deuterium is." But I knew nothing about its role in health. I knew nothing.

Dr. Mercola:

Some people who are deuterium advocates and passionate about it, they know who Boros is. So tell us who Boros is.

Stephanie Seneff:

Yeah, well he's a professor at UCLA (University of California, Los Angeles) I think in pediatric oncology. You may correct me if I'm wrong. But certainly pediatrics. Kind of a controversial fellow, I suppose. He's actually very outspoken. He's not exactly mainstream, right? But he comes from Hungary, and he went to school there at [Szent-Györgyi]. I never know how to pronounce that name. [University of Szeged, Albert Szent-Györgyi Medical Center]. He went to the place – Szent-Györgyi was famous for really phenomenal research in biology and biophysics many, many years ago, [inaudible 00:23:55] named after him.

Stephanie Seneff:

Deuterium research is really concentrated in Hungary, Russia and Ukraine, which is quite interesting. United States, we hardly know anything about deuterium. People aren't paying

attention except for some of your friends who are promoting deuterium-depleted water. There's an interested in the naturopath community of possibility of using deuterium-depleted water as a supplement to help solve the deuterium problem, as you well know.

Stephanie Seneff:

So we have an interest growing in that respect, and I think then American researchers are starting, some of them are starting to pay attention. I was blown away, and I immediately saw the connection to glyphosate, which is why I got so excited about this, and this was a year ago in December. And I've just been reading everything I can on deuterium I can since then and hooking it to glyphosate. It's just astonishing actually what I found. And even ultimately to COVID-19.

Stephanie Seneff:

So it's been quite a year for me in terms of what I would call major research breakthroughs in my understanding of how metabolism works and how it's getting messed up by glyphosate, and then how that's causing us to not be able to effectively deal with COVID-19. So it's an amazing story.

Dr. Mercola:

Okay. So perhaps it would be best to start with how in normal physiology in our cells, specifically the mitochondria, function to actually deplete our body of deuterium. There are little deuterium-depleting organelles that's just if they're healthy. If they're doing well and have a good diet and they're not dysfunctional mitochondria, then obviously if they're dysfunctional, they're not going to be able to complete that task well. Why don't you describe that process because it's important to understand that before you understand how deuterium works, interferes with it. You have to know that before you understand how glyphosate impacts that process.

Stephanie Seneff:

Right. It's all really fascinating and it gets into biophysics as well and also gets into structured water. So it all fits together. All these areas that I've been interested in and have done deep dives into in previous periods of time. They're all kind of coming together in this great confluence of ideas that is really great. I feel it's, I mean, I don't want to be, well, revolutionary might be the word that comes to mind in terms of understanding biology.

Stephanie Seneff:

So the thing is that deuterium is a bit like iron. Iron is both toxic and deficient at the same time when you have glyphosate messing it up. And in fact, manganese also. I think these minerals, these plus two cations are affected by glyphosate in such a way that the body's natural mechanisms for getting them where they need to be and making them be effective in what they can do gets messed up. So they become toxic. Iron is toxic if it's not controlled properly, and you have all these machinery to help to keep the iron safe and then to put the iron where it needs to be so it can help the enzyme do its job. All of that works beautifully as long as you don't have something like glyphosate in the way.

Stephanie Seneff:

It's very similar with deuterium. Deuterium, the way I understand it, is that deuterium actually gets trapped in the structured water because it has – so deuterium is heavy hydrogen. It has an extra neutron as well as the proton and electron. Hydrogen is the smallest atom. It's the upper left-corner of the periodic chart, and hydrogen is actually by far the most common atom in our body. It's something like 99% of the atoms in our body are hydrogen atoms. I believe that's right. And by weight, it comes out less because hydrogen's so tiny. It's like maybe 70% or 60-something. So it's amazing how much hydrogen we have in our body and how important hydrogen is for our well-being.

Dr. Mercola:

It's a fundamental atom of the universe.

Stephanie Seneff:

Right, right.

Dr. Mercola:

Molecule if it's got two of them put together.

Stephanie Seneff:

Right. Hydrogen, H2, yeah, the gas. And the gas is also, of course, very interesting because that can become therapeutic as well, and that's also because the deuterium, so the deuterium tends to stick to things. It has a stronger bond when it binds to things. So the protons, when the structured water actually releases protons, that's something that Gerald Pollack showed to the world. The whole idea of the structured water pushing protons out. You're looking puzzled.

Dr. Mercola:

I don't remember that as part of one of the benefits of structured water. So can you review that more? I must not [crosstalk 00:28:26]-

Stephanie Seneff:

It's fascinating. Actually it's an important part because it's the energy supply of the cell because the-

Dr. Mercola:

Oh, that's how the energy gets transmitted by pushing out the protons.

Stephanie Seneff:

Yes. It's negatively charged. So the structured water is negatively charged because it forms these water circles that lose one hydrogen and they're stable. They're like a super water molecule made out of water molecules in a circle, like six of them with missing one hydrogen. And that's a stable structure, and that hydrogen gets released. And then it gets pushed out. So the whole thing creates a battery at the place where it has interfaces with the fluid water. So it's gelled water, and then protons being pushed out into the fluid water, and then the fluid water, protons are then ushered. I think they're ushered into the cell alongside a skeletal pathway to be delivered to the

mitochondria. I suspect that's an important way to get deuterium-depleted protons into the mitochondrial intermembrane space.

Dr. Mercola:

So does that transfer of energy through the release of the protons from the structured water help increase mitochondrial energy production?

Stephanie Seneff:

Absolutely. Absolutely. If I'm right, and this is all speculative, theoretical, whatever you want to call it. But it makes a whole lot of sense to me, and it's part of how I'm figuring out the story when I read the papers and I can link it all together. But it's really, really interesting. So basically the cell has all this structured water around it, which it's maintaining with its sulfates. So the sulfate becomes critical. Sulfate gets messed up by glyphosate. So when you don't have enough structured water, you don't have a strong enough battery, you don't have enough protons delivered to the mitochondrial intermembrane space, and that makes the mitochondria have to work that much harder to do their job. Now they have their own mechanism to push the protons across the membrane, as you know.

Stephanie Seneff:

The mitochondria have this membrane that has a part inside the membrane that's really, really important. And that's where you have those protons, and you really, really don't want it to be deuterons, and this is what Laszlo brought home to me.

Dr. Mercola:

Before we go there, I just want to back up a little bit with the structured water because I'm so kind of fascinated with that concept. My understanding of one of the primary mechanisms that structured water is created is through the introduction of additional energy sources like light and infrared [crosstalk 00:30:44]. So if you've shined the infrared light, which you're getting plenty of in Hawaii, by the way.

Stephanie Seneff:

I know. I love infrared.

Dr. Mercola:

You suck it up with your body so that infrared goes in, penetrates your body. I guess hits the structured water, and because of that, energy is just translated into the [crosstalk 00:31:06] and that powers the ability of the structured water to release the proton?

Stephanie Seneff:

Exactly right. It actually in a paper that I read that Gerald Pollack published a paper together with co-authors that said that experimentally that when you expose – they build these sort of artificial structured water things with this molecule that they had that they work with. And when you shine infrared light on it, the structured water space expands by a factor of four.

Dr. Mercola:

Wow.

Stephanie Seneff:

So you're making a much stronger battery. You're turning that light energy into useful battery energy for the cell. And mobilizing those protons and then those protons are going to be pushed into the mitochondrial. And by the way, I think in the mitochondrial intermembrane space and also into the lysosomes. So the lysosomes are another very susceptible organelle inside the cells where things are broken down. And both the mitochondria and the lysosomes get sick in many, many diseases.

