

Toxic Legacy: The Impact of Glyphosate on Public Health and the Environment

A Special Interview With Stephanie Seneff, Ph.D.,

By Dr. Joseph Mercola

Dr. Joseph Mercola:

Welcome, everyone. This is Dr. Mercola, helping you take control of your health. Today we are joined by a repeat guest who's quite fondly appreciated here, and that's Dr. Stephanie Seneff who is a Senior Research Scientist at MIT (Massachusetts Institute of Technology), one of the most innovative research universities in the world. She earned not one, not two, not three but four degrees from MIT.

Dr. Joseph Mercola:

So she's got a Ph.D. in electrical engineering and computer science, and especially with some form of artificial intelligence too. That actually gives her incredible expertise to comment on a wide variety of topics in biology, which is one of her new passions. So she's thankfully applied her skillsets to this.

Dr. Joseph Mercola:

I didn't realize it until I read her new book, which is "Toxic Legacy: How the Weedkiller Glyphosate Is Destroying Our Health and the Environment," that she had read Rachel Carson's, "Silent Spring," when it was shortly after it was published, or maybe while it was still on the hit list. So that is crazy, it was published in 1962. I did something similar in 1968 when I read Ken Cooper's book, which inspired my journey to exercise, and I've been exercising ever since then, which is 53 years, but.

Dr. Joseph Mercola:

So, anyway, this Rachel Carson's book was the inspiration for "Toxic Legacy," which is, without a doubt, no questions, uncontroversially, the best book ever written glyphosate. I'm so happy to have her on here to go into this because with COVID-19 and everything else going on, we kind of tend to forget about some of the fundamental basics and, literally, what could be another potential existential threat to humanity with glyphosate and all its derivatives.

Dr. Joseph Mercola:

So, we're going to help you understand, remind you of the importance and the, really, requirement to appreciate the toxicity of this chemical that has been permeating our environment in massive amounts. So with all that introduction, welcome again, and thank you for joining us today.

Stephanie Seneff:

Thank you so much for having me, my pleasure.

Dr. Joseph Mercola:

It's been over a decade of research to put together this book but why don't you discuss your journey with it? That's a long time to put together one book.

Stephanie Seneff:

That's true. It's really just been a decade of learning everything I could about glyphosate. I got very fascinated with the chemical very early on. When I first heard about it I just, basically, dropped everything else I was doing because I was so confident that I had found the answer to the autism epidemic. That was the thing I was looking for. And that was back in 2012, I guess, that I heard this two-hour lecture by Don Huber, Ph.D., and it just really changed my focus entirely. I already understood the symptoms of autism, a very complex disease, lots of gut problems and mineral issues and it all came together with his lecture. Overnight, I just started poring over all the papers I could find.

Stephanie Seneff:

Shortly after that I found [Gilles-Éric] Séralini's paper, which had not yet been retracted at that time. But it was retracted and later republished, the paper by Séralini, a French toxicologist who had shown that very low doses of glyphosate over the lifespan of a rat could cause a lot of damage. And he pointed out that after three months everything looked good, so it's a slow kill. This is one thing I emphasize in my book. Glyphosate is subtle and that's really a huge problem because people don't hook it up. We have diabetes, obesity, autism and Alzheimer's. It's a long, long list, all the gut problems. Tons and tons of papers coming out lately on the gut.

Stephanie Seneff:

We didn't notice the gut back in the day because the gut was working fine. We didn't realize those microbes were so important for our health. The microbes are being very much disturbed by the chronic poisoning with glyphosate and then the gut becomes a central starting point for many, many diseases, including neurological diseases and arthritis. And so when you see that disruption of the gut and you realize glyphosate can cause exactly the things that we're seeing, and I have a whole chapter on the gut in my book. That was actually the hardest chapter to write.

Stephanie Seneff:

I had to do a lot of research and there are all these papers with really complicated diagrams and huge amounts of information. It's very hard to kind of sift through it and figure out what the real story is and I really tried to do that in my book. I'm always looking for the storyline for everything I see. And when I see a disease that's going up dramatically exactly in step with glyphosate, I look for the particular ways in which glyphosate could cause that disease. I love a puzzle and this is just like a gigantic puzzle.

Stephanie Seneff:

So it's been a lot of fun, actually, for me to do the research. And I believe glyphosate has helped me to understand human physiology, human metabolism. It's really been a great resource as a window on health when you see how things get disrupted by a chemical, which has the specific characteristic that glyphosate has, a very unique characteristic that no other chemical has.

Dr. Joseph Mercola:

Yes, indeed. And just to comment on your research, in my view there are two types of research. One is actually the bench lab research, which you're not doing.

Stephanie Seneff:

Not at all.

Dr. Joseph Mercola:

But you've got the brain power, the super brain power to really dive in and understand molecular biology and put the pieces together in a way that makes sense, at least from a theoretical perspective, which then could be later proved with bench science and correlational studies. So much appreciation for what you've been doing because there's not many people out there doing this, especially when the bulk of all the financial support is directly to counter that narrative and to really continue to allow it to permeate our environment. I deeply appreciate Don Huber, too, who is a professor emeritus, I think, from Indiana University or somewhere.

Stephanie Seneff:

Purdue.

Dr. Joseph Mercola:

Purdue, somewhere.

Stephanie Seneff:

He's over 80 years old and he's still very active. He's still giving talks around the world, so he's amazing. I really like him. He and I have become friends. We've given talks together back-to-back. We did an afternoon seminar at a town in Connecticut. And we were actually very effective because they banned glyphosate in that town after that event. So we were really happy about that, one small step.

Dr. Joseph Mercola:

Along those lines, he's the first person who I ever the shikimate pathway, which you're very fond of and it really ties into the gut issue that you were describing earlier, that's part of it.

Stephanie Seneff:

Absolutely.

Dr. Joseph Mercola:

So what's the next part of your journey in putting this all together?

Stephanie Seneff:

What does that mean? You mean what am I going to do after this book?

Dr. Joseph Mercola:

No, no, no, no. I'm just [crosstalk 00:06:57].

Stephanie Seneff:

Oh, my journey, my journey.

Dr. Joseph Mercola:

Your journey because it's a 10 journey-

Stephanie Seneff:

My journey actually started early.

Dr. Joseph Mercola:

-to learn it and compile it.

Stephanie Seneff:

Absolutely. It started very early because my best friend at the time back in the early 1980s had a young child who got a DPT shot (diphtheria, tetanus and pertussis) and had a high fever and a piercing cry and a week later had seizures. They told them, of course, the vaccine had nothing to do with it, but on the other hand, both of their kids no longer had to get that vaccine. They were given a medical excuse for both of their children, even though the vaccine "didn't cause a problem." But that child was later diagnosed with autism and that really stuck with me, made me think of vaccines and autism. And that's where I started.

Stephanie Seneff:

And I looked at the vaccines for five years before I discovered glyphosate and I do think they play a role. And glyphosate helps them play a role, as you may know, because there's Anthony Samsel and Zen Honeycutt, both of them independently found glyphosate contamination in the vaccines. And, actually, I think glyphosate is a contaminant in many of our drugs as well, I suspect. You just think it would make sense that it would be.

