

# 'Toxic Legacy' – How Glyphosate Destroys Your Health

Analysis by [Dr. Joseph Mercola](#) ✓ Fact Checked

## STORY AT-A-GLANCE

- › Glyphosate is a very efficient metal chelator. This, in turn, disrupts your gut microbes because it makes minerals unavailable to the microbes. Your gut microbes need those minerals, as their enzymes depend on them for proper functioning
- › There's a strong correlation between the rise in celiac disease over time and the rise in glyphosate usage on wheat, which is the primary culprit in celiac disease
- › Glyphosate may worsen the adverse effects of vaccines, in part because it binds very efficiently to aluminum used as an adjuvant in certain vaccines. Live virus vaccines that do not contain aluminum adjuvant have also been found to be contaminated with glyphosate
- › Non-GMO crops such as oats, wheat, barley and legumes like chickpeas and lentils tend to be very high in glyphosate because these crops are sprayed with glyphosate right before harvest as a desiccant to speed the drying process
- › Glyphosate also disrupts the shikimate pathway, both in plants and microbes, and beneficial microbes are particularly sensitive to glyphosate

Stephanie Seneff, Ph.D., a senior research scientist at MIT, has published a new book, [“Toxic Legacy: How the Weedkiller Glyphosate Is Destroying Our Health and the Environment”](#) – without doubt the best book ever written about glyphosate, the active ingredient in Roundup and many other toxic herbicides.

In this book, which has been a labor of love for the past decade, Seneff explains how and why glyphosate poses an existential threat to humanity, and why it's so important to avoid it if you care about your health and the health of your family.

*"It's been a decade of learning everything I could about glyphosate," Seneff says. "When I first heard about it I 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. Back in 2012, I heard a two-hour lecture by Don Huber, and it 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.*

*Shortly after that I found Séralini's paper,<sup>1</sup> which had not yet been retracted at that time. It was 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.*

*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 [make the connection]. We have diabetes, obesity, autism, Alzheimer's. It's a long, long list, all the gut problems.*

*The microbes are being very much disturbed by the chronic poisoning with glyphosate, and then the gut becomes a central starting point for many diseases, including neurological diseases and arthritis. So, you see that disruption of the gut, and glyphosate can cause exactly the things that we're seeing."*

## **Glyphosate Contamination in Common Products**

Before delving into glyphosate, Seneff spent five years focusing on the potential toxicities of vaccines. She still believes vaccines can play a role in the chronic diseases

we're seeing, including autism.

However, glyphosate may actually play a more significant role. Seneff believes it contributes to and worsens damage caused by vaccines, in part because it binds very efficiently to aluminum used as an adjuvant in certain vaccines. It likely binds strongly to many other toxic metals as well.

The theory is that, by being wrapped up with glyphosate molecules, the metals can more easily penetrate various barriers in your body. This is because glyphosate causes these barriers, such as your intestinal barrier and your blood-brain-barrier, to become more porous. And, as leaky gut or leaky brain set in, the toxic metals are shuttled across, along with the glyphosate.

Interestingly, Anthony Samsel, a public health research scientist, and Zen Honeycutt, founder and director of Moms Across America, have independently found glyphosate contamination in live virus vaccines that do not contain aluminum adjuvant.

Seneff suspects glyphosate may be a contaminant in many drugs as well, particularly drugs produced by genetically engineering *E. coli* or yeast. They've also found glyphosate in tampons, which may then be absorbed through your uterine lining.

Seneff also hypothesizes that, since glyphosate is found in many vegetable-based fats, such as [canola](#) and [soybean oil](#), studies comparing the health effects of fats may be compromised since they never consider the [effects of glyphosate](#). Interestingly, while not fat-soluble, glyphosate can still enter fats (and is found in the vegetable oils just mentioned).

Samsel suspects glyphosate acts as a phosphate analog, because it has a phosphonate unit, and fats have phosphates (phospholipids). This is something he's investigating right now, so eventually, we may learn more about that mechanism.