Dr. Mercola:

The mechanism is the same in the lysosomes? They also have mitochondria which benefit from protons?

Stephanie Seneff:

They are. Lysosomes are individual organelles that are highly acidic. They make themselves very, very acidic, lots and lots of protons inside in order to be able to breakdown [crosstalk 00:32:30]-

Dr. Mercola:

No mitochondria [inaudible 00:32:31]?

Stephanie Seneff:

Hmm?

Dr. Mercola:

They don't have mitochondria.

Stephanie Seneff:

They don't have mitochondria, no. They're independent of the mitochondria. There are other organelles inside the cell. The lysosomes, that's the cell's digestive system.

Dr. Mercola:

Yeah, yeah.

Stephanie Seneff:

So they bring in stuff; damaged molecules, for example, oxidized glycated proteins and whatnot. And they break them down into individual smaller units, and then they can use them as – they're basically turning into food.

Dr. Mercola:

They suck up the protons to assist in this process.

Stephanie Seneff:

Yeah, they have to make themselves extremely acidic. They're the most acidic organelles inside the – by far, actually, inside the cell. They have to be very acidic in order to be able to do it, and they also sweep up heparan sulfate inside the lysosomes. I mean, that also helps them with the digestion. It works with iron to help to break down. Heparan sulfate is what maintains the structured water. It's also important for the lysosomes.

Dr. Mercola:

I thought it was connected with the structured water of the [inaudible 00:33:29].

Stephanie Seneff:

Yes. It's really what's crucial for the structured water.

Dr. Mercola:

This is fascinating. I never realized the mechanism of how the structured water transferred the energy into the body. But it makes perfect sense now. So there are two routes, the lysosomes and the mitochondria.

Stephanie Seneff:

Yes. So they both need those protons, and they get them I think through the – and that's also fascinating because the water along the cytoskeletal wires is fluid water. That's because the cytoskeleton is made up of this F-actin. F-actin filaments, and those filaments are unusual proteins that actually destructure the water around them. Most proteins make the water around them structured water. Many proteins do. But F-actin is very special able to make it fluid water around the F-actin fibers, and eNOS makes nitric oxide, right? Very famous for that.

Dr. Mercola:

There are many types of nitric oxide synthesized, but eNOS is the good one. There's iNOS and eNOS.

Stephanie Seneff:

Right, right, right. Yeah, iNOS is the inducible one that can [crosstalk 00:34:31]-

Dr. Mercola:

Yeah, that's a bad guy.

Stephanie Seneff:

-play a role in inflammation. But eNOS makes nitric oxide, but people don't realize that for every molecule of nitric oxide that it makes, it makes two molecules of water. And those molecules of water are deuterium-depleted. And it hooks onto the cytoskeletal wires to make that water. So what eNOS, nitric oxide may just be a signal. “Hey, I've made some deuterium-depleted water for you.” You think of some of these, and you get into the lipids and all the different nasty lipids that cause inflammatory response. You know about those, I'm sure. The leukotrienes and the

thrombox, all these nasty lipids that are oxidation products of arachidonic acid, for example. Those guys are signaling molecules too, but those-

Dr. Mercola:

That's a metabolized linoleic acid. That's one of my new [crosstalk 00:35:18]

Stephanie Seneff:

Right. No, that's right. Linoleic goes to arachidonic acid then goes to these leukotreines that can cause all kinds of trouble with respect to inducing inflammation. And that is also a technique to produce deuterium-depleted water. When you look at all of these things from the standpoint of deuterium, you basically say, "Oh my god. This is so interesting," because it explains all these things that go on. We understand that inflammation is associated with all these diseases. Huge list of diseases that are associated with inflammation, and we're trying to find drugs that are going to reduce the inflammation. You're always looking for something that can tame the inflammation. The inflammation is there for a good reason, and the reason is to produce deuterium-depleted water, and it's so fascinating. So it's all because the mitochondria are failing in their task of producing their own deuterium-depleted water, which they get in part through the structured water from the sulfates. But maybe in large part through a whole bunch of enzymes that are highly skilled of choosing hydrogen over deuterium in their product.

Stephanie Seneff:

So there are all these enzymes that are – many of them are in the mitochondria that produce deuterium-depleted water as a product or that produce something that carries a deuterium-depleted proton. A proton that's very unlikely to be deuterium. It's all related to NADH, NADPH, FAD, FMN, all these [crosstalk 00:36:42]-

Dr. Mercola:

Let's stop there because I'm confused. My understanding of the production of deuterium-depleted water and mitochondria relates to just the normal metabolism in the-

Stephanie Seneff:

Citric acid.

Dr. Mercola:

Krebs citric acid cycle but there's oxidative phosphorylation. So when the transfer of the electrons through the different complexes, the five complexes. And it's a normal metabolism, part of that is to ultimately release this water, but the water's pure. Deuterium-depleted. There's no-

Stephanie Seneff:

Yes, and the question is why is it deuterium-depleted, and that's because there are many, many enzymes that are very, very good at making sure that it's not deuterium. That it's protons and not deuterons.

Dr. Mercola:

Those are the details. That's like FAD [crosstalk 00:37:26]-

Stephanie Seneff:

Right. And NADH. NADH and NADPH are so fascinating. I've been chasing them through all the proteins. They are so, so interesting because those guys are the carriers of that wonderful hydrogen that's not deuterium. NADH and NHDP and they're constantly moving back with H, not H in all these different reactions. When you trace who's doing what where, you realize that the cytoplasm is producing NADH and handing it over to the mitochondria, and then the mitochondria are taking that H off and throwing it into the intermembrane space. So the whole process ends up with the intermembrane space being assured that this is H and not D, which is crucial because then those protons, once they build up, they come back through those ATPase pumps. And if their deuterons are going to wreck the pump, and that's the whole thing that Laszlo taught me. The pump hates the deuterons. They destroy the pump, and of course then you can't make ATP. You release reactive oxygen species and then break it. So it's-

Dr. Mercola:

Let's take a little big step there just to amplify what you're saying. So the pump is cytochrome-5, ATP synthase, which is like a mini-motor. It's a mechanical motor actually.

Stephanie Seneff:

Yeah, it's so cool, isn't it? It's so interesting.

Dr. Mercola:

If the hydrogen atom comes through, not deuterium, but the hydrogen atom with one neutron comes through, it works flawlessly and generates the ATP. Spits out one ATP, but if you got a deuterium atom with two neutrons, twice as big, it destroys that mini-motor.

Stephanie Seneff:

Yeah. It's actually one neutron and one proton in the deuterium.

Dr. Mercola:

Oh, I'm sorry.

Stephanie Seneff:

One proton in the hydrogen.

Dr. Mercola:

Okay, I got-

Stephanie Seneff:

You're close. You're close. It's twice the weight because they both weigh the same amount. Yeah, but the extra neutron is what makes it all the difference for the deuterium. And deuterium

is amazing because it's natural. It's all over the place. You can't avoid it. And the body I think has learned how to use it because the body traps the deuterium in the structured water and even I think the deuterium supports the structured water, makes it easier to make structured water. So it's beneficial there. But if you can't make enough structured water, then the deuterium gets loose into every place else, and you can't maintain that low deuterium that you need in a mitochondria to get them to work properly. So you get mitochondrial dysfunction, and then you get all these different diseases.