Stephanie Seneff:

And many of the drugs are produced these days through genetic engineering of E. coli or yeast. They do these fancy things with genetics and they feed those animals high doses of glyphosate, probably, in their nutrients. These microbes grown in culture are fed nutrients where they don't pay any attention to whether there might be glyphosate. That's going to work into the products, I suspect. So I really wonder about glyphosate contamination in lots of things you would never think of. They've found glyphosate in tampons, for example.

Dr. Joseph Mercola:

If it's in the drugs, it's probably going to be there in such a small amount. "Is it clinically significant?" would be the basic question. But if it's in the vaccines, and I'm curious how it got in the vaccines. Is it because that you can-

Stephanie Seneff:

Culture.

Dr. Joseph Mercola:

Culture from the chicken embryos or the-

Stephanie Seneff:

Yeah, chicken embryos, gelatin, which Anthony Samsel – we have a whole paper about that. We wrote glyphosate six, was on the topic of the vaccines. We reported his results and it was consistent. It was the live virus vaccines. The ones that had aluminum in them, no glyphosate. But the live virus vaccines, if that virus is grown in the culture and they're fed nutrients. And it's the same thing with experiments that are done when cells grown in culture, even human cells grown in culture probably being exposed to glyphosate.

Stephanie Seneff:

It's kind of interesting to think about that. I don't know what the consequences of that are but I know there are consequences. And I see lots of studies on different kinds of fats and whatnot, different nutrients, which is good, different kinds of fats. It's just like they're not paying any attention to the glyphosate level and it may be the dominant story in their experiments. They've got two different kinds of fats they're studying. One of them has a lot of glyphosate, the one doesn't. They don't know that. They don't take that into account. They see the one that doesn't have the glyphosate is much healthier but it may not be because of the kind of fat it is. It may just be that it doesn't have glyphosate.

Dr. Joseph Mercola:

The glyphosate doesn't store fat, though, does it? It's because [[crosstalk 00:10:03](#)].

Stephanie Seneff:

It does go into fats.

Dr. Joseph Mercola:

It does? I just thought it had to integrate into a protein.

Stephanie Seneff:

It's not fat-soluble.

Dr. Joseph Mercola:

It's not?

Stephanie Seneff:

It's not fat-soluble. So in that sense it's not one of those chemicals that actually are fat-soluble and go into the fat for that reason. However, it is in fats. The government has rules about how much glyphosate is allowed in different nutrients. And they have upper limits for things that are — canola oil, soybean oil, they have upper limits, which means they're finding it in those fats.

Dr. Joseph Mercola:

That's odd. I just don't know how it'd be there because if glyphosate is glycine, which we'll get to the basis, which we'll go over shortly. It's glycine with these phosphate groups attached to it.

Stephanie Seneff:

Well, it could be the phosphonate, actually. And Anthony actually thinks so. He thinks that glyphosate is acting as a phosphate analog because it's got this phosphonate unit stuck to it. And fats have phosphates. You have those phospholipids, so Anthony suspects that could be how it's getting into fats, and I suspect he's right. He's actually working on – he's studying that idea right now and trying to put a paper together.

Dr. Joseph Mercola:

That's great. And I think the concern in the vaccines is somewhat similar to aluminum, another toxin that used as an adjuvant to improve the immune response. It's not good by itself, but when you swallow it, that's one form of toxicity, as opposed to actually injecting it, which is probably multiplied double exponentially.

Stephanie Seneff:

I know, and then you have synergy with glyphosate as well because glyphosate binds to aluminum extremely well in a [crosstalk 00:11:47].

Dr. Joseph Mercola:

Why don't you go into that? I'm just a little bit off tangent, but it's an interesting hypothesis that you posed with the dual toxicity of aluminum and glyphosate.

Stephanie Seneff:

And probably other toxic metals as well. People have looked at kidney disease in Sri Lanka and suggested that arsenic is combining. Arsenic is similar to aluminum, +3 cation, +3 charge. And that really keeps it from getting past barriers, but when you wrap it up with glyphosate molecules it becomes a small neutral molecule and what more easily passes through a leaky gut? Glyphosate creates a leaky gut, so that really makes it very convenient to get the aluminum across the gut barrier. Leaky gut sets up leaky brain, you get the aluminum across the brain barrier.

Stephanie Seneff:

And when you get in to the acidic environment of the terminal watershed of the blood circulation up there in the brain stem, more acidic is when glyphosate unloads its cargo. And then you have toxicity of both of them and glyphosate at that point, is what I think is happening. And that's theoretical. We haven't proven it, but Chris Exley has found high levels of aluminum in autistic brains. And he's gotten really concerned about the vaccines at this point.

Stephanie Seneff:

So I've been interested in that whole concept of aluminum in the vaccines associated with autism, which I still believe that. It's just that the glyphosate makes it worse, and it makes all the

metals, actually. It makes the minerals both toxic and deficient and I do talk about that in my book. Iron, manganese, the distribution system gets broken by glyphosate.

Dr. Joseph Mercola:

Why don't we go back to the beginning with respect to the introduction of glyphosate as a chemical into our environment? Because it didn't exist at some time. This is a relatively recent discovery. Maybe you can walk us through it was discovered and its initial purpose. And then it was repurposed for use as an herbicide. It went from zero to, I think the latest statistics you have in your book, and there are probably more current ones, was 150,000 tons. That's 300. Wait, it's [crosstalk 00:13:59].

Stephanie Seneff:

It was 125,000 kilograms.

Dr. Joseph Mercola:

Kilograms. It was 138,000 tons, but then went up to 150,000 tons. American crops, that's not worldwide. That's American crops.

Stephanie Seneff:

American, it's just incredible how much we use. They estimate it's a pound per person for every man, woman and child, a pound each every year, which is a huge amount to think about. We use more per person than any other country in the world. And our government is immune to it. They just think this stuff is so wonderful we don't even have to test for it, and that really annoys me.

Stephanie Seneff:

Canada has done a lot of testing, and they've found a lot of glyphosate in surprising places. That's the other thing people don't realize. Non-GMO is not good enough. And many of the foods that have the highest levels are non-GMO foods. And this is oats and wheat and barley and legumes like chickpeas and lentils, hummus, for example. These foods are testing very high with glyphosate because they're sprayed right before harvest as a desiccant.

Stephanie Seneff:

And I think that's the reason for the epidemic in celiac disease, it seems very clear to me. Anthony Samsel and I wrote a paper on that. And we showed in that paper that there's a strong correlation between the rise in celiac disease over time and the rise in glyphosate usage on wheat, specifically on wheat. It matches much better to wheat than it does to the other crops, which makes sense because wheat is the source of the celiac disease.

Dr. Joseph Mercola:

Yes, indeed. That's a pound of glyphosate per person per year being sprayed on our soils [crosstalk 00:15:36]. You present some very compelling evidence that there is no, no safe exposure to glyphosate.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

What would be the acute toxic dose? How much of it would you have to be exposed to before you'd die instantly? Are there reported cases of that?

