



**Glyphosate: How a simple molecule
can cause so much destruction:
Part I**

Stephanie Seneff
MIT CSAIL

WAPF Wise Traditions Workshop
November 17, 2018

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[people.csail.mit.edu/seneff/2018/
Seneff_WAPF_2018_Part1.pptx](http://people.csail.mit.edu/seneff/2018/Seneff_WAPF_2018_Part1.pptx)



“Something very wrong is going on, something that is killing good people and causing untold suffering to families and communities around the world. Never has such a high percentage of the population been afflicted with so many tragic and wasting illnesses. In the past thirty years, a group of diseases has reached epidemic proportions in the United States and many other countries. These afflictions, often collectively referred to as diseases of civilization (DOC), include multiple sclerosis, Alzheimer's disease, breast cancer, lupus erythematosus, rheumatoid arthritis, melanoma, and autism - a once rare birth defect. Because the incidence of these diseases has increased gradually over three decades, we are inclined to accept this as a natural, if unfortunate, part of modern life. But such a lethal trend is not natural; the changes that we have witnessed over the last generation are unprecedented in the history of medical science.”

Woodrow C. Monte, PhD. While Science Sleeps. 2011

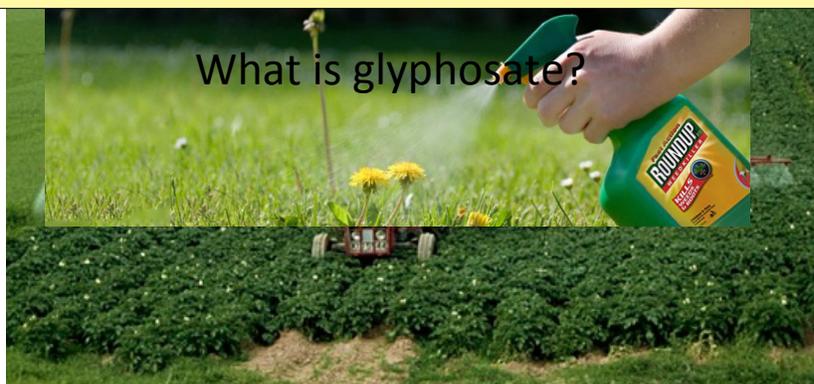
Outline: Part I

- Introduction
- California Lawsuit
- Celiac Disease, Autism and Glyphosate
- Glyphosate as a Glycine Analogue
- Fishing for Glycine
- Amyloid Beta, Dementia and Macular Degeneration
- Autoimmune Disease Epidemic
- Collagen, Chronic Pain and Opioid Drugs

Introduction

Roundup and GMO Crops

GMO Roundup-Ready corn, soy, canola, sugar beets
cotton, tobacco and alfalfa



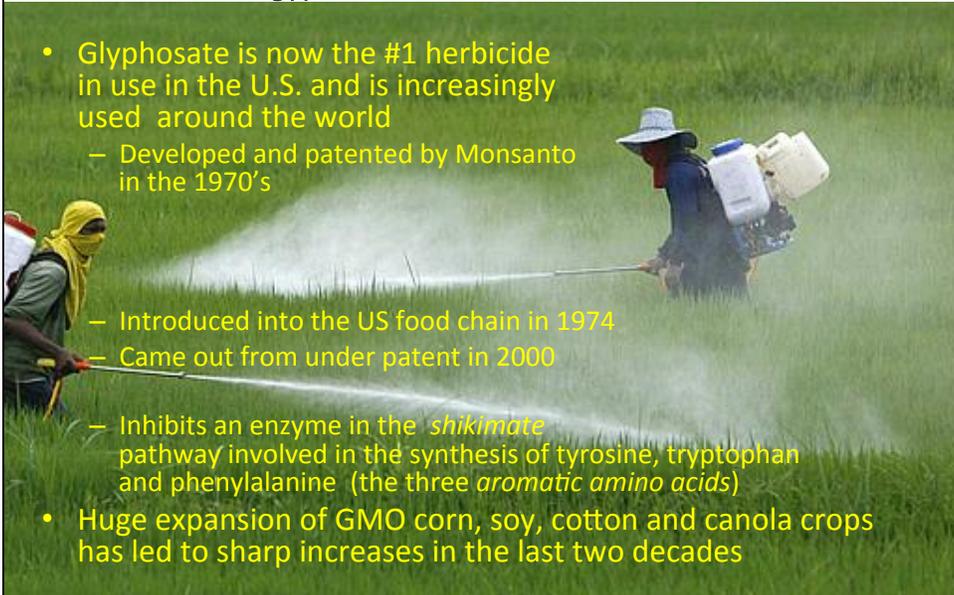
Roundup as a Desiccant/Ripener just before Harvest

Wheat, Oats, Barley, Rye,
Sugar cane, Beans, Lentils,
Peas, Flax, Sunflowers,
Pulses, Chick Peas