Dr. Mercola:

So walk us through again the process of how the structured water actually stores the deuterium. Still a little confusing.

Stephanie Seneff:

Yeah. Well, it's really very simple because deuterium binds more strongly than hydrogen and it's heavier. So it's less mobile. If you think of a heavy, stuck atom versus a more lighter and more- [crosstalk 00:40:04]-

Dr. Mercola:

The bond-

Stephanie Seneff:

-more easily to break through. So when you're losing one, you have to lose one to make the structure work in the structured water. So you might as well lose a proton rather than a deuteron because it's harder to lose a deuteron. So on average, it doesn't 100%, but on average it's going to kick out a lot more protons.

Dr. Mercola:

It has a greater affinity for deuterium in the structured water.

Stephanie Seneff:

Exactly. Yes. And same thing is true for hydrogen gas, by the way. I know you like this hydrogen gas idea of getting-

Dr. Mercola:

Like is a serious understatement.

Stephanie Seneff:

Oh, you love it, right?

Dr. Mercola:

It's my favorite.

Stephanie Seneff:

Excellent. I would tend to agree with you because it's so simple and it's not expensive, right?

Dr. Mercola:

No. As some supplements – as therapies go, it's relatively inexpensive, yes. I mean, there's a cost to it. But the benefits, I think, it's my absolutely favorite supplement. But once the structured water is storing the deuterium, what does it do with it? It's toxic to the body. It's a poison.

Stephanie Seneff:

It's sequestering it there so that it doesn't get into the fluid water [crosstalk 00:41:04]-

Dr. Mercola:

How does it release it? How does it excrete it into the environment, back to the environment?

Stephanie Seneff:

Well, I do think that there's the ability of the salivary glands to favor deuterium over protons. So the salivary glands will secrete, preferentially secrete deuterium and possibly the urine, although I can't get enough data. There's not much data on the levels of deuterium, as far as I can tell. I've been digging, and I haven't found much on how much deuterium typically is – I know breast milk has low deuterium, relative to the blood, and the blood has low deuterium relative to the saliva. I believe that's true.

Stephanie Seneff:

So you see there's a pushing of the deuterium out into the saliva, and then an attempt to keep the deuterium out of the breast milk to make the breast milk have low deuterium.

Dr. Mercola:

You got the deuterium in the saliva. The assumption is you swallow the saliva, and then you excrete the deuterium in your stool.

Stephanie Seneff:

Yeah. The bacteria accumulate in these biofilms that are very resistant to antibiotic treatments because they're hiding behind that shield. But I think they're trapping deuterium in that biofilm. So they're helping to deplete deuterium in the host environment.

Dr. Mercola:

So now that we've got the background to sort of have a conceptual understanding what's going on with the deuterium in the normal physiology, how does glyphosate enter this piece of this part of the equation?

Stephanie Seneff:

Yeah. Well, that's why it's so fascinating. So I had already been aware that I had deuterium in the glyphosate likely really messes up the flavoproteins. The flavoproteins are a large class of really important proteins that bind flavins. And flavins are FAD, FMN. So flavin adenine dinucleotide

and flavin mononucleotide, FMN and FAD. Those are really useful molecules that have a very fascinating biophysical skill of basically facilitating the transfer of protons and electrons from-

Dr. Mercola:

Excuse me for a second. Flavin, isn't that a B vitamin? Is it B1, B2?

Stephanie Seneff:

Yes. It is. It comes from riboflavin.

Dr. Mercola:

So B2.

Stephanie Seneff:

Yeah.

Dr. Mercola:

And nicotinamide would be B3. So they're-

Stephanie Seneff:

That's NAD. They are both B vitamins, and they are also products of the shikimate pathway. So there's a place where you're going to get deficiencies.

Dr. Mercola:

Wait, wait. How is this shikimate? I thought the shikimate pathway produced the aromatic amino acids?

Stephanie Seneff:

It does. But then when you look at mor.e detail of how these other things are produced, you find out that they come from things like chorismate, which is also something that's internal to that pathway. So the B vitamins are products of the shikimate pathway. NAD can actually be produced from tryptophan. Tryptophan is one of those aromatic amino acids. In fact, the liver makes NAD from tryptophan.

Dr. Mercola:

I've done deep dives on NAD and it certainly can. That is endogenous production pathway, but it's roughly a small amount. For every milligram of NAD you produce, you need 70 milligrams of tryptophan. That's a pretty poor ratio.

Stephanie Seneff:

Is that right? Wow. I didn't know that. [crosstalk 00:44:15]

Dr. Mercola:

It's a very tiny amount. It's roughly insignificant. It's almost all of it is in the salvage pathway with NAMPT, which is a rate-limiting enzyme. So yeah, you need it. If you're tryptophan deficient, it's going to cause a problem. I think it's an important contribution, but it's relatively minor. I'm kind of passing about optimizing NAD levels. It's really an essential part of the equation to improve longevity.

Stephanie Seneff:

Right. What the other thing is not just NAD levels but the ratio of H to the not-H. Because the NADPH wants to be – you want to have a lot of NADPH and not so much NAD.

Dr. Mercola:

This is just as important as NAD.

Stephanie Seneff:

They're both very important. But they have a different balance in the body. Like the NAD has much more of the NAD+ and the NADP has a lot more of the NADPH. So the ratios matter. The ratio of the pH to the P+ and the ratio of the H to the H+ to the plus. You know what I'm saying, right?

Dr. Mercola:

Yeah, yeah, yeah.

Stephanie Seneff:

And the enzymes that produce NADPH from NADP+ are disrupted by glyphosate, and that's been shown in studies, and it makes sense because they bind to flavins. A critical one is succinate dehydrogenase, and there's several papers that have shown that succinate dehydrogenase is affected by glyphosate. And succinate dehydrogenase actually, it has hydrogens from succinate and puts them into the membrane in coenzyme Q10.

Dr. Mercola:

That enzyme succinate dehydrogenase is in the Krebs cycle?

Stephanie Seneff:

Exactly. It's critical in the Krebs cycle because it actually is also connected to the electron transport chain. It does both. The citric acid cycle and it's the only enzyme I think that plays both roles by stuffing those protons into the intermembrane space attached to coenzyme Q10, ubiquinol.

Dr. Mercola:

Mm-hmm (affirmative).

Stephanie Seneff:

Of course, ubiquinol's another one people taking a lot of supplements, and that's the one that we're concerned about. It gets supplied with deuterium-depleted hydrogen from succinate

dehydrogenase. And then glucose 6-phosphate dehydrogenase is another one that's been shown to be inhibited by glyphosate, binds NAD. So it's these proteins that bind NAD at the class. NADP, NAD, those things all have phosphates in them. And it's the phosphate binding that's key because that's EPSP synthase has phosphate binding as well.

Dr. Mercola:

Isn't G6PD the enzyme that breaks down glucose to pyruvate, two molecules to pyruvate?

Stephanie Seneff:

No, I don't think so. Glucose-6, it's glucose phosphate that it starts with. Glucose-6 phosphate dehydrogenase. So it pulls hydrogens out of glucose-6 phosphate. It turns NADP+ into NADPH. It's active in the red blood cells, and it's essential for restoring glutathione to its reduced state because glutathione takes those Hs off of NADPH to bring back oxidized glutathione to reduce glutathione, which is of course the antioxidant form. So when you can't make enough NADPH, glutathione becomes oxidized, and you don't have good antioxidant defenses in the liver. That makes sense, right?