## **Glyphosate and the Rise in Celiac Disease**

In her book, Seneff details the dramatic increase in glyphosate use since its introduction in the mid-'70s. Estimates suggest every man, woman and child in America now consumes 1 pound of glyphosate a year through their diet, which is an astounding amount. It's not even enough to buy non-GMO products, as many non-GMO items have been shown to have some of the highest levels of glyphosate.

**“ There's a strong correlation between the rise in celiac disease over time and the rise in glyphosate usage on wheat ... which makes sense, because wheat is the source of celiac disease. ~ Stephanie Seneff, Ph.D.”**

Oats, wheat, barley and legumes like chickpeas and lentils tend to be very high in glyphosate because these crops are sprayed with glyphosate right before harvest as a desiccant to speed the drying process.

*“I think that's the reason for the epidemic in celiac disease,” Seneff says.*

*“Samsel and I wrote a paper on that. We showed 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 celiac disease.”*

A case study of an American woman who tried to commit suicide by drinking glyphosate reveal some of the chemical's effects. She developed a paralyzed gut, and this may well be what's happening to many, on a low-grade scale. In essence, people's guts are sort of semi-paralyzed by the glyphosate in the diet, which causes small intestinal bacterial overgrowth (SIBO).

Bacteria starts festering in the upper intestine because the peristalsis is not working properly, so food remnants get stuck. Glyphosate has also been shown to accumulate in

the brain, and animal studies show it causes neuro excitotoxicity due to excess glutamate in the brain. This, in turn, “is absolutely connected to autism,” Seneff says.

In her book, Seneff also discusses the importance of sulfur for optimal health, how sulfate deficiency is connected to autism, and how glyphosate can cause sulfate deficiency.

## **How Glyphosate Affects Your Gut and Autoimmunity**

Part of what makes glyphosate so toxic has to do with the fact that it’s a very efficient metal chelator. It binds metals and minerals really well. For example, glyphosate is a million times more effective at chelating aluminum than EDTA, a chelating agent used in heavy metal chelation treatment.

This, in turn, disrupts your gut microbes because it makes minerals unavailable to the microbes. Your gut microbes need minerals, as their enzymes depend on them for proper functioning. Glyphosate also disrupts the shikimate pathway, both in plants and microbes, and beneficial microbes are particularly sensitive to glyphosate.

When lactobacillus bacteria are killed off in your gut, your ability to digest gluten and casein (milk protein) is impaired, as this bacterium carries several enzymes your body does not have that specialize in breaking down proline, an amino acid found in gluten and casein. This, in turn, can eventually lead to autoimmune problems. Seneff explains:

*“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. Then the protein sticks around, the peptide sequence, and that's what causes an immune reaction.*

*Then you can get an autoimmune attack through molecular mimicry – the antibody mis-recognizes a human protein because it looks like the piece of gluten that they become sensitive to, so they attack a human protein instead.”*

## **Glyphosate Makes Harmful Fat Even More Hazardous**

Interestingly, glyphosate may also contribute to the [harm caused by the omega-6 fat linoleic acid](#) (LA). LA is metabolized into arachidonic acid, which is metabolized into an endogenous cannabinoid that eases pain. The enzyme that accomplishes this conversion is cytochrome P450 enzyme, which is disrupted by glyphosate.

Seneff suspects arachidonic acid is getting redirected through enzymes that convert arachidonic acid into extremely immunogenic products instead, such as leukotrienes, which act as signaling molecules that turn on an inflammatory response. A generic term for these signaling molecules is prostaglandins. She explains:

*“Leukotrienes are rightfully blamed for causing all the chronic pain we’re seeing – rheumatoid arthritis, joint and bone pain, and even, probably, problems with the brain, maybe headaches.*

*All the different kinds of pain we’re experiencing that are connected to inflammation could be a consequence of cytochrome P450 enzymes blocking the ability to convert arachidonic acid into the endogenous cannabinoid. Instead, it gets redirected towards these signaling molecules that cause all this damage.”*

On top of that, LA, when oxidized, turns into highly toxic free radicals such as 4HNE, which cause direct oxidative stress damage to cell membranes, mitochondria, stem cells and DNA. In your mitochondria, a feedback loop then occurs that causes the shutdown of your energy metabolism system, resulting in an increase in adipose tissue. Translation: Excessive LA causes accumulation of belly fat.

