

Glyphosate: Modern Attack on the Gut

By ZACH BUSH MD

Since last year, when the World Health Organization's International Agency for Research on Cancer (IARC) classified glyphosate as a "probable human carcinogen," there has been a lot of media coverage of the potential health risks associated with use of this herbicide.

Glyphosate is a weed killer, the active ingredient in Roundup®, that was first patented and introduced by Monsanto in 1974 for agricultural use. Later it was marketed to consumers as a household herbicide. It is sprayed in staggering quantities on most commercially grown staple crops, including wheat, corn, soybean, beet, cotton, canola, and alfalfa.

Glyphosate kills bacteria, fungi, and plants by blocking the Shikimate enzyme pathway in these organisms. The Shikimate pathway is responsible for producing the carbon ringed essential amino acids, such as tryptophan, that serve as critical building blocks for hormones and other proteins in animals and humans. By blocking the production of these critical nutrients in the soil and plant, the plant dies, thus the herbicide effect. Glyphosate has also been patented as an antibiotic/antiparasitic chemical. Unfortunately, this results in soil and crops that are deficient in critical nutrients for human health.

Glyphosate as Dessicant -- Wheat and Beyond

What many people do not know is that since 1992, glyphosate has also been widely used as a "ripening agent" or desiccant on wheat and many other grains. This application stresses or kills the plants, to accelerate the ripening and drying of the grain for an earlier harvest. This allows farmers, especially in Northern climates, to get two growing cycles each season in many cases.

Desiccating wheat with glyphosate is particularly common in years with wet weather and has been increasing in Upper Midwestern states in the US, as well as in areas of Canada and Scotland (where the process began). This pre-harvest application means there's even more glyphosate residue on the grain by the time it reaches market than there would be if the compound had only been used as an herbicide during the growing process.

In addition to wheat, glyphosate is also used as a dessicant on oats, rye, lentils, peas, flax, potatoes, buckwheat, and millet.

In our lab in Virginia, we have been testing glyphosate levels in common foods. The amount of glyphosate in one typical non-organic fast food meal is estimated at 20-40 ppm. That, in addition to the gliadin protein from gluten, is enough to degrade human

intestinal tight junctions in cell culture almost immediately upon contact.

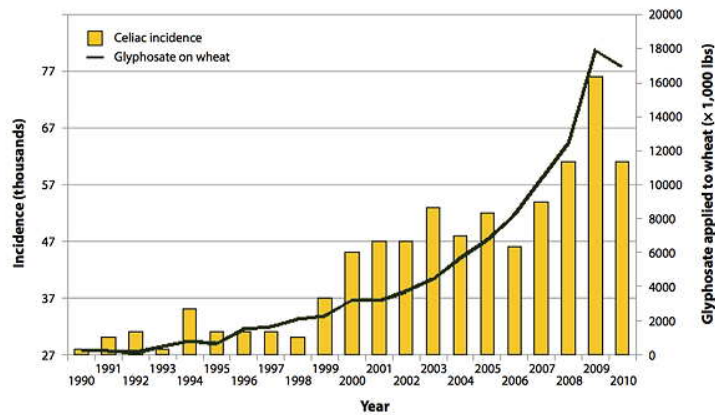


Figure 1. Hospital discharge diagnosis (any) of celiac disease ICD-9 579 and glyphosate applications to wheat ($R=0.9759$, $p<1.862e-06$). Sources: USDA/NASS; CDC. (Figure courtesy of Nancy Swanson).

Figure 1 reflects data from the USDA and the CDC, which demonstrates the sharp rise in usage of glyphosate on US wheat in the last decade, in step with the sharp rise in the incidence of Celiac disease.

Not “Safer than Salt”

Gluten intolerance and Celiac disease now affects an estimated five percent of the population of North America and Europe. Symptoms include nausea, diarrhea, skin rashes, macrocytic anemia, and depression. It is also associated with numerous nutritional deficiencies as well as reproductive issues and increased risk to thyroid disease, kidney failure, and cancer. In 1996, New York’s attorney general sued Monsanto over the company’s use of “false and misleading advertising” about Roundup. That case ended with Monsanto agreeing to stop calling Roundup “biodegradable,” and to pull ads claiming that Roundup was “safer than table salt,” “practically nontoxic,” and “stayed where you put it.”