Dr. Mercola:

Oh, absolutely. There are G6PD-deficient people because of a genetic defect, which are just horrible challenges. In my mind, it's almost as severe as Type-1 diabetes.

Stephanie Seneff:

It's the most common mutation. G6PD has more different SNPs than any other protein in the body. It's very commonly mutated. That's interesting too because I think it's under stress. I kind of feel like enzymes under stress undergo more rapid evolution. The body's trying to find a solution that's going to work in the context of these poisons and it makes a lot of mistakes. I mean, evolution is like that. Try this, try that, and lots of things don't work.

Dr. Mercola:

That's the largest pathway to produce NADPH, right?

Stephanie Seneff:

I think so. I think that's the dominate one, and it also depletes deuterium. So all these enzymes that are producing [crosstalk 00:48:16]-

Dr. Mercola:

What pathway depletes deuterium?

Stephanie Seneff:

Well, also the tricky thing is, and this is biophysics, and it's so cool because it's something called proton tunneling. Have you heard of proton tunneling?

Dr. Mercola:

I've heard of it. But I'm a little bit confused on [inaudible 00:48:30].

Stephanie Seneff:

It's really just so fascinating, and the FAD, the flavins play a critical role in that. And I think all these flavonoids and terpenoids and polyphenols that are so healthy, I think they also help to facilitate proton tunneling, which is the trick that the enzymes use to make sure that it's not deuterium. It's just really, really cool. It basically involves water wires. The protein has a hydrophobic hole inside it that allows just a few water molecules, like maybe 12, and then the water molecules line up on a line, and they're hooking two pieces of protein together. And then the protein facilitates the release of a hydrogen on one end, and then the water molecules are all holding two hydrogens because it's an oxygen holding – pictur0e somebody holding two footballs and a whole line of people holding two footballs. And then on the left end, another football is handed into this system. So I'm holding two [crosstalk 00:49:25]-

Dr. Mercola:

[inaudible 00:49:26].

Stephanie Seneff:

I get one here. I hand my other one off. All down the line. They hand off one of their footballs. So the one that arrives at the other side is not the same as the one that came in. Totally different one. But eventually the hydrogen gets to the other side, and if I've got a heavy one and a light one, I send off the light one. If there's any deuterium in there, it doesn't make it to the end of the line. So you end up with a very pure proton assurance in the product, and if the product's water, you've got deuterium-depleted water.

Dr. Mercola:

Well, that's a very elegant description. Thank you for sharing that.

Stephanie Seneff:

That's so cool. I was really blown away by that, and I think that's crucial also in the cytoskeleton. I'm theorizing that that's what goes on inside a skeleton when you push those protons in to the cell, they travel through that football process.

Dr. Mercola:

So this production of deuterium-depleted water in the G6PD pathway or the pentose phosphate pathway is – how does it store the deuterium-depleted water? Does it shuttle it somewhere, or what happens?

Stephanie Seneff:

So the G6PD actually produces NADPH.

Dr. Mercola:

Okay.

Stephanie Seneff:

[inaudible 00:50:27]. It's H.

Dr. Mercola:

H then gets shuttled into the mitochondria.

Stephanie Seneff:

Eventually, the H – you have to follow the Hs everywhere. It's so cool. For example, I just learned this. I was quite amazed. I found a paper just this morning. So this is brand new stuff. About these enzymes that desaturate. So there are enzymes that turn PUFA, polyunsaturated fatty acids, into WUFA – let's see, what is it called? HUFA, highly unsaturated fatty acids. PUFA into HUFA. These enzymes are amazing because they actually end up taking an H off of NADH, and then they take two Hs off of the fatty acid and two Hs off of NADH to make deuterium-depleted water out of oxygen. So it takes two oxygen atoms, an oxygen molecule, breaks it apart. Gives each of those oxygens two hydrogens, and two of them come from the fatty acid and two of them come from the NADH.

Stephanie Seneff:

All of them are deuterium depleted already and then the proton probably – the enzyme probably further makes sure that there's no deuterium. So at the time you're done, you've got a beautiful water molecule that is another product that is ignored. So they just say, "Oh yeah, it produces- They don't even know. Oh yeah, it produces water." I mean, that's just like that's nothing. You don't pay attention to the water. You need to pay attention to the water that's being produced in these enzymes. That's what I'm realizing. The water is the important product.

Dr. Mercola:

Yeah because you could make a deuterium water out of that if you had a deuterium isotope.

Stephanie Seneff:

Right. You could force it. But you know what happens is that it doesn't work. In fact, lipoxygenase is the one I'm really fascinated with because that is by far the highest ratio. They talk about a KIE, kinetic deuterium KIE. Kinetic something effect. Kinetic isotope effect. Kinetic isotope effect, KEI. So if something has a high KEI for deuterium that means that it very much favors protons over deuterons in its product.

Dr. Mercola:

Oh, very good.

Stephanie Seneff:

So you can look at the enzymes and find out which ones have high ratios, and it turns out that lipoxygenase has by far the highest ability to select protons over deuterons of any protein I've ever found.

Dr. Mercola:

Where is this enzyme found primarily? Is this a [inaudible 00:52:51].

Stephanie Seneff:

Lipoxygenase is upregulated. It's expressed under conditions of stress. It's highly upregulated in COVID-19 infection when people have a bad case of COVID-19. The virus actually triggers increase in the production of lipoxygenase because the virus captures linoleic acid in the pockets in its membrane. The virus has these holes that perfectly fit linoleic acid. So as it comes through the membrane, it picks up linoleic acid molecules, and then those molecules [crosstalk 00:53:21]-

Dr. Mercola:

SARS-CoV-2 virus picks it up.

Stephanie Seneff:

Yeah. SARS-CoV-2. And then the linoleic acid triggers this – with the inflammation that the virus induces, it triggers the release, the production of lipoxygenase which then modifies that linoleic acid into these leukotrienes that then have all kinds of signaling effects to bring in the macrophages and cause all the trouble. That whole cascade starts with lipoxygenase producing leukotrienes from linoleic acid.

Dr. Mercola:

Yes, indeed. So that's [crosstalk 00:53:55]-

Stephanie Seneff:

But it's also producing water. It's producing deuterium-depleted water. That's the cool thing about it.

Dr. Mercola:

Yeah, yeah, yeah. Ideally, yeah. Wow. That's pretty fascinating. Now where is this lipoxygenase? Is it intercellular?

Stephanie Seneff:

Yeah. I'm not sure actually, and I would like to know. [crosstalk 00:54:17] It may be in the ER.

Dr. Mercola:

Okay.

Stephanie Seneff:

Endoplasmic reticulum. But I have to go check actually. I don't know. I think all of these organelles are deuterium-depleted. So in other words, in the cell, the cytoplasm actually has structured water and has deuterium, and then you have these organelles, the mitochondria, the liposomes, the endoplasmic reticulum, those are the main ones. And then I guess there's the one that – I forgot the name. Anyway, all these organelles, the one that processes the fats. Peroxisome. Peroxisome? Yeah. Peroxisome, endoplasmic reticulum, mitochondria and this is giving me a quiz here. The endoplasmic reticulum and the liposomes. All of them I suspect have deuterium-depleted water, all of them. And they're constantly trying to make sure that they have low deuterium, and they do that with all these enzymes. It's so amazing.