Stephanie Seneff:

There have been a number of people who have successfully committed suicide by drinking Roundup, for example.

Dr. Joseph Mercola:

I think the Indian farmers did that, didn't they?

Stephanie Seneff:

They did, the Indian farmers. There are articles from Taiwan about that. Taiwan, actually, doesn't use much glyphosate, but they wrote an article about farmers who killed themselves by drinking glyphosate, and the United States. It's interesting to study those cases because there was a woman who tried to commit suicide with glyphosate. And it was interesting to study her case because she developed a paralyzed gut, which I found really fascinating because I can explain that. Her gut became paralyzed.

Stephanie Seneff:

We are all getting our gut numbed, sort of semi-paralyzed, I think, by glyphosate. That's why we're getting SIBO (small intestinal bacterial overgrowth) because the peristalsis is not working properly, so the stuff doesn't move down through your intestines the way it should, it gets stalled. And then you get this festering of bacteria in the upper intestine.

Stephanie Seneff:

And then she also had glyphosate in her brain. That was the other thing that they showed, that it went into her brain. It may have been a different article, but there's a woman who was poisoned with glyphosate. And they found it in her brain, postmortem that found it in her brain. So it's clear it goes into the brain. That's really, really disturbing to me.

Stephanie Seneff:

And there's lots of studies on animals that are showing that it causes neuro excitotoxicity due to excess glutamate in the brain, and that is absolutely connected to autism. I keep looking for the autism thread and that's certainly a good part of my book. And, of course, I talk about sulfur as well because that was my first passion, and I discuss in my book how important sulfur is for our health, and in particular, sulfate and how much that's connected to autism, sulfate deficiency and then how glyphosate can cause sulfate deficiency. I go into all of that in my book.

Dr. Joseph Mercola:

So let's go back again to the beginning to help us grasp this progression of Monsanto's introduction of this into our – did Monsanto, were they the company that initially discovered it?

Stephanie Seneff:

No, in fact, it was first-

Dr. Joseph Mercola:

Or bought it?

Stephanie Seneff:

-patented as a pipe cleaner. It strips metals off of pipes.

Dr. Joseph Mercola:

[crosstalk 00:18:07].

Stephanie Seneff:

It's a really good metal. It binds metals really, really well. That's part of its problem, it's really good metal chelator. And that, of course, disrupts the gut microbes too because it makes the metals unavailable to the microbes and they need those minerals for their enzymes that are dependent on them to function properly. The microbes get killed because of, of course, the shikimate pathway too. The microbes have the enzyme on the shikimate pathway that glyphosate famously disrupts in the plants. And, in fact, the beneficial microbes are especially sensitive to glyphosate and studies have shown that. Lactobacillus, bifidobacteria, those are really crucial microbes to keep our gut healthy and they perform a lot of services for the host that don't get performed if they get killed off.

Stephanie Seneff:

And you get into problems with digesting gluten, I think, because of lactobacillus being killed by glyphosate. Lactobacillus has to carry several enzymes that we don't have that specialize in breaking down proline. Proline is an amino acid that's common in gluten and casein. Casein is the milk protein.

Stephanie Seneff:

We have all these allergies to gluten and casein these days, all these different food sensitivities, and I think it's because the lactobacillus are being killed off. They can't support the digestion of those proteins anymore. And the proteins don't get broken down because proline is a difficult amino acid to pry apart from the string. And these enzymes that the microbes produce assist in doing that. And then they don't work and then the protein sticks around, the peptide sequence. And that's what causes an immune reaction. And then you get autoimmune attack through molecular mimicry, which is because the antibody misrecognizes a human protein because it looks like the piece of gluten that they become sensitive to, so they attack a human protein instead.

Dr. Joseph Mercola:

Yes, indeed. So, we talked about the glyphosate molecule being initially utilized for a scaling metal chelator. EDTA (ethylenediaminetetraacetic acid) is an example of another chelator, one that's very popular with chelation doctors. It's a form of therapy to treat heart disease. I was

actually part of that group for a while. I think it's the American Academy. I forget, ACAM, American College for the Advancement in Medicine, is the primary professional group that teaches chelation therapy. And you discuss in your book how glyphosate is a million times more potent at chelating aluminum than EDTA.

Stephanie Seneff:

It's remarkable. I was really shocked when I saw that study, and there's a reference to support that in my book. I was just stunned. I couldn't believe that it could be so powerful.

Dr. Joseph Mercola:

Anyone who's been following natural medicine knows how potently toxic aluminum is, as you mentioned earlier. Chris Exley is a strong proponent of that, probably one of the leading investigators in this in showing how it impacts the brain, especially when it's administered through an intramuscular subcutaneous injection. But when you combine it with the glyphosate, and it goes right past the blood-brain barrier, which is the issue and getting into the brain. That may be every bit as impactful as the aluminum that's being used as an adjuvant in the vaccines.

Stephanie Seneff:

I know. I agree. There are just so many ways, it's just astonishing how many ways. Of course, Nancy Swanson was the one who started looking at the statistics on the health on all of these diseases. And she dug through the databases to find diseases that were going up dramatically and showed incredibly strong correlation. We know that in this country we have such a problem with obesity and it keeps getting worse. And I think glyphosate is a direct hit on it. I would say it's the primary cause of our obesity epidemic.

Stephanie Seneff:

We keep on saying, "Well, we're just being lazy. We just sit in front of the TV and stuff our faces with processed foods." It is true that processed foods are not healthy, even independently of glyphosate. But I think, eventually, I hope they will do the research to prove this. But I suspect that glyphosate is the primary reason for the obesity epidemic, the autism epidemic, the Alzheimer's epidemic and some of the cancers too. Cancer is less obvious with glyphosate than these other diseases, but it's there, definitely is linked to cancer.

Dr. Joseph Mercola:

I'm not sure that I agree with the primary cause. I'm sure it's a contributing variable. I'm doing research. I need to share some of it with you now as I'm focusing passion upon the massive, explosive introduction of linoleic acid, which is an omega-6 fat, as being a primary contributor to obesity because it's, literally, a metabolic poison. It just destroys [\[crosstalk 00:22:59\]](#).

Stephanie Seneff:

Yes, it's true, but glyphosate is also contributing to that because-

Dr. Joseph Mercola:

Yeah, there's no question.

Stephanie Seneff:

-directly, because linoleic acid, it's actually very interesting. I found an article that talked about – you'd be interested in this. Linoleic, it goes to arachidonic acid, you probably know that, it can turn into arachidonic acid. Arachidonic acid can be turned into an endogenous cannabinoid, a naturally-produced hormone that acts like marijuana, an endogenous cannabinoid that eases pain. The enzyme that does that is the cytochrome P450 enzyme, and glyphosate disrupts cytochrome P450 enzymes. So I think arachidonic acid is getting redirected through these epoxygenase, cyclooxygenase, these enzymes that convert arachidonic acid into extremely immunogenic products.

Stephanie Seneff:

I know you probably know that the fatty acid system is really complicated. And for a long time I couldn't handle that research literature because it was so complex, all these different molecules that these fats get turned into that have different properties. But the products of the epoxygenase are leukotrienes, and the leukotrienes have an incredible signaling capacity to turn on an inflammatory response.