The state of California has also moved to classify the herbicide as a probable carcinogen. A growing body of research is documenting the detrimental effect of glyphosate as an endocrine disruptor. The substance also kills beneficial gut bacteria, damages the DNA in human embryonic, placental and umbilical cord cells, and is linked to birth defects and reproductive problems in laboratory animals.

One Pound Glyphosate Per Person

Monsanto introduced the glyphosate herbicide (Roundup) following the ban on DDT in the 1970s. The company started selling it direct to consumers in the 1980s. Since that time, agricultural and consumer use have both skyrocketed, washing out of our driveways, our lawns, and our croplands and into our water systems.

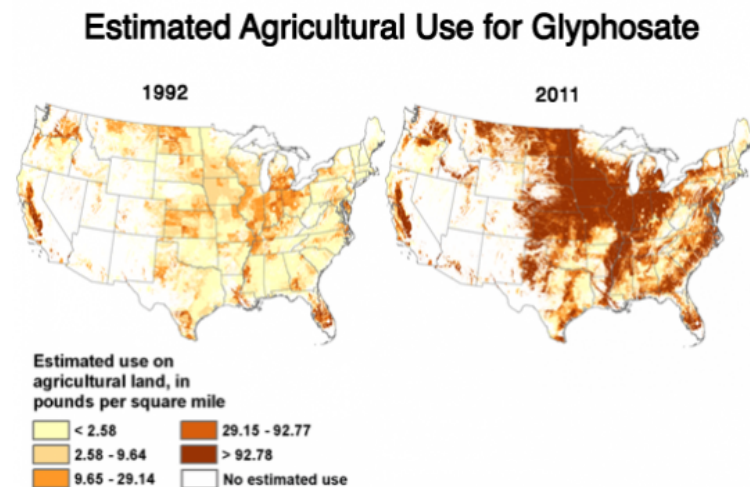
In 1996, Monsanto debuted the first genetically engineered glyphosate-resistant “Roundup-Ready” crops -- corn and soybean. Now the whole crop could be sprayed throughout its lifecycle to prevent weeds, and increase crop yield. With each passing year more acres of wheat, corn, soybean, beet, cotton, canola, alfalfa, and other staple crops are sprayed with glyphosate.

Glyphosate is dumped on us at the rate of 300 million pounds per year, almost one pound for every person in the US, according to [an article in Newsweek](#).

Another recent study in the Southern US found 75% of air and rainwater samples to be contaminated by glyphosate, [according to EcoWatch](#). The [US Geological Service reports](#) that more than 88,000 tons of glyphosate were used in the US in 2007, up from 11,000 tons in 1992. Since the advent of “super weeds,” the use of glyphosate has risen significantly.

Globally, glyphosate use has risen almost 15-fold since Roundup-Ready crops were introduced in 1996, now with more than 2 billion kg used worldwide in 2015.

The maps below are from the Department of the Interior’s US Geological Survey:

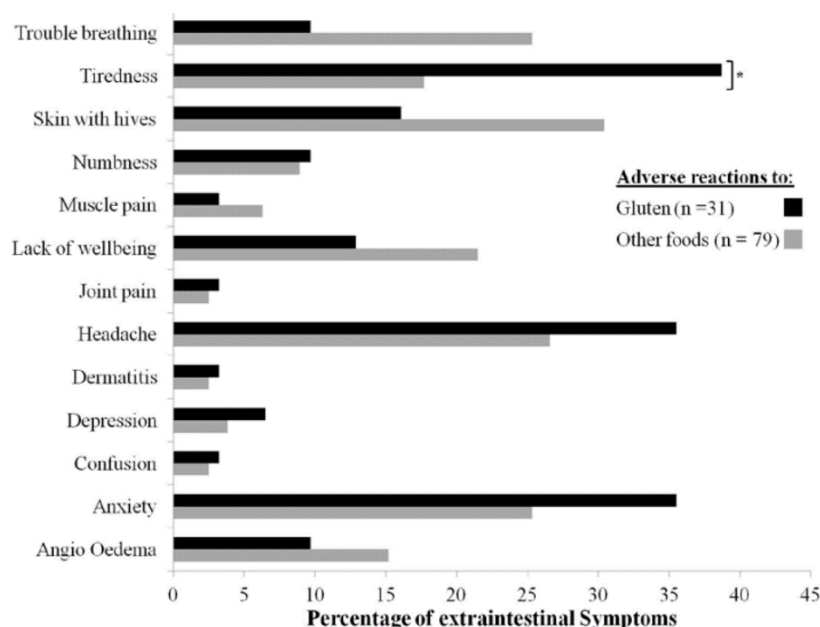


[Reuters reported](#) that researchers found residues of glyphosate in an astounding 41 of 69 honey samples, 10 of 28 samples of soy sauce, three of 18 breast milk samples and six of 40 infant formula samples.