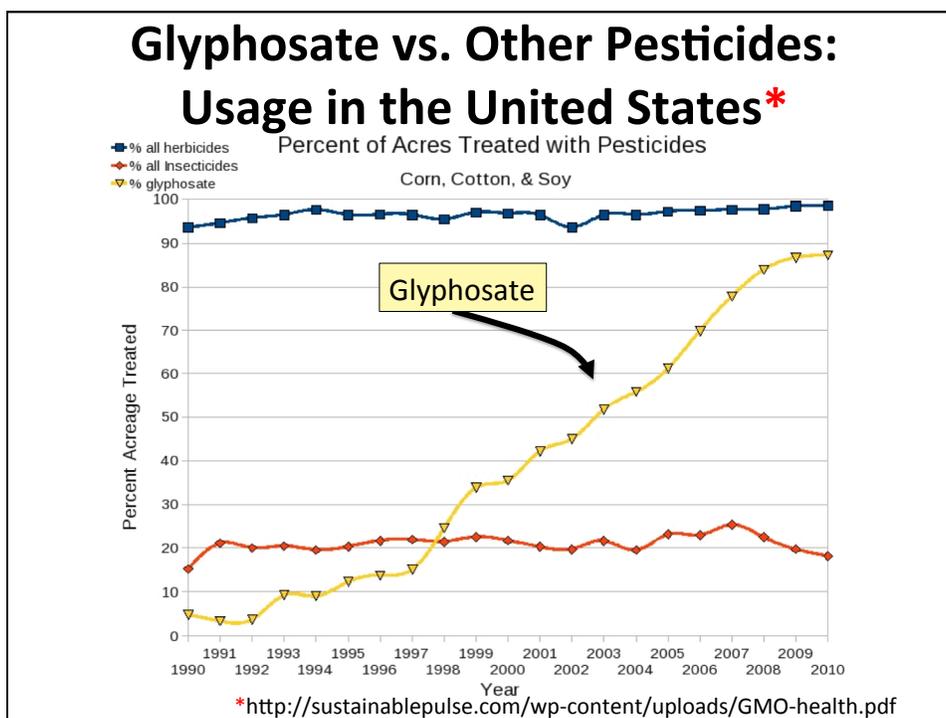


OC(=O)CNCP(=O)(O)O

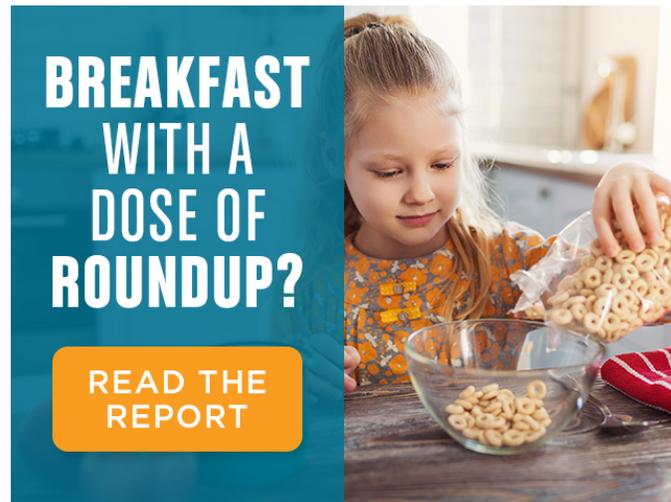
Glyphosate!!



- Glyphosate is now the #1 herbicide in use in the U.S. and is increasingly used around the world
 - Developed and patented by Monsanto in the 1970's
 - Introduced into the US food chain in 1974
 - Came out from under patent in 2000
 - Inhibits an enzyme in the *shikimate* pathway involved in the synthesis of tyrosine, tryptophan and phenylalanine (the three *aromatic amino acids*)
- Huge expansion of GMO corn, soy, cotton and canola crops has led to sharp increases in the last two decades

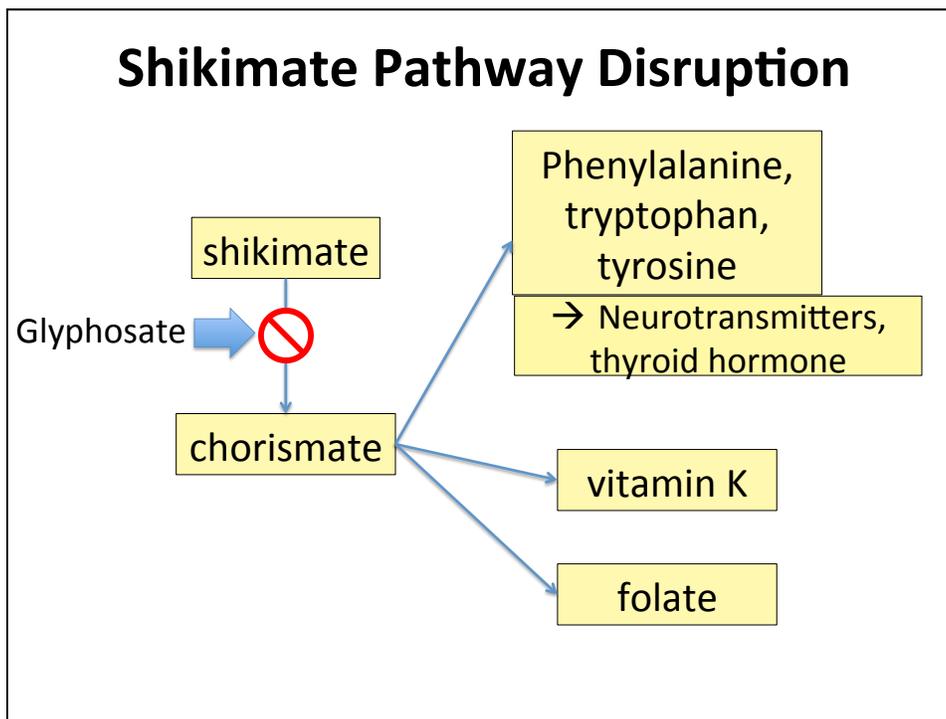


Environmental Working Group Results



Some Foods Containing Glyphosate





Paper Showing Strong Correlations between Glyphosate Usage and Chronic Disease

Journal of Organic Systems, 9(2), 2014

ORIGINAL PAPER

Genetically engineered crops, glyphosate and the deterioration of health in the United States of America