## **Glyphosate Is a Biological Toxin**

Its effect on the shikimate pathway is a key mechanism by which glyphosate causes biological harm in humans. The human body does not have this pathway – a fact used by Monsanto to argue for glyphosate’s safety. But the microbes in your body do have it.

Research has shown over half the microbes, on average, in your gut have the shikimate pathway and can therefore be decimated by glyphosate.

These include lactobacillus and bifidobacteria, which use the shikimate pathway to produce the aromatic amino acids tryptophan, tyrosine and phenylalanine, crucial coding amino acids that go into all the proteins of your body. They're absolutely essential for protein assembly, and your body must rely on your diet and gut microbes to produce adequate amounts of these amino acids, as your body cannot produce them any other way.

When your gut microbes are harmed, it can result in a deficiency of tryptophan, tyrosine and phenylalanine. These amino acids are also precursors to many other important biologically active molecules. For example, tryptophan is a precursor to melatonin and serotonin. Tyrosine is a precursor to thyroid hormone, dopamine and adrenaline.

*“These are all really, really important hormones that control brain behavior and regulate behavior and mood,” Seneff says. “Serotonin deficiency is connected to depression, and we have an epidemic in depression. So, I think there's a direct path there. Also, some of the B vitamins come out of the shikimate pathway, including thiamine (B1), riboflavin (B2) and niacin (B3) ...*

*You need thiamine for augmenting your immune system. If you don't have a lot of thiamine, you're not going to be able to generate a healthy immune response. That's why it's a part of septic protocols. If you're wrecking it with glyphosate exposure that's disrupting the shikimate pathway in your gut microflora, you've got a huge problem.”*

## **Glycine Can Help Counteract Adverse Effects of Glyphosate**

One simple remedy that can help lower your glyphosate burden is to take a glycine supplement. As explained by Seneff, the way glyphosate disrupts the shikimate pathway is by affecting an enzyme called EPSP synthase. That enzyme bonds to a molecule called phosphoenolpyruvate (PEP). The “phospho” in that name stands for phosphate.

At the place where SPSB synthase binds to PEP, there's a glycine molecule. It's a highly-conserved glycine in the enzyme. If that glycine is swapped out for alanine, a very similar amino acid, the SPSB synthase 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," Seneff says.*

Incidentally, this is how agricultural scientists create glyphosate-resistant GMO crops. They turn the glycine molecule into alanine, thereby rendering the plant impervious to glyphosate.

When glyphosate enters your system, it can take the place of the glycine molecule. While similar, (the "gly" in glyphosate stands for glycine) it's not identical and does not work the same way as glycine. Hence, this replacement causes all sorts of trouble.

By taking a glycine supplement, you can counteract this chain of events by making sure there's enough glycine present to fill up those glycine slots. As noted by Seneff, "If there's lots of glycine, you're going to be much less likely to pick up glyphosate." She continues:

*"I had thought about glyphosate being glycine, and knowing that it's a glycine analog and that it was affecting places where glycine binds. Glycine acts as a neural transmitter. Glyphosate messes that up. I thought, 'I wonder if it can get into the protein in place of glycine?'*

*My book actually centers on this idea that glyphosate substitutes for glycine in certain proteins. There's a specific algorithm for where it would happen, and you can show that those proteins are suppressed by glyphosate experimentally."*

Importantly, glyphosate suppresses glucose-6-phosphate dehydrogenase (G6PD), a very important enzyme in red blood cells that maintains NADPH in its reduced form. If you have reduced levels of NADPH, you're at increased risk for chronic disease, as your

ability to recharge antioxidants is impaired. This is yet another mechanism by which glyphosate contributes to any number of disease states.