Stephanie Seneff:

And so, the leukotrienes are rightfully blamed for causing all the chronic pain we're seeing with rheumatoid arthritis and the bone issues and all the joint pain and bone pain and even, probably, problems with the brain, maybe headaches. All the different kinds of pain that we're experiencing that are connected to inflammation, I think, could be a consequence of the cytochrome P450 enzymes blocking the ability to take arachidonic acid into the endogenous cannabinoid. Instead, it gets redirected towards these signaling molecules that cause all this damage.

Dr. Joseph Mercola:

A generic term for those signaling molecules would be prostaglandins.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

They're broken down [crosstalk 00:25:00].

Stephanie Seneff:

That's the other one, that's the cause, I think. Prostaglandins is the cause [inaudible 00:25:04]. It's also, what do they call it, eicosanoids or something?

Dr. Joseph Mercola:

Eicosanoids.

Stephanie Seneff:

Which is a big group. They're complicated names to keep track of.

Dr. Joseph Mercola:

And there's no question it's a part, but, from perspective, the primary toxicity of linoleic acid is that it has these double bonds, which are, essentially, oxidized. It's this oxidation that turns them into very toxic free radicals, 4HNE would be a classic example.

Stephanie Seneff:

You are absolutely right. I agree with you.

Dr. Joseph Mercola:

An increase in oxidative stress directly, not through some hormonal signaling molecule, but direct oxidative stress damaging the cell membranes, the mitochondria, the stem cells, the DNA that causes the bulk of the damage.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

And specifically in the mitochondria where this feedback loop occurs in the electronic transport chain, especially, I think, cytochrome one, that causes the shutdown of the normal energy metabolism system, which results in the increase in adipose tissue. It's complex, but they're both bad. There's no way you should have glyphosate. There is no way you should have excess linoleic acid. Most people are eating 10 times the ideal amount, 10 times, at a bare minimum. Some are much more.

Stephanie Seneff:

Yes, I know. It's really interesting, the omega-3, omega-6 and also the saturated fats, which I actually think are the healthiest fats. I don't know how you feel.

Dr. Joseph Mercola:

Of course.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

[crosstalk 00:26:32] oxidation.

Stephanie Seneff:

They don't oxidize because they're already fully-

Dr. Joseph Mercola:

They're fully [crosstalk 00:26:37].

Stephanie Seneff:

Exactly, they don't have any place to go. And you get those cute little triangles where the oxygen is hooked to the two carbons. That's what happens with the epoxygenase. You get this cute molecule, but it's very, very reactive. The epoxygenase produces these leukotrienes that are very reactive. And then not only are they reactive, but they're also excellent signaling molecules. So they make the cell behave in a different way that is going to cause the inflammation and the pain.

Dr. Joseph Mercola:

Well, I want to bring it back to glyphosate because that's the primary topic of your [crosstalk 00:27:12].

Stephanie Seneff:

I know, it's easy to wander off.

Dr. Joseph Mercola:

I can talk for hours on linoleic acid. I just always like to squeeze it in there somewhere. But the shikimate pathway is so profoundly important, and I think if you could expand on that it would be so useful because it really identifies them, in my view, the primary mechanism of how glyphosate exposure is so biologically toxic. Obviously, there are others but this is the primary way. So why don't you expand on that and the aromatic amino acids, the tryptophan, the [crosstalk 00:27:41].

Stephanie Seneff:

Totally, yes, tyrosine, phenylalanine.

Dr. Joseph Mercola:

Tyrosine, tyrosine.

Stephanie Seneff:

That's become so easy for me because I've said it so many times, but it's really quite amazing how important that pathway is. We don't have a shikimate pathway in our cells, not in any of our cells, not in our genes, which is why Monsanto proudly says that this chemical is great, that we're not sensitive to it. But what they're overlooking is that our gut microbes do have the pathway. In fact, a study that I talk about in my book showed over 50% of the microbes, on average, in our gut have the shikimate pathway. And so, they're the ones that are going to get hard by glyphosate.

Stephanie Seneff:

And as I said, lactobacillus and bifidobacteria, they use that shikimate pathway to produce these aromatic amino acids, tryptophan, tyrosine and phenylalanine. Those are crucial coding amino acids that go into all the proteins of our body, according to the DNA code. There are about 20 amino acids, and this is three of them, so you can see they're quite important. They specialize in certain skills that the other amino acids don't have. So they're absolutely essential to assemble the

proteins. And we depend upon our diet and on our gut microbes to produce adequate amounts of these amino acids for the host.

Stephanie Seneff:

So when these microbes are being harmed, there could be a deficiency in those molecules. And those are not only part of the proteins but they're also precursors to a lot of important biologically active molecules. For example, tryptophan is a precursor to melatonin and serotonin. And tyrosine is a precursor to-

Dr. Joseph Mercola:

Dopamine?

Stephanie Seneff:

The thyroid hormone.

Dr. Joseph Mercola:

Oh, thyroid, that's it.

Stephanie Seneff:

And also dopamine and adrenaline, these are all really, really important hormones that control brain behavior and regulate behavior and mood and all these things. Serotonin deficiency is connected to depression and we have an epidemic in depression. So I think there's really a direct path there with the deficiencies in these products. Also some of the B vitamins come out of the shikimate pathway, both riboflavin and-

Dr. Joseph Mercola:

B2, niacin, thiamin.

Stephanie Seneff:

Niacin and riboflavin, yes, exactly.

Dr. Joseph Mercola:

It's huge, because you've got it coming from both ends. You've got the direct depletion of these really essential aromatic amino acids that augment our own intake that we get through the food normally and, really, is an important component, especially these B vitamins because these B vitamins are so crucial, especially – but we're finding it in COVID-19 you need thiamin for augmenting your immune system. If you don't have a lot of thiamin, you're not going to be able to generate a healthy immune response. And that's why it's a part of a lot of the septic protocols, intravenous vitamin B1, thiamin. And if you're wrecking it with glyphosate exposure that's disrupting your shikimate pathway in your gut microflora, you've got a huge problem.

Dr. Joseph Mercola:

Now, another mechanism that I was reluctant to accept as a hypothesis, and many of my friends were too, was the issue of substitution of glyphosate for the amino acid glycine because we said

it's a core. It's an amino acid, is what glyphosate is it's what the "gly-" comes from, except it's got these other groups attached to it, phosphoneal groups, which presents something called stereochemicals, it's basically large molecules around there.

Dr. Joseph Mercola:

But you present a very elegant argument. And, actually, I think your book finally was the straw that broke the camel's back for me because there's so much evidence that you provide in it that I think it's almost noncontroversial now if you're a careful student and you review it. Because I didn't accept it until just recently, but I think you're right.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

So why don't you review that evidence? Because I think it's an evolution in understanding it, and I suspect more and more people are going to accept your hypothesis now.