Nancy L. Swanson¹, Andre Leu^{2*}, Jon Abrahamson³ and Bradley Wallet⁴

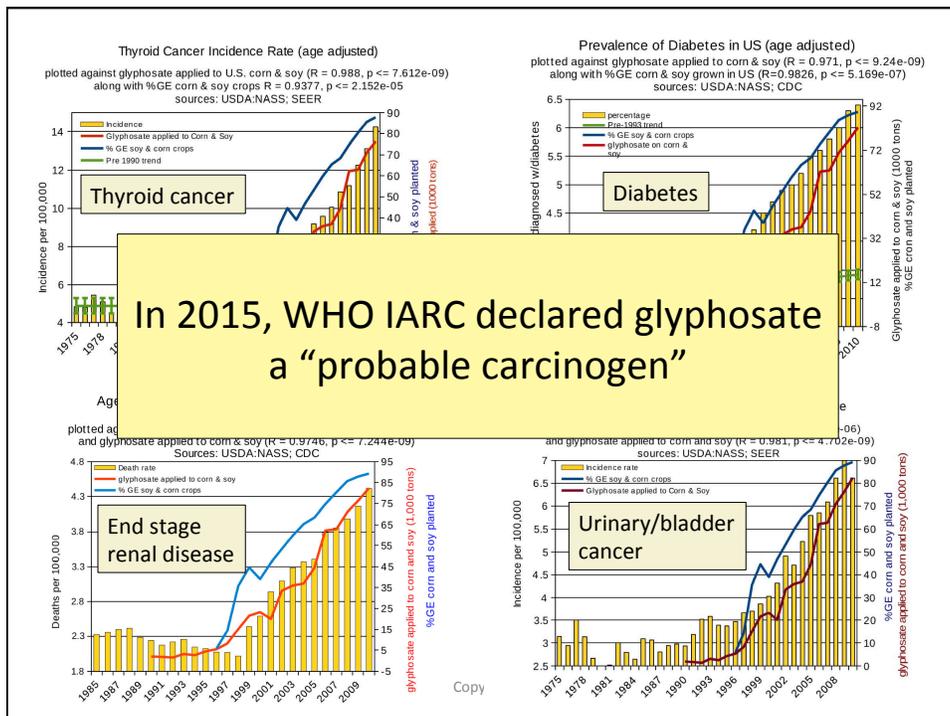
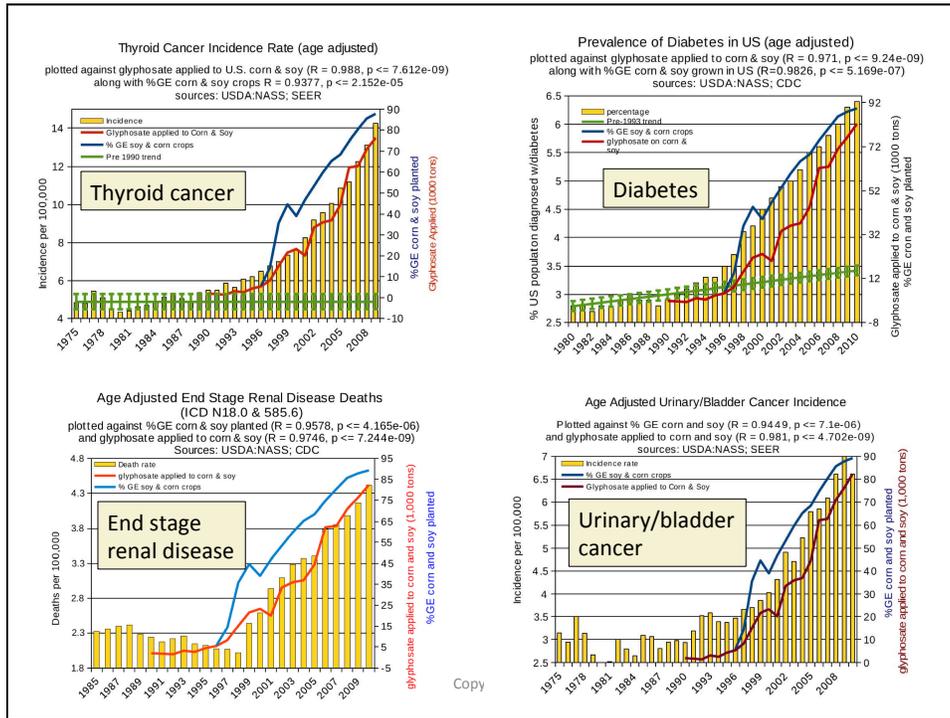
¹ Abacus Enterprises, Lummi Island, WA, USA

² International Federation of Organic Agricultural Movements, Bonn, Germany

³ Abacus Enterprises, Lummi Island, WA, USA

⁴ Crustal Imaging Facility, Conoco Phillips School of Geology and Geophysics, University of Oklahoma, USA

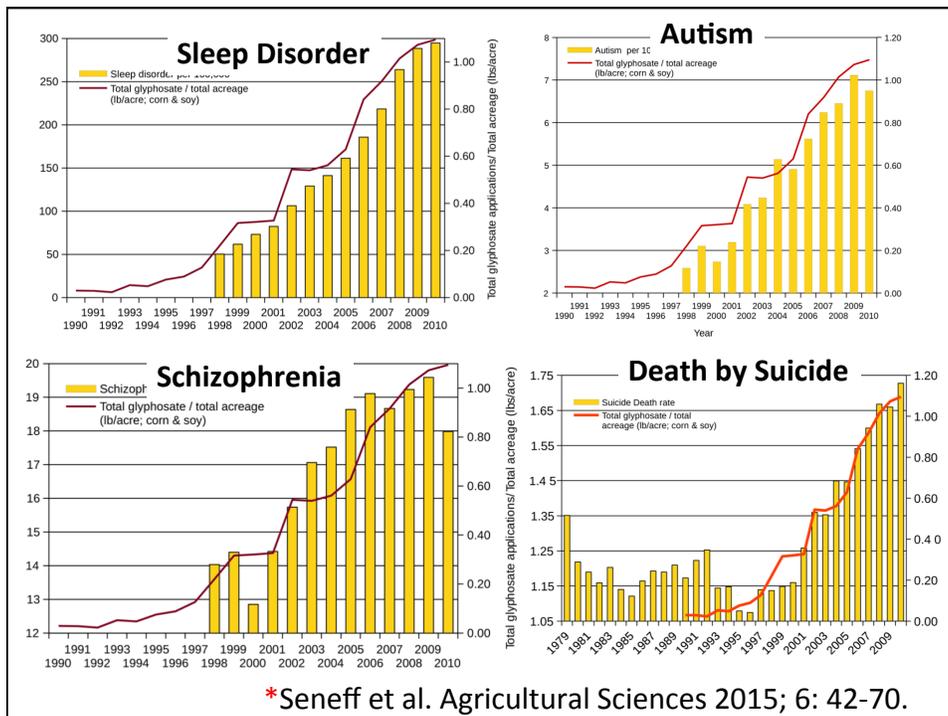
* Corresponding author: andreleu.al@gmail.com



Quote from the Conclusion*

“Although correlation does not necessarily mean causation, when correlation coefficients of over 0.95 (with *p*-value significance levels less than 0.00001) are calculated for a list of diseases that can be directly linked to glyphosate, via its known biological effects, it would be imprudent not to consider causation as a plausible explanation.”

*NL Swanson et al. Journal of Organic Systems 9(2), 2014, p. 32,



America's Children are in Trouble!

- It is now "normal" for a kindergarten child to have 12 colds every year and for a baby to have nine
- Fourfold increase in childhood obesity
- Double the asthma rate since the 1980's
- "Chronic illnesses" rose from 1.8% in 1960 to 7% in 2004
 - Today, 43% of US children are chronically ill
- 1 in 6 children in the USA has a neurodevelopmental disability
 - 1 in 38 boys are autistic
- US has the worst neonatal death rate of all industrialized countries
- Today's children in the US will have a shortened life span compared to their parents

Source: <http://www.vaccineviolence.com/>

What's Making Our Children SICK?