Stephanie Seneff:

And I can take all these different classes of molecules that are really important in health, like the whole sterol classes of cholesterol, the vitamin D, and all the hormones, the sex hormones, all of those guys. That's one class. There's the class that comes out of the aromatic amino acids, which is all the neurotransmitters, dopamine and serotonin, melatonin, the skin-tanning agent. Those are all out of the aromatic class. The fatty acids, the whole synthesis of fatty acids I think involves deuterium depletion. So all of these molecules that go through all of these complicated steps are all focused on delivering deuterium-depleted water to the mitochondria. I mean, it's an absolutely obsession that the cell has. It's really central to metabolism.

Dr. Mercola:

I'm pretty sure the creation of the fatty acids requires NADPH. It might be [crosstalk 00:56:02]-

Stephanie Seneff:

You're right. You're right. NADPH, but the thing is [crosstalk 00:56:04]-

Dr. Mercola:

One of the biggest consumers of NADPH is-

Stephanie Seneff:

It is. It absolutely is. Yes. That's exactly right, but the NADH is involved in the specific enzymes that turn PUFA into HUFA. These are already highly unsaturated fats, and the ones that even further desaturate them. Those guys use NADH, but most of involvement of making fatty acids involves NADPH, you're right. And that H in both cases is deuterium depleted. The NADs are carrying around deuterium-depleted hydrogens and passing them all around. Ultimately delivering them to [crosstalk 00:56:39]-

Dr. Mercola:

Well, that is fascinating. So you've unraveled the primary mechanism, which is you've got to follow these intermediates, like NADPH, NAD and water to figure out where these deuterium, non-deuterium hydrogen atoms are floating around. So that's the key and focus on it.

Stephanie Seneff:

That's the game, and it's of course I like puzzles, and it's a really fun puzzle. It's overwhelming to try to remember all the different enzymes and also where they're located, and you can see how in many cases enzymes that are located in the cytoplasm are generating a deuterium-depleted proton that can then be passed into the mitochondria, and then even you have to pass the substrate into the mitochondria too. It's kind of a real pain. The body goes through contortions, and it's puzzling. Why do you have to do this in the mitochondria? Well, that's because this is delivering the mitochondria the water. The deuterium-depleted water. So the things that are making the water are in the mitochondria, and they're making deuterium-depleted water, which is what they need.

Stephanie Seneff:

I mean, some of them are outside, like in the ER, because the ER wants deuterium depleted water too. And you can actually eventually transport it to the mitochondria.

Dr. Mercola:

Yeah, and the ER is not the emergency room. That's the endoplasmic reticulum.

Stephanie Seneff:

Right. Good point.

Dr. Mercola:

[inaudible 00:57:53].

Stephanie Seneff:

A lot of stuff. I mean, the science is really, really complicated, and it's hard to keep track. And I'm still playing around with it. I still discover new things every day. I mean, I'm so enthralled by it all because it's-

Dr. Mercola:

It's a great journey because I'm a firm believer – I love molecular biology. The understanding of molecular biology on a deep level that allows you to figure out these really important features of biology that contribute to health and disease. If you don't understand molecular biology, you get confused real easily. So it's so [inaudible 00:58:27]. I'm so grateful for applying your expertise to this and helping tease us some of the details. It's really important.

Stephanie Seneff:

Yeah, and what I would say too is that Big Pharma seems to be – they're hung up because they sort of see, "Oh, this is bad. Inflammation is just causing damage. We need to find a drug that's going to suppress this." In fact, they offer – there was a paper that talked about using as a nutrient supplement fatty acids that had been intentionally populated with deuterium. [crosstalk 00:58:54]. Isn't that great?

Dr. Mercola:

Let's poison you. Let's poison you to death.

Stephanie Seneff:

Yeah, and the logic was because this lipoxygenase won't work on deuterium.

Dr. Mercola:

Oh geez.

Stephanie Seneff:

So we'll prevent lipoxygenase from happening by just loading up deuterium in the membrane and then good luck with that.

Dr. Mercola:

That's [inaudible 00:59:11] of basically solving the problem but killing the patient.

Stephanie Seneff:

Yeah. I think they look at everything all wrong because I always believe that whatever biology's doing, it's doing it for a good reason. I really believe in biology being smart. There may be damage, but there's a good reason why you need that damage in order to survive long-term. It's trying to fix a problem that's very serious, and that's what I think is happening with the virus, which is so fascinating because not only does it, as I told you, the virus induces this lipoxygenase, which produces this deuterium depleted water and then it creates this inflammatory environment, which brings in the platelets and the macrophages, the immune cells, and the stem cells coming out. And all these guys are having a big party in there in all this fluid that's building up inside the lungs.

Stephanie Seneff:

Then meanwhile, it also increases the production of hyaluronic acid. Hyaluronic acid is able to trap deuterium-depleted water. It makes structured water. So you get structured water inside the alveoli of the lungs, and then you get fluid water in the interstitial spaces. Everything's coming out of the – the blood vessels are leaky, the capillaries are leaky. So everything's coming to of the capillaries into this interstitial space where there's this fluid water, and you've got this lipoxygenase making fluid water that's deuterium-depleted. So you're producing this environment of deuterium-depleted water, inviting the macrophages to come in, and the platelets release their mitochondria, but each platelet has like five to eight mitochondria. There are a lot of platelets. There's trillions of platelets. So there are tons of mitochondria.

Stephanie Seneff:

The platelets become activated, release their mitochondria, and the stem cells also come in and release their mitochondria, and then macrophages sweep them up.

Dr. Mercola:

Do they release them into the blood stream?

Stephanie Seneff:

No, into the interstitial space in the lungs where the fluid is there and you can't breathe. You're drowning.

Dr. Mercola:

That's odd because you normally don't think of mitochondria being extracellular.

Stephanie Seneff:

No, you don't. But that's what's super, super fascinating. I've only learned this recently. So the platelets, each platelet has a handful of mitochondria, and I think that may be one of the most important things platelets do is hang on to mitochondria that they can deliver to the macrophages under conditions of stress. So what happens is all these mitochondria get released in that

interstitial space, and the macrophages induce this macropinocytosis, it's called, where they actually sweep up the water and everything that's in it and bring it inside the macrophage, including the mitochondria. So it's actually been shown that platelets can release mitochondria into the environment, and macrophages can take them up and use them as perfectly functioning mitochondria. It's astonishing.

Dr. Mercola:

Amazing.

Stephanie Seneff:

So what they're doing is restoring the mitochondrial health to the immune cells. Immune cells are shot to hell because glyphosate's been ruining them for a long time. I mean, if you're an old person, you've been exposed to glyphosate for decades. So the older you are, the more exposure you have on average, and the people who have all these comorbidities, like obesity and diabetes and high blood pressure, increased risk, those are symptoms of glyphosate poisoning. So I think it's mostly about glyphosate. I think if you've accumulated a lot of glyphosate in your tissues, you're not going to do well with COVID-19, and that's because the virus is trying to repair the mitochondria in the immune cells so that the immune cells can actually clear the virus because the immune cells are helpless. If they can't make ATP, they can't do their job. And the virus flourishes.

Dr. Mercola:

I don't know if this is going to be very beneficial to continue to elaborate on the mechanism much more because I think you've done a fairly phenomenal job. But I would like to summarize this stuff because it probably confused a lot of people. But if I can just summarize this saying it's just intellectually satisfying to understand what's going on in the molecular biological level, which is why we're engaged in this discussion. But the truth and the reality is it's just another confirmation of the importance of making sure you are not exposed to glyphosate because yet this is another newly appreciated mechanism of how avoiding glyphosate will benefit your health. I think that's the take-home summary. You just got to avoid glyphosate.