Stephanie Seneff:

I certainly hope so and it's been an incredible resistance to it. I've really felt very alone in this hypothesis but I'm so confident because the more I studied the more it became clear to me that I was right and I'm stubborn. Although everyone is telling me, "No, this can't happen. It can't be true," I was [crosstalk 00:32:10], "You're wrong. You're wrong. I'm right." We'll see. Eventually, hopefully, someone will be able to prove it beyond a shadow of a doubt.

Stephanie Seneff:

Monsanto went a long ways toward proving that this is happening in their own research. They just don't admit it. Even their researches said perhaps it's being incorporated into the protein to understand what they saw when they studied glyphosate. And, of course, the interesting thing to me was the actual way that it disrupts the shikimate pathway, which is to affect this enzyme, which is called EPSP (5-enolpyruvylshikimate-3-phosphate) synthase. That enzyme binds to a molecule called PEP, phosphoenolpyruvate, and the phospho is a phosphate.

Stephanie Seneff:

And so at the place where the enzyme binds this PEP, there's a glycine. And it's a highly-conserved glycine in the enzyme. And if that glycine is swapped out for alanine, which is a very similar amino acid, it just has an extra methyl group, the enzyme becomes completely insensitive to glyphosate. So it's black and white, either there's a glycine there, in which case it's incredibly susceptible to glyphosate, or there's alanine, in which case it's completely insensitive.

Stephanie Seneff:

And they haven't found any other molecule that behaves that way. In fact, they have other toxic chemicals that disrupt that enzyme by pretending to be PEP and that's what they're saying glyphosate is doing. It's pretending to be the substrate, and I don't think that's the case. It may do

that as well, and that may be an effect. But the real effect is getting into the protein itself and sticking its-

Dr. Joseph Mercola:

Sorry for the interruption but isn't this the way they create the GMO-resistance, by making [crosstalk 00:33:46]?

Stephanie Seneff:

Yes, they get rid of that glycine. They turn it into alanine.

Dr. Joseph Mercola:

That's what I thought.

Stephanie Seneff:

And so, it's really quite remarkable because glyphosate has this methyl phosphonate unit sticking off of its nitrogen. And that is a problem with steroid hindrance. I'm confident that if you have a glyphosate residue with a couple of bulky amino acids next door, glyphosate is not going to substitute. It won't fit, so it does have that issue – that it needs to fit.

Stephanie Seneff:

But the thing is with enzymes that bind phosphate, they're designed to have comfortable room around that [inaudible 00:34:21] because they need to fit the phosphate, the substrate needs to fit there. The enzyme is designed, shaped, so as to provide room for the phosphate and the substrate to bind. For that reason, the enzyme has the room for glyphosate's methyl phosphonate units.

Stephanie Seneff:

So it's the enzymes that bind phosphate at sites where glycine is highly conserved that are the ones that are going to be especially sensitive to glyphosate. And when I finally worked out that algorithm and then looked for enzymes, then you start to see, "Oh, my god. These enzymes that glyphosate actually is known to suppress, experimentally, have that property. They bind phosphate at a place where there's, at least, one, sometimes three highly-conserved glycine residues at the place where it binds phosphate." And they've been shown to be suppressed by glyphosate. That just all adds up to a story in my book, you know?

Dr. Joseph Mercola:

Yeah, it was brilliant. You're certainly the one who popularized it and developed it. Was it you or Samsel, or concurrently you developed it together?

Stephanie Seneff:

Well, it's interesting because I had thought about the idea that glyphosate, being glycine and knowing that it's a glycine analog and it was affecting places where glycine binds. Glycine acts as a neural transmitter. Glyphosate messes that up. I was thinking, "Jeez, I wonder if could get into the protein in place of glycine." And I initially rejected the theory in my mind because of the fact that it has that extra stuff on it, nitrogen. I thought that would make it impossible for it to

hook up. And Anthony, though – I remember a conversation, it was December, and I forget which year. But it was in December we had this conversation.

Dr. Joseph Mercola:

[crosstalk 00:35:57].

Stephanie Seneff:

Because I went off to Hawaii, and I just immersed myself in this idea. I drowned myself with papers on glycine mutations because you can find enzymes where if the glycine was mutated, then it causes the disease. And glyphosate also causes that disease, that kind of stuff. You could just work everything together to make the whole story make sense, which is what I do in my book.

Stephanie Seneff:

My book actually centers on this idea that glyphosate substitutes for glycine in certain proteins. And there's a specific algorithm for where it would happen. And then you can show that those proteins are suppressed by glyphosate experimentally. People have shown, for example, G6PD, glucose-6-phosphate dehydrogenase, a very important enzyme in the red blood cells that maintains NADPH (nicotinamide adenine dinucleotide phosphate) in its reduced form. And NADPH feeds into glutathione to keep it in its reduced form, so it's very, very important.

Dr. Joseph Mercola:

You're just like a fire hydrant of all this information.

Stephanie Seneff:

I know.

Dr. Joseph Mercola:

I want to stop you for a moment. I just apologize for interrupting you but that is such a key component because not everyone fully appreciates the value of NADPH. That's one of the most – if you have limited quantities of this biomolecule, you are really in bad shape. And people who have this enzyme deficiency, it's almost like Type 1 diabetes. It's genetically determined. They are at such an increased risk for disease because they don't have that reducing capacity to recharge antioxidants. So this is huge.

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

It's absolutely [inaudible 00:37:26].

Stephanie Seneff:

I totally agree, and I wrote about it in my book. In fact, I think it's connected to autism as well, the G6. And that is the protein that has the most mutations of any protein in the body, the most

number of different SNPs, single-nucleotide substitutions. And I think that's because that enzyme is under pressure, I really think that there's a mechanism by which enzymes mutate more quickly when they're under stress. And I think that enzyme is really under stress because of glyphosate. It's such an important enzyme for maintaining healthy glutathione.

Stephanie Seneff:

Autistic kids have low glutathione. The glutathione is oxidized. It's supposed to be reduced. And some of them have this G6PD genetic defect as well. But I think that glyphosate messing of G6PD is a major player in various disease states because of this insufficient antioxidant capacity of that. It's really fascinating. Another one is succinate dehydrogenase, which is a crucial enzyme in the mitochondria. It binds phosphate, has been shown to be suppressed by glyphosate.

Dr. Joseph Mercola:

Let me go back to the G6PD. How does the glyphosate interrupt that specifically?

Stephanie Seneff:

G6P-

Dr. Joseph Mercola:

Does the glyphosate substitute for glycine in the-

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

-one of the enzymes?

Stephanie Seneff:

Well, that's what I think. They don't know, but that's what I think, is that it's substituting for the glycine and messing it up. That enzyme binds two NADPH molecules. Actually, it's quite interesting because it has a sort of spare NADPH ready to go. It has to work so fast that it needs to buffer. So there are two places in that enzyme where it binds NADPH. And both of them have glycines that are crucial for it to be able to bind NADPH. Glycine is needed at the places where you bind phosphate. Because it's tiny, you need the room for that phosphate.

Dr. Joseph Mercola:

So who would have known? We talk about the shikimate pathway but this substitution in the G6PD and reduction of all your endogenous antioxidants may be one of the primary ways that glyphosate takes you out prematurely.