How Industrial Food Is Causing an
Epidemic of Chronic Illness,
and What Parents (and Doctors)
Can Do About It

EXPLORING THE LINKS BETWEEN
GM FOODS, GLYPHOSATE, AND GUT HEALTH

Michelle Perro, MD *and*
Vincanne Adams, PhD

cineviolence.com/

Decreasing IQ scores after 1975*

“scores increased by almost 3 percentage points each decade for those born between 1962 to 1975 -- but then saw a steady decline among those born after 1975.”



“What specific environmental factors cause changes in intelligence remains relatively unexplored.”

*Rory Smith, CNN.

<https://www.cnn.com/2018/06/13/health/falling-iq-scores-study-intl/index.html>

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Glyphosate was introduced on the market in 1975

“What specific environmental factors cause changes in intelligence remains relatively unexplored.”

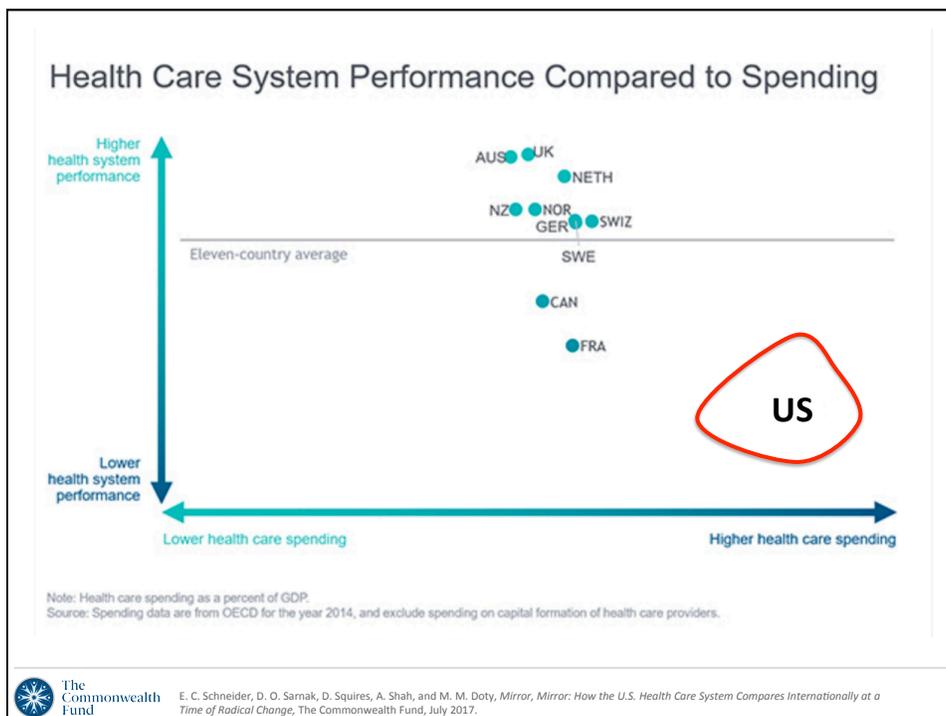
*Rory Smith, CNN.

<https://www.cnn.com/2018/06/13/health/falling-iq-scores-study-intl/index.html>

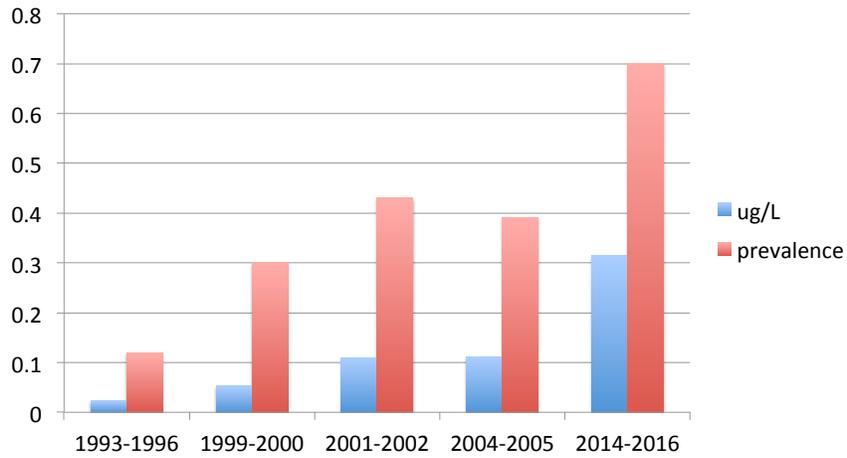
1 in 4 American Adults suffer from a serious disability (according to the CDC)*

- Mobility (serious difficulty walking or climbing stairs)
- Cognition (serious difficulty concentrating, remembering or making decisions)
- Hearing (serious difficulty hearing)
- Vision (serious difficulty seeing)
- Independent living (difficulty doing errands alone)
- Self-care (difficulty dressing or bathing)

*<https://www.cbsnews.com/news/1-in-4-u-s-adults-has-a-disability-cdc-says/>

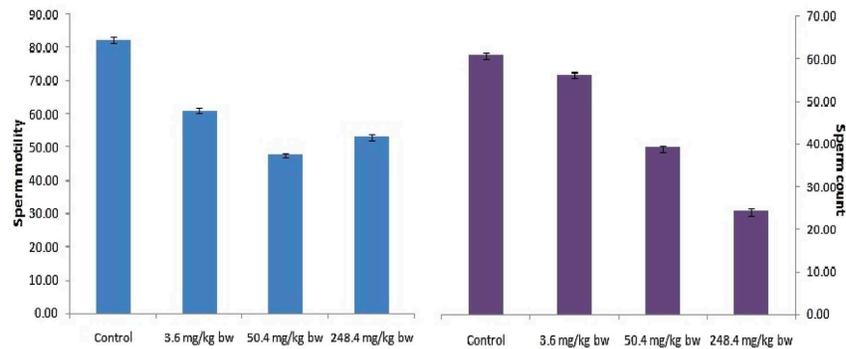


Glyphosate in Human Urine: U.S. Southern California*



*PJ Mills et al. JAMA 2017; 318(16): 1610-1611.

Glyphosate reduces sperm motility and sperm count*



*FO Owagboriaye et al. Experimental and Toxicologic Pathology 2017 Sep 5;69(7):461-468.