## **Glyphosate's Impact on Collagen**

Yet another protein that has a high glycine content is collagen, the primary protein for your connective tissue. It constitutes about one-quarter of your body's proteins. Because of the presence of glycine, glyphosate has the ability to impair collagen as well.

*"I feel confident that glyphosate is messing up collagen," Seneff says. "Collagen has a beautiful triple helix structure, which gives it really special properties of tensile strength and flexibility to hold water. Collagen has long, long sequences called GXY, GXY, GXY, where every third amino acid is a glycine. Those glycines hook together to form that triple helix.*

*There are people who have mutations in those glycines that cause joint and bone diseases, and I think glyphosate is causing that. Ehlers-Danlos syndrome is associated with glycine mutations in collagen, and there's an increase in the prevalence of that syndrome recently.*

*Of course, you have many more people getting hip replacement surgery, and people have back issues, back pain and shoulder surgery, knee and foot problems. All these different problems with the joints, I suspect, are being caused by misfolded collagen because of glyphosate messing it up."*

## **Glyphosate's Impact on Your Vascular System**

Another mechanism of action involves the suppression of nitric oxide (NO), primarily through the suppression of endothelial nitric oxide (eNOS), which is one of three ways your body makes NO. eNOS is a close relative to cytochrome 450 enzymes which, as mentioned, are decimated by glyphosate.

*"The NO works together with sulfur dioxide to control the viscosity of your blood," Seneff explains. "NO turns into nitrate, which is a kosmotrope. And*

*sulfur dioxide turns into sulfate, which is a chaotrope ... Chaotropes and kosmotropes are very interesting molecules that control the viscosity of blood. It's all about water structuring, stuff that Gerald Pollack talks about.*

*Kosmotropes make the water structure more like gel and the chaotropes make it more like fluid, liquid. Those two work against each other to maintain the correct viscosity of the blood while other things are going on. If you put a bunch of lipid particles into the blood, it's going to get more viscous, so you've got to make it less-viscous by adding NO.*

*So, there's a back and forth between NO and sulfur dioxide that's regulated by eNOS. This is a theory that I have, and it makes a lot of sense. I have continued to gather evidence that supports it.*

*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, so you end up with blood clots."*

## **More Information**

One piece of good news is that Mexico is banning glyphosate and will phase it out entirely by 2024. There are fears Mexico may also start banning U.S. imports found to be contaminated with glyphosate, which would actually work in everyone's favor by shining a bright light on the matter.

While the ultimate answer is to ban the use of glyphosate worldwide, in the meantime, a key strategy to protect your own health is to buy certified organic or biodynamic food. Glyphosate is not permitted in organic agriculture, and even if contamination occurs, the levels are going to be far lower than that of conventionally-grown foods.

Seneff also recommends eating a high-sulfur diet, as sulfur is crucial for the health of your metabolism and immune system. "Sulfur deficiency, I think, is a driver behind some of our health problems," she says.

Also consider taking a glycine supplement to counteract and push out any glyphosate you might be exposed to. “Glycine is not very expensive and it is very safe, so it's an easy thing to take as a supplement, which I think could definitely help,” Seneff says.

Other health-promoting habits include eating plenty of **fermented foods** and getting optimal amounts of vitamin D and K2. As noted by Seneff, your vitamin D conversion is also adversely affected by glyphosate.

As is typically the case when talking to Seneff, as she is phenomenally well-informed, we cover far more details in this interview than I've summarized here – including environmental effects and countermeasures to speed the cleanup of soil and water – so I encourage you to listen to the interview in its entirety.

Of course, to learn more about glyphosate, be sure to pick up a copy of “**Toxic Legacy.**” It's by far the best book to date on this pernicious toxin that is robbing people everywhere of their health and quality of life.

## Sources and References

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- <sup>1</sup> [GMOSeralini.org](http://GMOSeralini.org)