Tight Junction Damage

In the intestines, glyphosate directly damages the extracellular matrix (the connective proteins that maintain the structure of the cell, and the cohesive nature of the gut and vascular membranes). It damages the epithelial tight junction tissue on contact, weakening the barriers that protect us on the inside from the barrage of other environmental toxins to which we are exposed. Injury to the tight junction membrane in the gut can lead to intestinal permeability.

Like the gliadin protein from gluten, glyphosate acts through zonulin-mediated pathways to damage the tight junction system. Zonulin can then go systemic to affect the extracellular matrix and tight junction systems throughout the body; injury to the tight junction membrane in the vascular system of the blood-brain barrier can result in the host of neurological symptoms typical with gluten sensitivity and Celiac disease.



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With the collapse of the tight junction firewalls, all organ systems go under duress. Just behind that microscopically thin layer of protection of the endothelial cells that separate you from the outside world is the gastrointestinal lymphatic tissue (GALT). The GALT is a layer of immune cells that are vigilantly standing guard to address any breach in your firewall. It is estimated that 60-70% of the immune system, and more than 80% of the antibodies that the immune system produces, originate in the GALT.

The acute inflammatory response becomes chronic inflammation as the system is overwhelmed with toxins from the outside world.

The gliadin protein in gluten also stimulates release of zonulin. I agree with William Davis, MD, author of [Wheat Belly](#), who holds that, "When gliadin triggers zonulin release, intestinal tight junctions are disrupted, and unwanted proteins ...gain entry to the bloodstream. Immune-activating lymphocytes, such as T-cells, are then triggered to begin an inflammatory process against various 'self' proteins, thus initiating ...conditions such as celiac disease, thyroid disease, joint diseases, and asthma."

Glyphosate enhances the damaging effects of other food-borne chemical residues and environmental toxins. Negative impact on the body is insidious and manifests slowly over time as inflammation damages cellular systems throughout the body ([Samsel A, Seneff S. *Entropy*. 2013; 15\(4\): 1416-1463](#))

Glyphosate & GMOs

Genetically-engineered or genetically-modified organisms (GMOs) are live organisms whose genetic components have been artificially manipulated through creating unstable combinations of plant, animal, bacteria, and even viral genes that do not occur in

nature, or through traditional crossbreeding methods. Genetic modification was created to allow our staple crops to be heavily sprayed with Roundup without dying. These Roundup-Ready crops have become the dominant component of the diet in our human and livestock food chains, and also contribute to ethanol-based gas for transportation and utilities.

In the US, 88% of the corn crop, 93% of the soybean crop, 90% of sugar beets (accounting for 54% US sugar production), and 94% of cotton are genetically engineered to be able to survive the application of glyphosate. Consequently, they can be sprayed heavily with glyphosate to control weeds and simplify harvest.

What this means is that much of the US food supply is contaminated even prior to harvesting – think of the corn, soy, and their oils, and beet sugar used in processing packaged foods. Additionally, factory-farmed livestock fed corn and soy products concentrate the glyphosate in their flesh, further contaminating the food supply chain.

How to Best Avoid Glyphosate

Here are some recommendations I give to my patients for avoiding exposure to glyphosate:

- *Eat as low on the food chain as possible:* This is good advice for a number of reasons; avoiding glyphosate is a big one.
- *Obviously, avoid all GMO foods:* including processed and packaged foods containing non-organic corn, soybean, and sugar in all their myriad varieties. Organic means non-GMO. There are many non-organic packaged foods now bearing the non-GMO certification.
- Choose vinegar as a home weed killer: Don't use Roundup!

Animal-derived foods pose complex issues for people trying to avoid environmental toxins. Animals fed and fattened on corn, soybean, and alfalfa feed are basically accumulating and concentrating glyphosate, as well as other toxins, including animal antibiotics. This holds true for non-organic dairy products as well, which also concentrate glyphosate in cows' milk.