Stephanie Seneff:

I think so too. I find all these things that could be primary. It's just amazing. I can see why it could be. If people say, "Ha, ha, ha, how could one chemical be so related to so many diseases?" I say, "Of course it could if it does this, it totally could." I find that really interesting. It's been

fun for me because I keep on finding proteins that are potential candidates and then I have to learn all about that protein and what happens with mutation and this, that, and that.

Dr. Joseph Mercola:

Let's go to another protein that is well known to be extraordinarily high in glycine and it constitutes one-fourth of our body's proteins, one-fourth, and that protein is collagen, the primary protein for our connective tissue. So tell us the story with collagen.

Stephanie Seneff:

I just really feel confident that I'm right, that glyphosate is messing up collagen. Collagen has a beautiful triple helix structure and it gives it really special properties of tensile strength and flexibility and ability to hold water. And collagen is, as you say, one-quarter of our proteins are collagen. Collagen has long, long sequences that are called GXY, GXY, GXY where every third amino acid is a glycine. And those glycines hook together to form that triple helix. And there are people who have mutations in those glycines that cause disease, joint diseases and bone diseases. And I think that glyphosate is causing – there's Ehlers-Danlos syndrome, you've probably heard of that.

Dr. Joseph Mercola:

Yes, [[crosstalk 00:41:00](#)].

Stephanie Seneff:

That's associated with glycine mutations in collagen. And there's an increase in the frequency of that, in the prevalence of that syndrome recently. And, of course, you have many more people getting surgery for hip replacement surgery and people have back issues. All kinds of people have back pain and shoulder surgery. There's just knee problems, foot problems. All these different problems with the joints, I suspect, are being caused by misfolded collagen because of glyphosate messing it up.

Dr. Joseph Mercola:

I think it's useful to identify all these mechanisms of how glyphosate adversely affects your body because if it's going to, ultimately, I hope, motivate and catalyze people's behavior to eliminate this toxic poison from their body and their environment and their family. Another one is its impact on nitric oxide, primarily through eNOS. There's at least three separate ways that your body makes nitric oxide, but eNOS would be the one that's beneficial nitric oxide, which is endothelial nitric oxide.

Stephanie Seneff:

Yes, and eNOS is what's called a – I've forgotten. It's not a CYP (Cytochromes P450) enzyme, but it's a close relative to cytochrome 450 enzymes. Orphan, they call it an orphan CYP enzyme. People talk about how it has the same principles that the CYP enzymes have. And I think it gets suppressed by glyphosate because glyphosate suppresses the CYP enzymes. I'm hypothesizing that it would, and also because it has these sensitivities with glycine residues. And also, of course, because it binds iron, and iron is another one that gets messed up by glyphosate.

Stephanie Seneff:

So there's various ways in which eNOS could be expected to be affected by glyphosate. eNOS makes nitric oxide and, of course, I think it also makes sulfur dioxide. And I talk about that in my book, very, very interesting idea that makes sense to me for reasons that we could get into. Glyphosate, I think, disrupts eNOS, and I think that is, of course, disrupting the whole control.

Stephanie Seneff:

The nitric oxide actually, I think, works together with sulfur dioxide to control the viscosity of the blood. Nitric oxide turns into nitrate, which is a kosmotrope. And sulfur dioxide turns into sulfate, which is a chaotrope. Nitrate is a chaotrope, and sulfate is a kosmotrope. And chaotropes and kosmotropes are very interesting small molecules that control the viscosity of the blood. It's all about water structuring, and this is stuff that Gerald Pollack talks about. But the kosmotropes make the water structure more like gel. And the chaotropes make it more like fluid, liquid. And those two work against each other to maintain the correct viscosity of the blood while other things are going on.

Stephanie Seneff:

So you put a bunch of lipid particles into the blood, it's going to get more viscous, so you've got to kind of make it less-viscous by putting more nitric oxide. So there's a back and forth between nitric oxide and sulfur dioxide that's regulated by eNOS. This is a theory that I have. And it makes a lot of sense. And I have continued to gather evidence that supports it. And if glyphosate messes up eNOS, then it messes up the blood's ability to maintain its proper viscosity, which means your blood could be too fluid. You could end up with hemorrhaging. It could be too thick, it can't circulate. You end up with blood clots. So there's a disruption of the blood circulation, profound disruption because of disrupting eNOS, in my opinion.

Dr. Joseph Mercola:

So we've compiled a list of a variety of different ways that glyphosate can take you out prematurely and will likely take you out. So before we go into some of the practical strategies as a result of how we can catalyze this to implement these strategies, I'm wondering if you can give us an update, from your perspective, on the recent litigation with glyphosate because Monsanto, of course, was bought by Dow, not Dow, Bayer, Bayer in Germany, and assumed all their liabilities.

Dr. Joseph Mercola:

I think the last lawsuit that went to jury trial, they were awarded \$2 billion. And there was like 1,500 other, or 15,000. I forget the zeroes on that. But there was literally hundreds of billions of dollars at potential stake. This is one of the downsides of our legal system, is they have these class action suits. Essentially, it allows the attorneys to negotiate a very big reward for themselves with relatively little work, rather than having each of those independent litigants go to trial separately. Do you know the latest status on that? Because I think they settled. I just don't know what the settlement was.

Stephanie Seneff:

Well, that's so confusing because I've been following it. It was complicated because it looked like that they had a settlement that was way too low, of course. That settlement had a catch, which was really scary because it looked like it was going to be they could form this committee. And, of course, Monsanto could stack the deck. And then the committee would decide for everybody forever in the future that glyphosate doesn't cause cancer. It was incredible. They were hooking that as a requirement to go with.

Stephanie Seneff:

Bayer was willing to pay this \$10 billion, whatever it was, on the condition that there would be this committee that would be formed. And, obviously, the committee would then decide that glyphosate doesn't cause cancer. And after that nobody could sue anymore, was the kind of idea that was being put together there. And I think the lawyers balked on that. The last that I had heard they said, "No, we won't sign this," and that it was still sort of being fussed over. I haven't heard anything recently.

Dr. Joseph Mercola:

So it's not finalized. I thought you might have heard. I don't recall.

Stephanie Seneff:

I should be following it. Usually I get people telling me. I have friends and it's been quiet for a while. I heard that a few months ago and I don't know if there's [crosstalk 00:47:35].

Dr. Joseph Mercola:

They're going to weasel their way out of this. Literally, the potential, it should have been over \$100 billion, which would have put them out of business, would have destroyed it. But the end result of that is there's clearly a huge liability. Has that resulted in decreased administration or selling of glyphosate from your-

Stephanie Seneff:

I think so. In fact, there are stores now that normally sell glyphosate that are getting nervous about it. And that's actually working really well, that the stores are starting to refuse to sell it because they're afraid of their liability with a lawsuit. And once that starts happening, I think it's a domino effect.

Stephanie Seneff:

Mexico banned glyphosate. They're going to phase it out entirely by 2024, which makes me very, very happy because they're our next-door neighbor. And our country, of course, is pressuring them that that's not reasonable and you should do this. Our country is even worried that they're going to start banning our food because it's contaminated with glyphosate, refusing our imports. We're getting anxious about that. Well, I certainly hope they do. I think that would be awesome if Mexico refused our food because it was too highly contaminated with glyphosate. That would really, really send a message to our government that I would think they couldn't ignore.