Glyphosate Damages Second Generation*

- Pregnant rats exposed to glyphosate starting at day 9 of gestation
- Two exposure levels (low, high), both levels considered to be safe according to regulators
- Neither the rats nor their offspring showed any obvious effects
- The second generation offspring from both exposed group showed delayed growth, lower fetal weight and length and a higher incidence of abnormally small fetusus
- *Most surprising: there were three cases (each from a different mother) among the second generation offspring with major fetal abnormalities (conjoined fetuses and abnormal limb development)*



*MM Milesi et al. Archives of Toxicology June 9, 2018 [Epub ahead of print]

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Genetically Modified Children



California Lawsuit

Dewayne “Lee” Johnson vs Monsanto: Glyphosate & Non-Hodgkin’s Lymphoma*

CNN U.S. • Crime + Justice • Energy + Environment, Extreme Weather • Space + Science Live TV U.S. Edition

He's dying of cancer. Now, he's the first patient to go to trial to argue Roundup made him sick

By **Holly Yan**, CNN
Updated 6:16 PM ET, Sun June 17, 2018

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Dewayne "Lee" Johnson



Skin lesions on Lee's back

*<https://www.cnn.com/2018/06/17/us/monsanto-roundup-dewayne-johnson-trial/index.html>

Details of the Lawsuit*

- Johnson was a groundskeeper for the school district in Benicia, CA, just north of San Francisco
- He was diagnosed with non-Hodgkin's lymphoma (NHL) in 2014, at age 42.
- In 2015, WHO's IARC classified glyphosate as "probably carcinogenic to humans"
- Donna Farmer, Monsanto's "product protection lead" said in email to colleagues:
 - "You cannot say that Roundup does not cause cancer."
- Timothy Litzenburg, one of Johnson's lawyers, said:
 - "so much of what Monsanto has worked to keep secret is coming out."



www.theguardian.com/business/2018/jul/09/monsanto-trial-roundup-weedkiller-cancer-dewayne-johnson

"We're going to see for the first time evidence that nobody has seen before, evidence that has been in Monsanto's files that we've obtained from lawyers and the people in Monsanto... I don't think it's a surprise after 20 years Monsanto has known about the cancer-causing properties of this chemical and has tried to stop the public from knowing it, and tried to manipulate the regulatory process."

-- *Robert F Kennedy, Jr.*
Co-counsel for Johnson

“Rampant Corporate Malfeasance”*

EMAIL TO DONNA FARMER
TOXICOLOGIST, MONSANTO

Per our phone call with John the other day, the next two most important things that we need to do are the Meta-analysis publication and the Ag Health Study Follow-up publication, assuming we can get our hands on the data in a reasonable tin

A less expensive/more palatable approach might be to involve experts only for the areas of contention, epidemiology and possibly MOA (depending on what comes out of the IARC meeting), and we ghost-write the Exposure Tox & Genetox sections. An option would be to add [REDACTED] and Kier or [REDACTED] to have their names on the publication, but we would be keeping the cost down by us doing the writing and they would just edit & sign their names so to speak. Recall that is how we handled Williams Kroes & Munro, 2000.

also, get a cost estimate from him.

For the overall plausibility paper that we discussed with John (where he

to do the analysis when we get the data;

WILLIAM HEYDENS
TOXICOLOGIST, MONSANTO

*<https://www.facebook.com/HighWireTalk/videos/2157052507846542/>

“Rampant Corporate Malfeasance”*

EN
TO:

“A less expensive/more palatable approach might be to involve experts only for the areas of contention, epidemiology and possibly MOA (depending on what comes out of the IARC meeting), and we *ghost-write* the Exposure Tox & Genetox sections. An option would be to add BLANK and Kier or BLANK to have their names on the publication, but we would be *keeping the cost down by us doing the writing* and they would just edit & *sign their names* so to speak. *Recall that is how we handled Williams Kroes & Munro, 2000.”*

*<https://www.facebook.com/HighWireTalk/videos/2157052507846542/>

AUGUST 11, 2018



🏠 SUSTAINABLE FOOD
SUSTAINABLE AGRICULTURE
GLOBAL GMO FREE COALITION
GMO EVIDENCE

Monsanto Loses Landmark Roundup Cancer Trial, Set to Pay USD 289 Million in Damages