Supporting Tight-Junction Integrity

Our company, Biomic Sciences, has developed a product called Restore™, a liquid mineral supplement that supports tight-junction integrity. We have been doing a number of interesting studies investigating the effects on intestinal tissue from gluten and glyphosate. One of them, which has been submitted to a peer-reviewed journal, shows that glyphosate and the gliadin protein found in gluten appear to have a synergistic negative effect on gut permeability/leak.

Restore is a new generation, earth-derived supplement that promotes an optimal gut environment. It is not a probiotic. It is not a prebiotic. Rather, it is a carbon-rich, alkaline liquid. The active ingredient in Restore is Terrahydrite, a family of molecules that are made by bacteria as they digest (metabolize) nutrients, that function as a communication network throughout the cellular systems of the body. These bacterial metabolites are extracted from fossil soil (lignite) to access the vastly more diverse

bacterial ecosystem that existed in the verdant soils of 60 million years ago. Biomic Sciences combines our 100% US-sourced, all natural ingredients using a proprietary, multi-step state-of-the-art manufacturing process in our own labs and production facility in Virginia.

Tight junctions are protected by the activated metabolites of bacterial digestion. Restore is the first dietary supplement that delivers a balanced family of bacterial metabolites, to promote a healthy firewall of tight junctions in the gut wall and blood-brain barrier. These tight junction firewalls are intelligent gates, which keep things out of the immune system and bloodstream (and out of the brain) that shouldn't be there, and at the same time allow nutrients to enter the bloodstream.

Additionally, the bacterial metabolites Restore provides are the interspecies communication network to support the return of biodiversity to the gut ecosystem, which in turn supports normal immune function. With 70% of the immune system located in the gastrointestinal-associated lymphoid tissue (GALT) of the gut, the optimal gut environment supported by Restore can lead to greater overall health. When the intestinal bacteria are balanced and thriving in extreme diversity of 20,000 or more species, this matrix of metabolites produces a strong enzyme defense system that protects the tight junctions from the toxin zonulin, which is made at the intestinal lining when it is exposed to toxins, leading to intestinal permeability/leak.

The hallmark of Restore is that it is based in science. Our Science Team is currently exploring how Restore directly supports the entire extracellular matrix (ECM). The extracellular matrix has long been recognized as the scaffold system for every single cell in the body, and in recent years the science has leapt forward, recognizing the ECM as a dynamic structure composed of tight junctions, gap junctions, and actin filaments that manage mobility of the organ structures.

There have been a few other soil extract supplements on the market over the centuries, but Restore is the first to target and deliver the bacterial metabolites rather than the mineral content of the soil, and the first to directly support the tight junctions and extracellular matrix. In addition, other soil extract products (shilajit, humic acid, fulvic acid) can have significant kidney toxicity; in laboratory cell culture studies, causing an increase in kidney cell death by more than 250% within hours of exposure (kidney tubule cells are the most sensitive cells in the body, and the gold standard for toxicity testing). We have conclusive laboratory evidence that kidney cells bathed in 100% concentrations of Restore reveal no toxicity, but show increased cell longevity.

Recommended usage of Restore is one teaspoon three times daily. At three teaspoons per day, a 16-ounce bottle is a one-month supply for one person, and a 32-ounce bottle the best value as a two-month supply. Taking Restore before meals is preferred for maximum efficacy. Optimally 30 minutes before a meal because of Restore's protective effects versus gluten and especially glyphosate, but you can take it immediately before, with a meal, or after a meal, or on an empty stomach, and still receive benefit. Restore is vegan, gluten-free, dairy-free, soy-free, latex-free, sulfite-free, preservative-free, non-GMO, and is produced in a facility free of allergens, including peanuts and tree nuts.

Most important, many people feel Restore working in the gut, sometimes within 20 minutes of taking the first teaspoon. It has little taste and can be taken alone or in non-chlorinated water.

Check out our website, restore4life.com, to see a video presentation of how Restore™ supports human intestinal tight junction cells in the presence of gliadin and glyphosate exposure.

Zach Bush, MD, is medical director of a new, integrative medicine practice in Charlottesville, Va. He is also the founder of Biomic Sciences, a nutraceutical company that recently launched Restore, a unique supplement product that can support the repair of the gut wall by reestablishing proper tight-junction function.