Dr. Joseph Mercola:

And it's not unprecedented. I believe in the book you mentioned in 2015, Russia refused to [crosstalk 00:48:54].

Stephanie Seneff:

Yes.

Dr. Joseph Mercola:

-and they put a total ban in 2016 on GMO imports.

Stephanie Seneff:

Yes, Russia is really-

Dr. Joseph Mercola:

That's five years. That's five years.

Stephanie Seneff:

Putin has said they want to be the sort of king of organic. They want to export organic food to the world. They still have a lot of small organic farmers in Russia, so they're in better shape to get back to where we need to go. Our massive, huge agrochemical farms need to be shut down and need to be turned into small family farms. That's going to be a big effort. We have to do it, I believe.

Dr. Joseph Mercola:

Let's get a bigger picture too with respect to the hurdles and dangers that we face from having introduced all this glyphosate, 200,000 tons a year in the United States alone. It's crazy. So, how long does it last in the soil? What's its half-life, and is there any way that can be accelerated, the degradation of it?

Stephanie Seneff:

That's an excellent question. Of course, Monsanto came out and said that it was really great. It breaks down within two weeks, it's gone [crosstalk 00:50:00].

Dr. Joseph Mercola:

Two weeks, maybe you meant two days.

Stephanie Seneff:

Of course, people did studies and there was a study that was done with pot, and they had this sand and silt in a pot. And they put glyphosate in, and then they were just tracking it over time. Two years later, two-thirds of it was still around. So it was really going away very, very slowly. And it really depends on the soil type. Some soil types, it's actually kind of trapped, and then the microbes can't get at it, and it just sits there. Most microbes cannot metabolize it, so it depends upon having microbes in the soil that can break it down. If you do have those microbes, I think it's great. And I think people are learning to cultivate that idea.

Stephanie Seneff:

In fact, it's interesting because there's this fungus, aspergillus. Aspergillus is a fungus that's actually toxic. We've had trouble with aspergillus micro-toxins in our food. And aspergillus is very capable of completely breaking down glyphosate and using its phosphorus as a source of phosphorus. I think some of the overgrowth of pathogens that we're seeing is a consequence of those pathogens being able to metabolize glyphosate. It depends on the soil type. It depends on the sun. If glyphosate gets into the ocean and gets too deep to have sunlight exposure, that also makes it last a long time.

Stephanie Seneff:

A recent experiment on glyphosate in waterways, they were really surprised. They did an experiment with glyphosate in water that had sort of organic matter in it, these sort of biofilms in the waterway. And they found that glyphosate went right into the biofilms and disappeared from the water. So it looked as if it was gone. But then when they looked in the biofilm, it had like, I don't know, a thousand times as much glyphosate as what was in the water.

Stephanie Seneff:

So that's scary too because I just wrote an article together with Jennifer Margulis on the manatees in southern Florida. It was published in The Washington Post, an opinion piece. I wrote about the Florida problems with glyphosate in the book, I have a section on that with the overgrowth of the red tide and the blue-green algae. They've got quite a mess over there with the overgrowth of these microbes.

Dr. Joseph Mercola:

That may be related to the fertilizer they're using.

Stephanie Seneff:

It is, yes.

Dr. Joseph Mercola:

Because with Lake Okeechobee is where most of the rivers drain into from the farmlands. And they're spraying all these phosphates or fertilizers, and it winds up feeding the algae, and you get the red tide.

Stephanie Seneff:

But the cyanobacteria, actually, are able to fully metabolize glyphosate, and they can use the phosphorus in glyphosate as a source of phosphorus.

Dr. Joseph Mercola:

That's interesting.

Stephanie Seneff:

So glyphosate is a phosphorus fertilizer as far as the cyanobacteria are concerned. And then they-

Dr. Joseph Mercola:

But then you've got the phosphorus they're adding in addition to that too.

Stephanie Seneff:

Yes, exactly. And we talked about that in the article. We talked about the phosphate fertilizer, but people are overlooking glyphosate as a source of phosphorus-

Dr. Joseph Mercola:

Interesting.

Stephanie Seneff:

-particularly because it kills off the competition and so the cyanobacteria just take off. And then they block the sun, and then the food that the manatee eats can't grow because it's too dark, plus it's being poisoned by glyphosate. A recent study found glyphosate in the manatees. Manatees are testing positive for glyphosate. And I think the glyphosate is a major player in their problems. They've been in really bad shape this year. I got diverted there, didn't it? But it's basically-

Dr. Joseph Mercola:

No, no, it's an important topic because, as a company, we came up with a solution and actually proposed it to some of the governmental agencies, which they didn't implement, which is really simple because it's primarily the sugarcane fields that are being grown and have the glyphosate and the phosphate fertilizers. So, it's a tremendous supplier of biomass.

Dr. Joseph Mercola:

So you could take the sugarcane husks and create biochar and, essentially, filter all that affluent runoff through the biochar, collect it, essentially eliminate the phosphate and the glyphosate, bind it all up, and then you put it back in the soil. It completes the cycle and eliminates the problem, but they refuse to do it because you have to create biochar. A few million dollars of investment to create the generators, not the generators, the kilns or the furnaces to do that. But it's a total solution, and it completes the regenerative cycle.

Stephanie Seneff:

I know. It's sad that they don't recognize these obvious solutions to us that make so much sense. I know there's that phosphate catchment basin that's leaking in Florida right now. They've been pumping tons of highly phosphate-contaminated water into the bay because they're afraid the dam is going to break and people are going to – it's just an awful mess. That's a problem with the phosphate fertilizer.

Stephanie Seneff:

That gets back to the whole notion of organic farming because these are synthetic fertilizers. The phosphate and nitrate fertilizers are probably a major contributor to global climate change, nitrate in particular because that nitrous oxide. And glyphosate disrupts the uptake of the nitrogen into the soil. So you end up with a combination effect there which is true in so many cases where the

nitrous oxide gets released into the air. And that's 100 times worse than carbon dioxide as a fuel, global warming.

Dr. Joseph Mercola:

We've kind of talked about the permanent solution, which is to eliminate glyphosate from the environment. But in the meantime, best-case scenario it's going to be a long time away, that's best-case. And then we may never be able to eliminate it. It's possible. So, what are the practical things that we can do personally to protect ourselves from this onslaught of metabolic catastrophe from glyphosate exposure?

Stephanie Seneff:

Well, obviously, the key thing to do for yourself is to buy certified organic food. I think that helps a lot. Studies have shown that they're not necessarily glyphosate-free, but if they do have glyphosate it's typically a lot less. And they're not allowed to use glyphosate, but, of course, it's pervasive, so they can't avoid it. It shows up in the foods but at much lower levels. I'm very conscious about purchasing only certified organic when I shop at the grocery store. And I think that has really helped to improve the health of both myself and my husband. We've really seen health benefits from that. I think that's number one.