Posted on Aug 11 2018 - 1:31am by Sustainable Pulse « PREVIOUS |

Categorized as

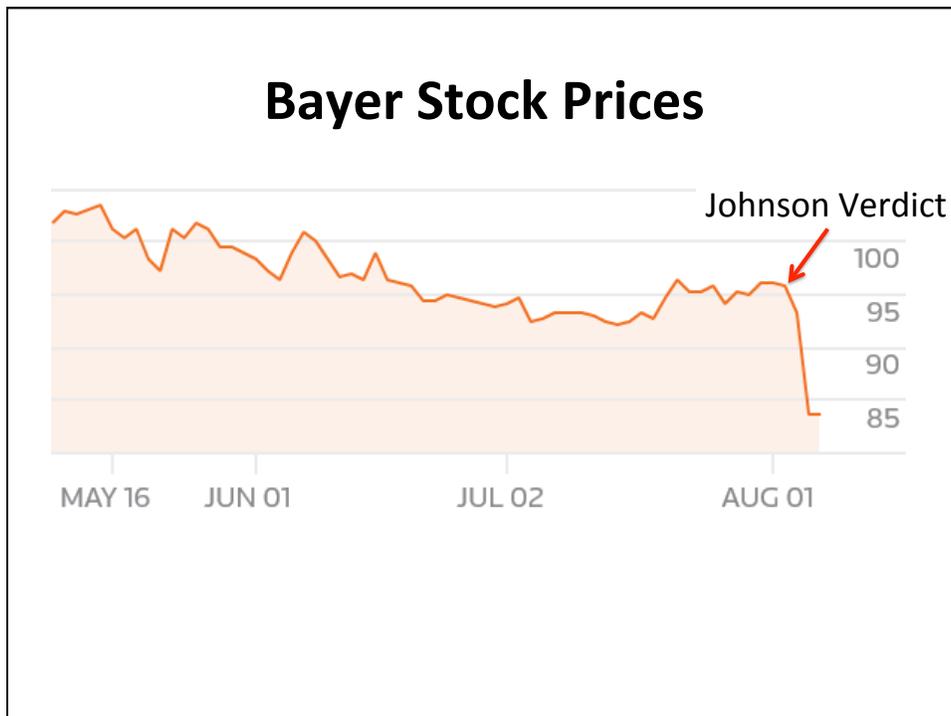
Breaking News

News

Pulse News

Highlights

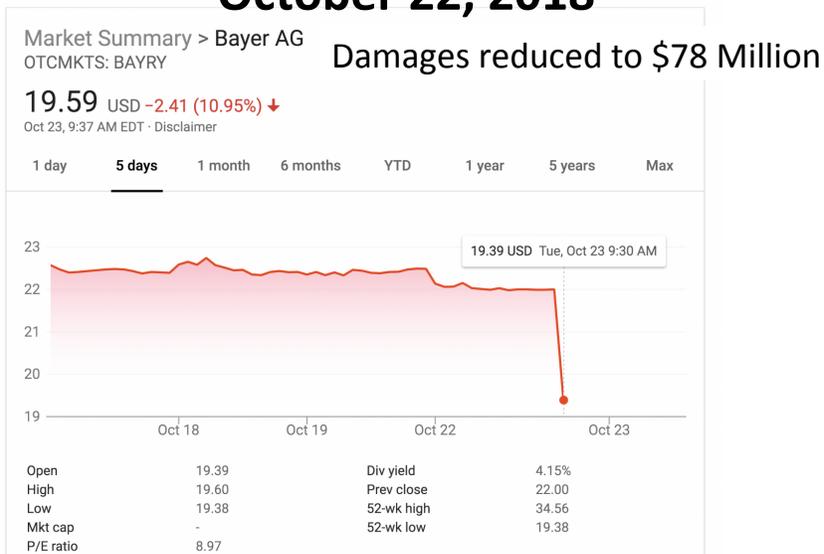
Monsanto has lost a landmark cancer trial in San Francisco and has been ordered by the Judge to pay over USD 289 Million in total damages to the former school groundskeeper Dewayne Johnson, a California father who has non-Hodgkin's lymphoma, which was caused by Monsanto's glyphosate-based weedkiller Roundup.



“Johnson’s jury heard evidence that for four decades Monsanto maneuvered to conceal Roundup’s carcinogenicity by capturing regulatory agencies, corrupting public officials, bribing scientists and engaging in scientific fraud to delay its day of reckoning. The jury found that these activities constituted “malice, fraud and oppression” warranting \$250 million in punitive damages.”

Robert F Kennedy, Jr. (lawyer in the defense)

Verdict Upheld in Higher Court: October 22, 2018



Celiac Disease, Autism and Glyphosate

Celiac Disease, Non-Hodgkin's Lymphoma and Glyphosate*

- People with Celiac disease statistically have a shortened life span, mainly due to increased risk to non-Hodgkin's lymphoma
- Statistics from the American Cancer Society show an 80% increase in non-Hodgkin's lymphoma since the early 1970's (when glyphosate was introduced)
- Several studies have shown a statistical correlation between occupational glyphosate exposure and non-Hodgkin's lymphoma
- Dewayne Johnson's lawsuit was based on non-Hodgkin's lymphoma



*A Samsel and S Seneff. Interdiscip Toxicol. 2013; 6(4): 159-184.

Proline-enriched Gluten Peptides

- Gluten is especially rich in proline, and the most allergenic peptides have even more proline
- Prolyl amino peptidase specializes in breaking proline bonds in peptides
 - It depends on manganese as a catalyst (glyphosate chelates manganese)
 - It has multiple highly conserved glycine residues that are essential for its function
- Especially allergenic 33-mer:^{*}
LQLQPF^PQPEL^PYPQPEL^PYPQPEL^PYPQP^PQPF

^{*}S Derum et al. Scientific Reports 2015; 6:25565.

Association Between Celiac Disease and the Risk of Autistic Spectrum Disorders

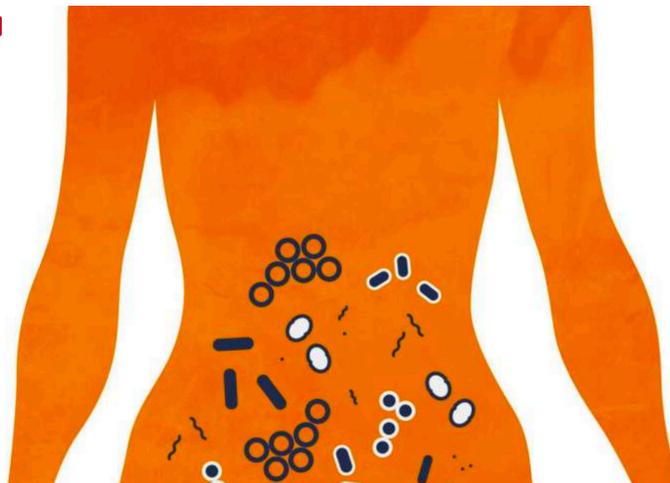
- In a large population-based study, autistic children had a much higher probability of testing positive for antibodies against gluten and/or against transglutaminase (an enzyme that modifies gluten)^{*}
- The mechanism appears to be distinct from that in celiac disease^{**}
 - Suggests immunologic and/or intestinal permeability abnormalities in affected children

^{*}JF Ludvigsson. JAMA Psychiatry 2013;70(11):1224-1230

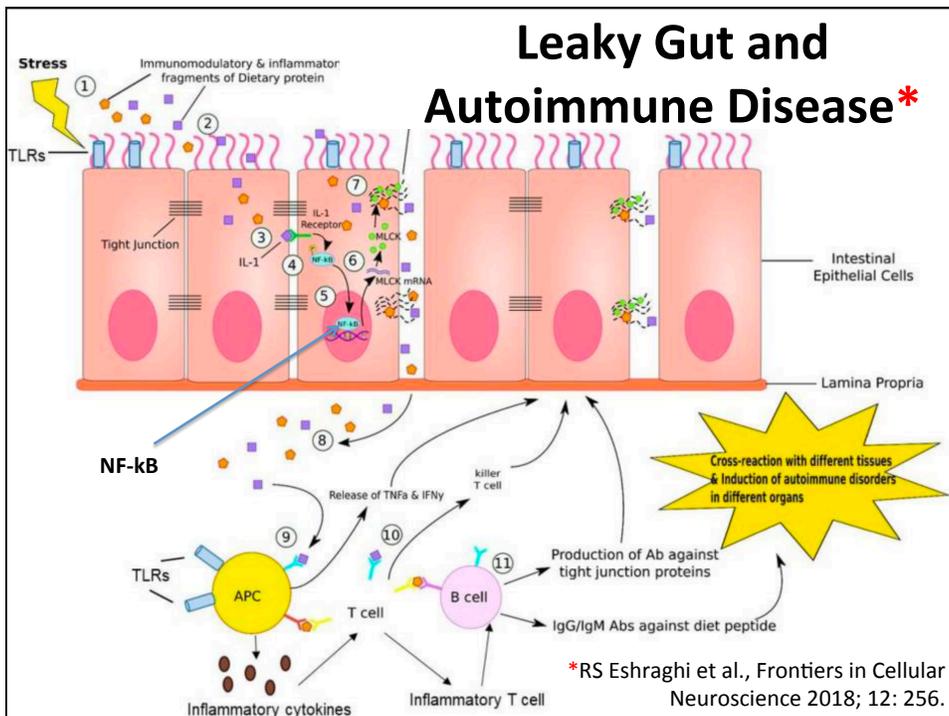
^{**}NM Lau et al. PLoS One 2013;8(6):e66155