Dr. Mercola:

Yeah, yeah. So it's just so crucial. I thank you for bearing the banner, and I've certainly been a long-time advocate of avoiding it. But it sometimes gets lost, especially now with the pandemic and the focus on everything else. We look at nutrients, and we kind of forget about the basics, which is glyphosate. You simply cannot have non-organic food if you ever hope to be healthy. I mean, the smallest amount is going to be a problem. So that's my overall view. But I certainly want to have you summarize it and give us your specific recommendations.

Stephanie Seneff:

Right, absolutely organic food. I mean, we won't buy it if we can't find a certified organic, any product that we shop at the grocery store. We always buy certified organic, and we've seen really in health improvements because of it since we've started doing that. I really swear by it, and I try to get all my friends to do the same. I think we can really push the market too because if people don't buy the food, they won't make it. The toxic food. They can't [crosstalk 01:04:23]-

Dr. Mercola:

As far as I understand, hasn't there been an increase in the purchase of organic foods?

Stephanie Seneff:

Increase in the purchase of organic foods has gone up exactly in step with the increase in autism. Those guys like to make fun of that because of course organic food is still a very small percentage of the population, and organic is going up because people are aware that it's making them sick. And one of the things that's making them get is autism. So they say that shows that organic food causes autism. So laughable.

Dr. Mercola:

Classic mistake of causation is not-

Stephanie Seneff:

Yeah, they're trying to show that causation is in correlation – no relation to [inaudible 01:05:01]. But glyphosate is correlated with these diseases with incredible correlation coefficients with incredibly few values that are several zeros before the first significant digit-

Dr. Mercola:

Wow. [crosstalk 01:05:11]

Stephanie Seneff:

-significant correlations. I don't see anything else like that. Nothing else. That's really a big reason why I think glyphosate is the cause, the primary cause. Obviously other chemicals are not good, and there's plenty of them. And you have to worry about those too. But I think if you can eliminate glyphosate, you can really see a great improvements in your health no matter what your problems are. And I just think that's so number one. I also like to promote sulfur-containing foods and certified organic eggs, for example. Eggs are really healthy. Seafood.

Dr. Mercola:

[inaudible 01:05:43] eggs. I've actually have 19 chickens now.

Stephanie Seneff:

I know. That's so fun with your chickens.

Dr. Mercola:

I'm doing experiments. No, I have 18 chickens. But I've been experimenting. Most all chickens are given grains. Grains are wholly with linoleic acid, depending which grain it is but typically like 50%. So their eggs can have high linoleic acid because that's the primary fat that they're consuming. Basically my chickens are on a linoleic acid-free diet. I mean, not free, but pretty low linoleic acid diet. I put them on a stick of butter a day.

Stephanie Seneff:

I know. I think that's so great. I read about that in one of your articles. I was so amused, and I met your chickens too. I met them because I was at your house.

Dr. Mercola:

Oh yeah, you did. My coop has grown now. [crosstalk 01:06:30]-

Stephanie Seneff:

That's so great.

Dr. Mercola:

I'm raising a dozen from they were 2 days old. So that's pretty good to see them go through the whole transition.

Stephanie Seneff:

That's really fun. You're going to do your own scientific experiment.

Dr. Mercola:

Yeah. We're going to actually do an assay to find out what the linoleic acid [inaudible 01:06:44].

Stephanie Seneff:

I'm really looking forward to seeing how that works.

Dr. Mercola:

[inaudible 01:06:47] two months away from getting the results because it takes a while to clean it out of their system. We've got [crosstalk 01:06:51]-

Stephanie Seneff:

Yeah.

Dr. Mercola:

Low LA diet for three or four months.

Stephanie Seneff:

So butter, of course, is a very good food not only because of that but also because it's low deuterium. That's another thing you can look into with respect to [crosstalk 01:07:02]-

Dr. Mercola:

Yeah, I didn't realize that.

Stephanie Seneff:

Butter is one of the lowest deuterium foods that you can find.

Dr. Mercola:

Is that right?

Stephanie Seneff:

Mm-hmm (affirmative).

Dr. Mercola:

Do you know the reason for that?

Stephanie Seneff:

Well, I imagine it's coming from milk, and milk is low deuterium because the human actually produces breast milk that's low deuterium. So it's probably something similar there with the cow. Yeah. It's healthy for the infant, the calf.

Dr. Mercola:

So that is interesting because that's yet another mechanism where a relatively high-fat diet, healthy fat diet – obviously you don't want a lot of vegetable oil fat diet – could be healthy because as opposed to a plant-based diet, which a lot of plants are pretty high in deuterium. I mean, that's one of the things. Hardly anyone talks about that, and literally we could talk for another two to three hours of going in deep about deuterium. We just gave you a taste of this, at least in this one shadow because there's a lot of information about deuterium. I dove deep into that about a year, maybe 18 months ago, but I kind of got disenchanted for reasons I won't discuss.

Dr. Mercola:

There's still something there. I'm just not sure how significant it is. But-

Stephanie Seneff:

I don't think it's necessarily low deuterium. I think low deuterium is good actually because people who [crosstalk 01:08:19]-

Dr. Mercola:

Yeah, of course. I mean, you're not going to argue-

Stephanie Seneff:

-glacier water. You look at the Iceland, places where people live a long time and are healthy, they get glacier water. That glacier water is naturally low in deuterium. And people market that too, and I think that's interesting. Glacier water and then animal fats, those are sort of the two best sources for low deuterium.

Dr. Mercola:

It's related to the latitude. So the higher the latitude, the closer to the [inaudible 01:08:44] you are, and the higher the elevation, the lower the deuterium. Those are the two that are connected with it.

Stephanie Seneff:

Yeah, that's interesting, isn't it? It has something to do with evaporation I think.

Dr. Mercola:

Yeah, yeah.

Stephanie Seneff:

Because evaporation depletes the protons. That's another thing with the hydrogen. You mentioned hydrogen gas, and I wanted to say that because hydrogen gas has very low deuterium because it's leaving the liquid phase. And deuterium being heavier and better able to form bonds doesn't want to leave. So when you make hydrogen gas, it's very low. In fact, there's a paper that showed bacterial production of hydrogen gas enzyme that produced it, and they measured the deuterium level in the hydrogen gas. And it was only 20 parts per million instead of the usual 155 parts per million. Incredibly depleted in deuterium. So I suspect that that's a major benefit of hydrogen gas is the fact that it's deuterium-depleted.

Dr. Mercola:

Wow. That's another benefit too. Yeah.

Stephanie Seneff:

It's interesting how you look at these things in a different way.

Dr. Mercola:

I tried to hook up Tyler LeBaron to Laszlo Boros, and boy that was just a nightmare on steroids. It just degenerated quickly. He had no respect for Tyler. He just didn't respect his understanding, his science, his knowledge base, and it just degenerated real quickly, which is sad.

Stephanie Seneff:

Yeah, Laszlo is very firm in his opinions and very stubborn. He's not receptive I think too.

Dr. Mercola:

Science doesn't evolve that way. You need to be open-minded. Of all the researchers I personally know, you really are at the top, man. You're just so open-minded and receptive, and you're not stayed in your ways. You're open to new ideas. You embrace them actually. So that's the ultimate scientist, which is unfortunately a rare commodity. Most of them are just-

Stephanie Seneff:

I know.

