Glyphosate, Chronic Use and Chronic Toxicity, a Global Pandemic and Matter of Immediate National Security

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Objectives:

- Present Glypohsate MOA, unique properties, and its basis for Chronic Toxicity
- Present current patterns of use and implications
- Present platform for awareness and change

***Glyphosate Facts and Mode of Action***

- Glyphosate is a systemic chemical used primarily for herbicidal application in agriculture and home use. Glyphosate was originally patented as a chelator for industrial boilers and pipes, with two subsequent patents, as an herbicide and as a broad-spectrum antibiotic[1]. The main threat posed by glyphosate is its background, chronic effects on microbiological stability, critical enzyme pathways, and degradation of immunological mechanisms.

- Glyphosate is a chelator. It chelates most cations, or positively charged mineral elements, including Calcium, Magnesium, Copper, Zinc, Manganese, and many more.

- Glyphosate is labeled for its disruption of the Shikimate Pathway, at the target site of the 5-enolpyruvylshikimate 3-phosphate synthase, or EPSPS enzyme (Glyphosate label, SDS). This is the pathway for biosynthesis of the essential aromatic amino acids Phenylalanine, Tyrosine, and Tryptophan. Humans and animals do not have the shikimate pathway, and must get these *essential amino acids* from our food and gut microorganisms. However, nearly all plants, bacteria and fungi DO have the shikimate pathway.

- Glyphosate destabilizes a number of enzymatic pathways, not just the shikimate pathway. Glyphosate disrupts nearly 300 known critical enzymatic pathways, by pulling out the mineral catalysts (cation trace minerals) (Wei Lu, 2013).

- Glyphosate is systemic; it cannot be metabolized by plants. Microbial degradation of glyphosate rarely goes beyond the Aminomethyl Phosphonate (AMPA) stage, which is still a very powerful chelator. It is persistent in many soil types, and takes far longer to degrade than originally proposed. It is very stable in the soil, and competes for exchange sites with organic phosphorous, binding to the clay fraction of soil (Tomlin, 2006) (Prata*, Cardinali, Lavorenti, Tornisielo, & Regitano, 2003).

- In the soil, glyphosate is toxic to beneficial microorganisms, including mycorrhizal fungi (Magdalena Druillea, (2013) ), fluorescent pseudomonads, rhizobia, baccilus, and many

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[1] Glyphosate patents, 1964, 2008, 2010

more. At very low rates these organisms are highly sensitive to glyphosate (Carvalho, 2014). ***Pathogenic microorganisms*** are 10-100 FOLD less sensitive to glyphosate (M.Sihtmäe, 2013). Current recommended field application rates are more than sufficient to favor the overgrowth of pathogenic microbes, while concurrently devastating the beneficial populations.

- Glyphosate persistence in soil also presents the issue of immobilizing critical cation minerals in the soil environment (Luiz Henrique Saes Zobiole, 2010), making those minerals inaccessible to plants to acquire nutrition and develop into nutrient-dense foods (Marcelo Pedrosa Gomesa, 2015) (Selim Ecker, 2006) (Prata, Cardinali, Lavorenti, Tornisielo, & Regitano, 2003; Prata, Cardinali, Lavorenti, Tornisielo, & Regitano, 2003).

- Furthermore, the microbes that make inorganic forms of minerals plant-available are, again, the beneficial strains of microorganisms, and are susceptible to glyphosate at fractions of recommended application rates (Sarah H Lancaster, 2009).

***Patterns of use and Implications***

- The introduction of Herbicide Ready and Roundup Ready GMO crops in cereal and commodity production has changed the pattern of use for these herbicides. Whereas they used to be spot-applications, selectively used, they are now broadcast applied directly to crops (Kremer*, 2014). Herbicide-ready and glyphosate tolerant plants have been engineered to bypass the shikimate pathway through the insertion of bacterial genetics and a viral promoter to express the by-pass pathway. Those genetics have proven to be promiscuous in the soil environment through decomposition of plant residues, providing opportunities for lateral gene transfer of viral genetics for virulence in the soil microbial environment (Hart).

- Patterns of use in industrial agriculture include direct broadcast application for growth regulation, ripening dessicant, and weed control. Glyphosate is systemic. It is both xylem and phloem active. It accumulates in meristematic and reproductive tissue. Uptake from the soil is another pathway into food crops. Through these pathways the accumulation of pure glyphosate in our cereal and other food crops is reaching unprecedented levels (Marit R. Myhre, 2006) (Laboratories, 2016).

- Glyphosate disrupts human and animal gut microflora and fauna (Kru¨ger, 2015) (Kru¨ger A. A., 2013) (Emilie Clair, 2012). At 10 ppb, far less than residual levels in many common commodity crops, beneficial gut microbes are compromised, stimulating overgrowth of pathogenic and antagonistic gut organisms (Kru¨ger M, 2013) (Valentina Imparatoa, 2016). Gut dysbiosis is implicated in many modern diseases, including Autism, Parkinsons, Alzheimers, Crohn’s disease, and so many more. Glyphosate in food, as well as the rise of antagonistic microbes, increases inflammation in the gut and weakens intestinal tight junctions, allowing harmful compounds (including glyphosate) and proteins to enter the bloodstream, where they can provoke immune responses and, in the bloodstream, potentially reach the Blood Brain Barrier.

- Glyphosate's unique formulation, the amino acid glycine with a phosphonic acid moiety, presents even more insidious implications for biological life. Proteins are formed by the translation of RNA sequences of amino acids. RNA has been shown, repeatedly, in mammalian (including human) cell lines, to mis-incorporate synthetic amino acids in the place of their natural counterparts in protein synthesis, leading to increased proteolysis and to the misfolding of proteins (Hieronim Jakubowski*, 1992). Misfolded proteins are implicated in diseases where plaque forming proteins disrupt organ function, including in ALS, Parkinson's, and amyloid-related diseases.

***Platform for Awareness and Change***

- Consumers need this information. Chemical companies have built marketing campaigns for decades that portray glyphosate as 'harmless' and lacking any implications for biological life. Access to consumer groups, community leaders, and other influential groups is essential for change.

- Motivating farmers to move away from this and other systemic chemicals and herbicide dependent crop rotations will require community **support**, not attack. Farmers will respond to market demand when consumers show them the support and the desire for a return to a food system where soil health, water security, and nutrient density are at the fore.

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