Autism risk determined by health of mom's gut, research reveals

July 18, 2018, University of Virginia



*<https://medicalxpress.com/news/2018-07-autism-health-mom-gut-reveals.html>



CASE REPORT

Elevated Urinary Glyphosate and Clostridia Metabolites With Altered Dopamine Metabolism in Triplets With Autistic Spectrum Disorder or Suspected Seizure Disorder: A Case Study *

William Shaw, PhD

- Triplets: two boys, one girl. Both boys have autism and girl has seizure disorder
- Very high levels of glyphosate in urine in all three
- *Clostridia* overgrowth due to glyphosate disruption of gut microbes
 - Clostridia produce toxins HPPHA and p-cresol, which block the conversion of dopamine to norepinephrine.
 - Damage to neurons in the brain through oxidative stress

*W. Shaw. Integrative Medicine 2017;16(1);50-57.

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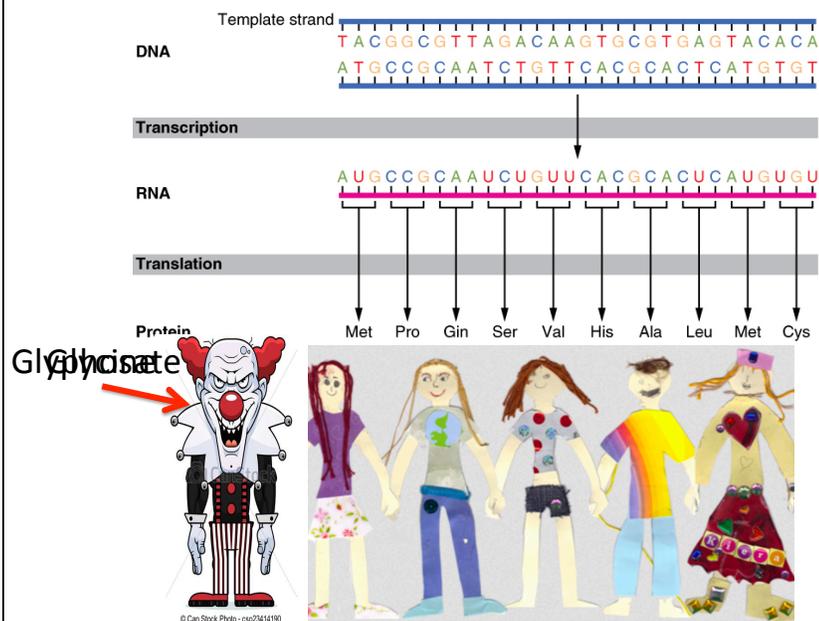
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 - Clostridia produce toxins HPPHA and p-cresol, which block the conversion of dopamine to norepinephrine.
 - Damage to neurons in the brain through oxidative stress

A recent study showed that patients with neurological disease had decreased activity of dopamine beta hydroxylase, the enzyme suppressed by Clostridia toxins. **

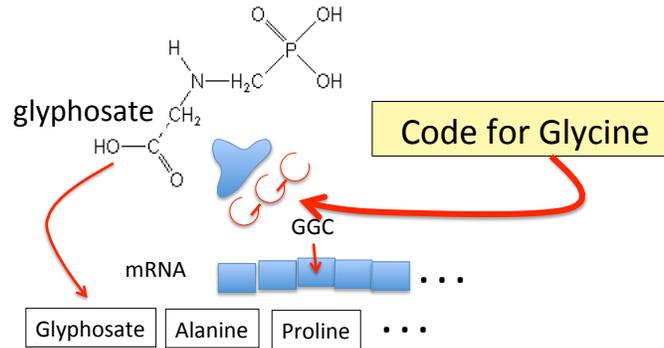
**Md. Khalilur Rahman et al. Int J Biomed Sci. 2009 Dec; 5(4): 395-401.

Glyphosate as a Glycine Analogue

The Basics of Protein Synthesis

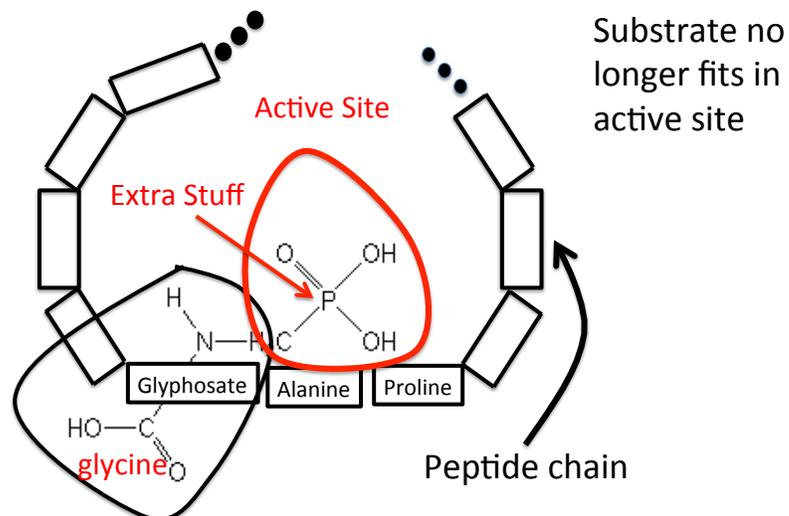


What If Glyphosate Could Insert Itself Into Proteins during Synthesis???