Dr. Mercola:

Basically continuing to perpetuate what they learned, and they don't have a microgram of innovation in their brain cells.

Stephanie Seneff:

I know, Jimmy. It's actually frustrating how straitjacketed people are in the mainstream. And they do research on what gets funded and what gets funded is broken. It's so broken in terms of what [Big] Pharma wants.

Dr. Mercola:

Yeah.

Stephanie Seneff:

So it's kind of sad.

Dr. Mercola:

We see that in this part of the storage of glyphosate too. Monsanto, as we've discussed in many interviews in the past, has really cleverly funded most agricultural science departments at most of the major universities. And if you even dare to publish or investigate something that counters their narrative, you are defunded and maybe discredited. So any researcher who seeks to publish stuff on this is just essentially ostracized from the research committee. They have to quit. They cannot engage in the profession they trained in. They have to find a new job.

Stephanie Seneff:

Yes, and that's very intimidating. I think most people are just not sufficiently strong to be willing to go against that to take on that task, and they would rather just let everybody get sick, which is what I find so frustrating. I can't stand the fact that we've got such a high rate of autism in this country, and we need to fix it fast. If we don't, we're going to have a whole bunch of adult autistic people very soon with no place to go.

Dr. Mercola:

I don't think there's a way to avoid it. I think the path is already set. There's already so many. What are the current numbers as you understand them? Last I heard was somewhere between 1 in 30 and 1 in 40 of the children being born now have autism.

Stephanie Seneff:

Yeah, I think that's right. I think it may even be higher than that with the ones being born. There's 1 in 54 was a report on 12-year-olds. But when you project it back to 1 [year-olds], it's going to be a lot higher. So it's really frightening. I just don't understand why that's not a total panic for the government. The government should be really obsessing on how do we fix this, and they don't seem to care at all. It just infuriates me.

Dr. Mercola:

I started seeing patients in 1985, and it was 1 in 10,000. I did not see an autistic patient for almost 10 years. I mean, you read about it in textbooks, but you never saw one personally. And then my office was inundated with them.

Stephanie Seneff:

Mm-hmm (affirmative).

Dr. Mercola:

I started seeing them from all over the country, and it was just so sad. It's just gotten much worse because I stopped seeing patients pretty much this century. I mean, I was seeing a few in the beginning of the century but mostly it was the last century I saw most of the people.

Stephanie Seneff:

They came out with this new number 1 in 54, which was another increase over 1 in 59, which it was the previous time. They came out with that number last April, and there wasn't a peep about it anywhere. I mean, you couldn't really even hear about it unless you were actively looking for it. It was just not news. Oh yeah, of course autism went up. That's not news anymore.

Dr. Mercola:

Well, it got sequestered because the bigger concern was COVID-19. So anything after March pretty much got buried.

Stephanie Seneff:

Yeah. I mean, it's just incredible to me, and it's going to ruin our country I feel by the time – just the enormous resource that goes into taking care of these people.

Dr. Mercola:

Yeah. There's no question. I personally think EMF (electromagnetic field) is a factor.

Stephanie Seneff:

Yes, a lot of my friends are talking about that, and I think you're probably right.

Dr. Mercola:

Yeah. It's probably a powerful synergistic toxicity with both of them because EMFs are so convenient. The vast majority, virtually everyone is resistant to even being open to the fact that they may be harmful because they don't want to have to make a commitment to giving up this convenience.

Stephanie Seneff:

I know. It's really interesting how we've just slowly slipped to a point where we can't live without it, and because of that, we don't want to even think about the idea that it might be toxic. And it does the same thing glyphosate does, both of them cause calcium uptake in the cells, which is causing toxicity to the neurons. So they both do that. So it's just going to be synergistic toxicity.

Dr. Mercola:

Yeah, it increases just a simple mechanism, and we have increase intercellular calcium concentration. You get elevated superoxide and nitric oxide, and they combine to peroxynitrite, and that [inaudible 01:14:51] to be the oxidative stressor that causes all the damage.

Dr. Mercola:

So I know that's speculative mechanism for EMFs. But is it glyphosate – glyphosate's a different mechanism though, isn't it?

Stephanie Seneff:

Well, glyphosate definitely causes calcium uptake. There have been several studies that have shown that.

Dr. Mercola:

Really? I wasn't aware of that. I thought it was mostly the shikimate pathway.

Stephanie Seneff:

Well, it does so many things. I mean, when you mess around with glycine in the proteins, it's just in a million things. [crosstalk 01:15:16]

Dr. Mercola:

Proteins, too, was another. I thought that had been more, but I didn't realize that – so does it increase the intercellular calcium concentration because of the glycine integration to replenish it?

Stephanie Seneff:

Well, I think it may because I think that will mess up the ability to take the glutamate out of the synapse. So it's related to glutamate, and there's the NMDA receptors. The NMDA receptors have glycine and glutamate, and glyphosate has been shown to cause excess glutamate, external to the cells. Excess glutamate, and that stimulates the NMDA receptors which causes the calcium uptake. So it's really a glutamate problem, but I think glyphosate is actually taking up on glutamate transport channels as well. So the glycine might even be an analog of glutamate in the sense that it has a similar shape with a negative charge about the same size, but it also combined to the glycine receptors. So it's really messing up the NMDA receptors and causes overstimulation.

Stephanie Seneff:

Then there's the other side of it is the glutamate is taken out of the synapse by the helper cells, and then they turn it into glutamine, which is non-toxic. That enzyme is also disrupted by glyphosate, and part of that's because of the manganese. It depends on manganese and glyphosate makes manganese unavailable. But also that enzyme has glycine, serious glycine dependency. So it could be substituting for glycine in that enzyme as we know. So there are a lot of ways it could be doing it.

Stephanie Seneff:

People observe that it is doing it, and then they don't necessarily have the full explanation for why. But in many of these things, glyphosate is G6PD in suppression of succinate dehydrogenase, I mentioned earlier. Both of those have been observed and both of those could be explained by substituting for glycine at the place where it binds phosphate. That's the critical thing that I think is happening in all of these proteins that have that critical dependency. There's a

motif at the phosphate binding site that has three glycines out of six amino acids, and that motif is there for a very susceptible to glyphosate substitution, especially because glyphosate can slip its methalphosphonate unit into the place where the phosphate of the substrate is supposed to go. So glyphosate occupies this space, and then the enzyme is just completely shot. It can't do its job.

Dr. Mercola:

While you were giving that wonderful explanation, just to curve me. I got confused earlier by the G6PD being the enzyme responsible for breaking down glucose. But actually it's PDH, it's pyruvate dehydrogenase that does that.

Stephanie Seneff:

Yes.

Dr. Mercola:

Does glyphosate impact PDH at all?

Stephanie Seneff:

I suspect it does, and again, I think it's got those glycine dependencies. So I don't believe I've found a paper that says that it does. So I always look for papers that actually find that it suppresses things. But I think it would be predicted to do so. I'd have to go back and refresh my memory, but I believe that is one that it could affect.

Dr. Mercola:

All right. So this is an important question. I'm glad I remembered it because it's sort of a practical take-home that's really simple and really inexpensive, and I think could be really healthy. I'm curious as to what your current insights and recommendations are. All relates to glycine. Glycine can be taken therapeutically as an inexpensive supplement. It's one I take every day about 5 to 10 grams. And, guess what, it's easy to take because it's sweet. It's actually a sweetener.

Stephanie Seneff:

That's so interesting.