Stephanie Seneff:

And then, of course, I also think eating a high-sulfur diet is important because sulfur is, I think, really crucial for the health of your metabolism and the health of your immune system. Sulfur deficiency, I think, is a component of our problems, a driver behind some of our health problems.

Dr. Joseph Mercola:

And what's your current position on glycine, the amino acids?

Stephanie Seneff:

Yes, glycine, that's right.

Dr. Joseph Mercola:

[crosstalk 00:57:07] because the theory is that if you have a sufficient amount of glycine in your body to create your own amino acids, it's not going to necessarily substitute the glycine in glyphosate into that amino acid [crosstalk 00:57:22].

Stephanie Seneff:

There's going to be a competition between glycine.

Dr. Joseph Mercola:

[crosstalk 00:57:26].

Stephanie Seneff:

If there's lots of glycine, you're going to be much less likely to pick up glyphosate. I think that's, actually, a really good idea. And you've suggested that and other alternative medicine specialists

have told me that they've had success with glycine. And glycine is probably not very expensive and very safe, so it's an easy thing to take as a supplement, which I think could definitely help to chase away the glyphosate from affecting your bones. People have talked about folic acid.

Dr. Joseph Mercola:

I even give it to my chickens.

Stephanie Seneff:

That's great. I love your chickens. That's so fun that you're growing your own chickens.

Dr. Joseph Mercola:

I've got almost two dozen now. It's great.

Stephanie Seneff:

That's just wonderful. So glycine and sulfur and, perhaps fermented foods, I think, are good. Vitamin K2 is important to make sure you have plenty of that. And vitamin D, of course, sunlight exposure, so I'm really a big fan of sunlight. And vitamin D is getting messed up by glyphosate as well because that's the cytochrome P450 enzymes, both the liver and the kidney have CYP enzymes that turn vitamin D into the active form.

Dr. Joseph Mercola:

It's interesting, that's what I was taught in medical school, but the more recent science shows, although it's still true, it's in almost in all your immune cells. It's [[crosstalk 00:58:41](#)].

Stephanie Seneff:

I know it is, yes. I know.

Dr. Joseph Mercola:

It's crazy.

Stephanie Seneff:

They also convert into other things. It goes down different pathways, not necessarily the pathway that activates it. It can actually get taken out of your blood and turned into sort of an inactive form by the immune cells, under conditions, probably, that reflect some status that the cells are trying to deal with. The cells have just an amazing ability to change their behavior on the basis of signals that they see and that's related to health issues.

Stephanie Seneff:

I think when the mitochondria get sick, the cells behave very dramatically differently from when the mitochondria are healthy, necessarily because they can't make enough ATP (adenosine triphosphate) with the mitochondria. That's how you end up with a cancer cell too because it starts making ATP use glycolysis, taking in lots of sugar and turning it into lactate, and then shutting down the mitochondria, the cancer cells do that. And I think that's because the mitochondria are disturbed.

Dr. Joseph Mercola:

Fortunately, there's really only a handful of principles you need to follow. And if you follow those, you're going to be healthy and you're going to avoid almost all disease. There's literally five or six things to do. Part of those five or six, avoiding glyphosate assiduously, religiously, obsessively.

Stephanie Seneff:

There you go.

Dr. Joseph Mercola:

You've got to be ridiculous about it because it's so dangerous. And you have to know and understand that because no one in the media will tell you this, no one. They'll tell you the exact opposite, which is [crosstalk 01:00:14].

Stephanie Seneff:

That's very frustrating.

Dr. Joseph Mercola:

It's doublespeak and it's becoming the norm now, not the exception. Everything they tell you, it's the exact opposite.

Stephanie Seneff:

It's amazing, isn't it? You can't believe they could get so many things wrong.

Dr. Joseph Mercola:

I know. It's crazy. You have made such a magnificent contribution. It literally is the bible of glyphosate, from my perspective. I've never read a better book on it. It doesn't go into the history and some of the politics and stuff, but that's fine. But if you just want the science, the solid science, well-referenced and documented, you've got to pick up this book. I think I wrote-

Stephanie Seneff:

I've got it here.

Dr. Joseph Mercola:

I wrote an endorsement of your book.

Stephanie Seneff:

[inaudible 01:00:55]. What does it say? Where is it?

Dr. Joseph Mercola:

Toxic Legacy.

Stephanie Seneff:

Oh, your endorsement.

Dr. Joseph Mercola:

Endorsement is on there too. In the endorsement I said, "This is the 21st Century equivalent of 'Silent Spring.' This is what it is."

Stephanie Seneff:

That's great. Thank you.

Dr. Joseph Mercola:

And I really believe that. I wouldn't say that if I didn't believe it was true. It's so obvious, and it's such an amazing synchronicity or serendipity that you actually read her book when it first came out.

Stephanie Seneff:

I know. That's so amazing. I was 14 years old at the time. I remember it well. I was really stunned by it, actually. It planted a seed in my mind that never left. I've always been concerned about toxic chemicals. I actually never used Roundup on my lawn because I just don't like toxic chemicals. I didn't know at the time that it was so toxic, but I just don't use these chemicals.

Dr. Joseph Mercola:

Well, I'm sure that's part of the reason why at your age your mind was working great. I know people who are not nearly as old as you and there's a bit of a challenge there going on. And we can see that in certain individuals in our administration. Because your body is designed to function incredibly well until you die. You just drop off like a dead Eveready battery bunny. But you've got full capacity until then, and if you don't do that, you're going to run into problems. And you've really applied these principles, and as a result you're reaping the benefits now. So if you want to reap the same benefits as Dr. Seneff, don't eat glyphosate. Avoid it like crazy.

Stephanie Seneff:

It is hard to avoid because it also could be in your water supply. It could be in the air.

Dr. Joseph Mercola:

You've got to filter your water. The air too, that's a tough one. We're all going to be wearing masks.

Stephanie Seneff:

I know because there's a new study out from Brazil that showed glyphosate. They measured glyphosate in the nanoparticles in the air, and they found, actually, higher levels in the city than they did in the areas where the glyphosate was being sprayed, which was very surprising.

Dr. Joseph Mercola:

Yes, indeed. All right, so the book is available pretty much everywhere. If you get on Amazon you can preorder it, or at your favorite bookstore. You don't have to use Amazon at all, pretty much everywhere. Any other closing comments you'd like to make?

Stephanie Seneff:

Just thank you for helping to promote my book. I really appreciate that, and I really do hope it sells well, not because I want to make a lot of money, but because I want to get the message out about glyphosate. I really hope it will have an impact.

Dr. Joseph Mercola:

I do too, because it's really rare where you're ever going to generate large sources of revenue from writing a book. Most people, not that they should know, but they really have no clue or understanding of the amount of effort and energy that goes into compiling a resource like this. You maybe make 50 cents or 75 cents an hour. The minimum wage would be like a magnificent improvement over what you're getting for writing this book because you have to put in hundreds, in your case probably thousands of hours to compile this.

Stephanie Seneff:

Yes, absolutely.

Dr. Joseph Mercola:

It's such a bargain to get this, and thank you so much for making that sacrifice and providing us with this great resource.

Stephanie Seneff:

Thank you.