Dr. Mercola:

Almost no calories to it. Probably less than 1 calorie for 10 grams.

Stephanie Seneff:

Wow.

Dr. Mercola:

And it's not terribly expensive. You can get it as a powder, and it'll sweeten anything you put it on. So I'm wondering what is your current understanding of the value of that intervention specifically to mitigate the toxicity of glyphosate?

Stephanie Seneff:

I think it's probably a good idea, and I've had a number of people say that they're taking glycine without any ill effect and that they feel that it's helping them. And it makes sense because it's basically going to outnumber the glyphosate molecules. Remember, something's going to compete with glycine in building the protein. If there's a lot of glycine around, then it's much less likely that glyphosate will get in there. So I think it makes a lot of sense.

Dr. Mercola:

Okay. So if you, for whatever reason, have to be consuming non-organic food that you know is likely loaded with glyphosate and contaminated – non-organic wheat would be a good example. The wheat itself isn't genetically modified, but they use it in the process to dry it out. So it's loaded with glyphosate. And if you're having that, then take that with some glycine. You're crazy not to.

Stephanie Seneff:

Yes. I agree.

Dr. Mercola:

Well, good. I'm glad you – that's a simple take-home. Any other take-homes like that? Avoidance. And if for whatever reason you have to be exposed to it, then load up with some glycine. What'd you recommend?

Stephanie Seneff:

And also probiotics is important. I think that's also important for COVID-19. They've seen that vitamin K2 is protective against COVID-19 and probiotics contain vitamin K2. Menaquinone. So I encourage people to eat probiotic foods, like sauerkraut and apple cider vinegar.

Dr. Mercola:

And a carnivore-type diet will be relying on vitamin K2 too. Butter.

Stephanie Seneff:

Absolutely, butter. Yes, that's a good point. You can't go wrong with butter. I'll tell you.

Dr. Mercola:

Oh man. Well, it should be a [inaudible 01:20:27].

Stephanie Seneff:

Oh, organic for sure. Absolutely. And also the glycine, by the way, the glycine supplement. Make sure it's organic also. It's probably got glyphosate in it.

Dr. Mercola:

Interesting. Boy, I didn't thought about that. Why? Where is the glycine extracted from?

Stephanie Seneff:

Well, I don't know. But I imagine they may be getting some-

Dr. Mercola:

From corn or something?

Stephanie Seneff:

I don't know. I mean, I'd have to go and look. I find some of these things that are supplements are actually made through GMO technology. I don't know if you know that. I don't know how glycine's made. But often they mix with E.coli or yeast.

Dr. Mercola:

There's a difference with GMO technology and glyphosate. I mean, typically glyphosate is associated with GMO because it's used – they use it on GMO plants and the reason they do is to use glyphosate. But just because it's a GMO-

Stephanie Seneff:

No, no. What I'm saying is what they do is they muck with the genome, for example, yeast or E.coli to get them to produce tons of something and then they harvest that thing that they make tons of.

Dr. Mercola:

Yeah. It doesn't mean there's glyphosate in there because that's the way they make insulin.

Stephanie Seneff:

Well, if they're feeding them non-organic nutrients, they're going to put that glyphosate into the glycine that's extracted from it.

Dr. Mercola:

It would seem to me to be pretty small amount.

Stephanie Seneff:

I don't know. You may be right.

Dr. Mercola:

It might be insignificant, I would think.

Stephanie Seneff:

It would be interesting to test.

Dr. Mercola:

Yeah, it's simple to test. I mean, technologies not terribly expensive. We can use [crosstalk 01:21:47]-

Stephanie Seneff:

Yeah. Right. That might be an interesting thing to do. Yeah, I don't know, and I haven't measured anything. So I can't say. It just seems to me that if you're taking glycine, I'd worry about-

Dr. Mercola:

It's important to differentiate between just because it's GMO doesn't mean it's contaminated with glyphosate because that's the way they make insulin.

Stephanie Seneff:

No, no. I know. But what I'm saying is that they then grow these bugs and feed them something, and often what they feed them has glyphosate in it.

Dr. Mercola:

Check your insulin and see if it's contaminated with glyphosate. It's probably worse injecting it than it would be eating it I would think.

Stephanie Seneff:

I know. In fact, there are problems with insulin. People are developing antibodies against insulin and having problems, people who take insulin.

Dr. Mercola:

It's interesting because you would think that most of the insulin now is human, I would think.

Stephanie Seneff:

Well, they do make this synthetic insulin that's not quite the same as the normal human insulin.

Dr. Mercola:

Really?

Stephanie Seneff:

I don't know if they still do, but they used to get insulin from animals, right?

Dr. Mercola:

Yeah, yeah, yeah. Yeah. [crosstalk 01:22:47]

Stephanie Seneff:

Then they learned how to have the bugs make lots of insulin. So there's all these different ways to make insulin and different kinds of insulin, and I know there are issues with the antibodies developing autoimmune disease because of insulin and becoming very sensitive to insulin so you can't take it anymore. Different forms of it and probably taking the human insulin might be the safest.

Dr. Mercola:

Yeah, and that's an example of the incredible crimes of the pharmaceutical industry. Here they got a molecule that was developed literally a century ago, and when the inventor, I think it was Banting, specifically decided not to make any money. He sold the patent for a dollar. Now the drug companies have it, and literally when I was practicing, it was pretty inexpensive. It was $10, $15, $20. Now it's hundreds of dollars for a month's supply.

Stephanie Seneff:

That's really interesting.

Dr. Mercola:

And there's absolutely no reason other than greed that it's exploded. It's not like it's an increase manufacturing costs or anything. They just want more money.

Stephanie Seneff:

And of course the people who depend on it really critically depend on it. It's not like something they just cannot take. Yeah. That's really terrible. That's the same thing with the EpiPens, right? The EpiPens went way up.

Dr. Mercola:

Another good example.

Stephanie Seneff:

Yeah.

Dr. Mercola:

EpiPens for an accident, but if you don't get insulin, you're a Type 1 diabetic, you are dead. You are dead in the middle of the day.

Stephanie Seneff:

Right. That's really sad, isn't it, that they make you [crosstalk 01:24:12]-

Dr. Mercola:

Fortunately the reality is that most of the insulin being used is for Type 2 diabetics, which is another medical ignorance crime that the physicians who do that should have their license reprimanded and go back to basics 101 to understand that Type 2 diabetes is not an insulin deficiency. That's a resistance.

Stephanie Seneff:

Yeah.

Dr. Mercola:

Oh giving more is going to make it worse.

Stephanie Seneff:

It's really amazing how far off [Big] Pharma is from where they need to be. I'm so fascinated by their inability to choose the right path.

Dr. Mercola:

Yeah. Well, for sure, and their clever marketing schemes to brainwash physicians to believe this, and the ignorance of the physicians to not be open, like you, to explore why they don't have to believe this stuff. And it's wrong. They're prematurely killing patients by integrating this into their clinical practice.

Stephanie Seneff:

Right. Yeah.

Dr. Mercola:

All right. Well, it's been a pleasure, man. It's always fun talking to you, and I'm so looking forward to reading the draft of your new book. And we'll definitely have you back on to go over that. We'll dive deep, more into glyphosate. And I can't wait to learn more of what you've compiled.

Stephanie Seneff:

Great. Well, it's always a pleasure to talk to you. Thank you for having me again. So I really enjoyed it.

Dr. Mercola:

All right. We look forward to the future.