-- Any proteins with conserved glycine residues are likely to be affected in a major way

Extra Piece Sticks Out at Active Site



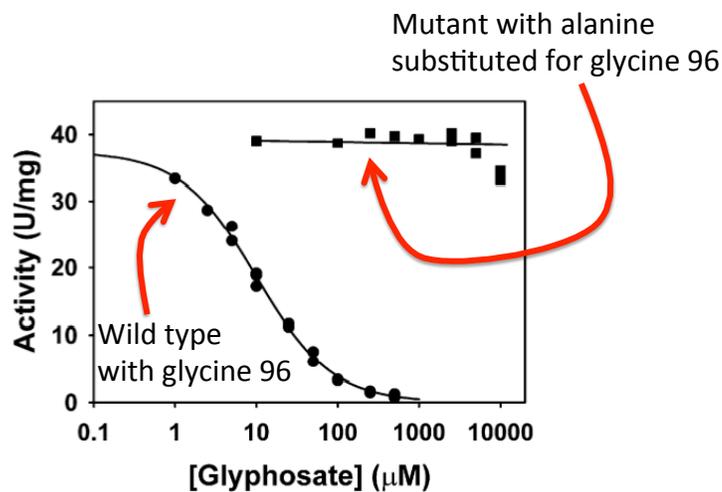
Extra Piece Sticks Out at Active Site

This explains how glyphosate disrupts EPSPs in the shikimate pathway: Multiple bacteria have developed resistance by replacing active site glycine with alanine and this is the basis for GMO Roundup Ready crops*

Substrate no fits in site

*T Funke et al., Molecular basis for the herbicide resistance of Roundup Ready crops. PNAS 2006;103(35):13010-13015.

Inhibition of EPSPs by glyphosate: Resistant E coli mutant*



*Figure 3, S Eschenburg et al. Planta 2002;216:129-135.

Only Glyphosate Works!*

“More than 1,000 analogs of glyphosate have been produced and tested for inhibition of EPSP synthase, but minor structural alterations typically resulted in dramatically reduced potency, and no compound superior to glyphosate was identified.”

Hypothesis:

These other molecules failed to work as an amino acid analogue of glycine, because they were not amino acids.

*T Funke et al. PNAS 2006; 103(35): 13010-13015.

Quote from Monsanto Study (1989)*

- Study exposed bluegill sunfish to carbon-14 radiolabelled glyphosate
- Measured radiolabel in tissues greatly exceeded measured glyphosate levels
- Proteolysis recovered more glyphosate
 - 20% yield → 70% yield



"Proteinase K hydrolyses proteins to amino acids and small oligopeptides, suggesting that a significant portion of the 14C activity residing in the bluegill sunfish tissue was tightly associated with or *incorporated into* protein."

*WP Ridley and KA Chott. Monsanto unpublished study. August, 1989.

Some Predicted Consequences*

- Neural tube defects
- Autism
- Impaired collagen → osteoarthritis
- Steatohepatitis (fatty liver disease)
- Obesity and adrenal insufficiency
- Hypothyroidism
- Impaired iron homeostasis and kidney failure
- Insulin resistance and diabetes
- Cancer

*A. Samsel and S. Seneff. Journal of Biological Physics and Chemistry 2016;16:9-46.

An Analogy: ALS in Guam

- An epidemic in ALS in Guam was traced to a natural toxin found in cycads
- BMAA is a non-coding amino acid that gets inserted by mistake in place of serine
- Defective versions of a glutamate transporter have been linked to ALS*
- The transporter has an essential serine-rich region in its sequence**

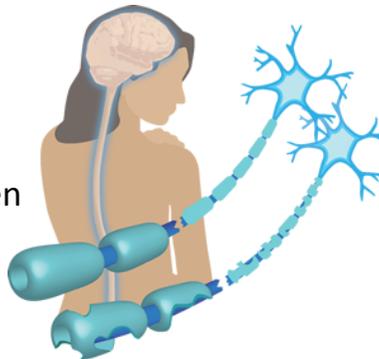


*Antioxidants & Redox Signaling 2009;11: 1587-1602.

**DJ Slotboom et al., PNAS 1999; 96(25): 14282-14287.

Another Analogy: MS & Sugar Beets*

- Sugar beets contain an analogue of proline called Aze
- Remarkable correlation between MS frequency and proximity to sugar beet agriculture
- Myelin basic protein contains a concentration of proline residues that are absolutely essential for its proper function



*E. Rubenstein, J Neuropathol Exp Neurol 2008;67(11): 1035-1040.

Fishing for Glycine

I want to teach you how to fish!



How to Fish

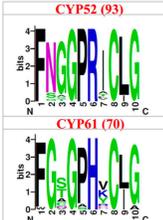
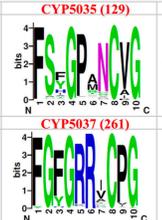
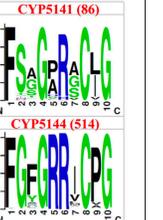
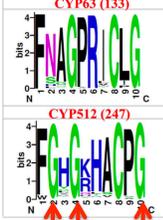
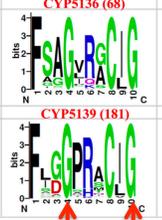
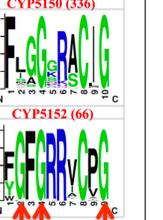
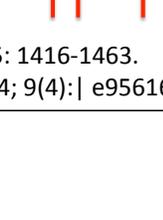
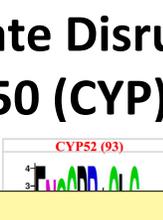
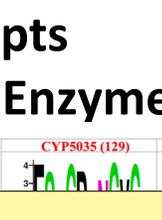
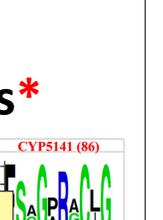
Myosin alignments

	170	645	180	190	HF																			
LT-DREN	S	S	G	G	V	N	T	R	V	I	Q	Y	108											
LD-DRON	S	S	L	L	I	G	G	T	T	E	N	T	K	V	I	Q	Y	108						
LS-EGKD	S	S	L	V	L	G	G	T	T	E	N	T	K	I	L	Q	Y	120						
RS-EGEN	O	C	I	L	I	G	G	T	T	E	N	T	K	E	A	S	K	Y	I	M	Q	Y	108	
RD-FDRD	O	C	I	L	I	G	G	T	T	E	N	T	K	E	A	S	K	L	V	M	S	Y	108	
AR-DEEM	O	S	I	I	V	G	G	T	T	E	N	T	K	V	S	A	K	Y	A	M	R	Y	109	
IR-DEVM	O	S	I	I	I	G	G	T	T	E	N	T	K	T	E	T	A	K	I	A	M	Q	Y	106
IN-EGKN	S	S	L	V	L	G	G	T	T	E	N	T	K	M	L	M	R	Y	109					

1. Find a glycine residue in an important protein class that is highly conserved across multiple species
2. Find papers describing the functional role of that glycine in the protein
3. Find an example of a genetic mutation mapping that glycine to something else and identify the resulting disease profile
4. Ideally: find papers that describe dysfunction of that protein linked to glyphosate exposure or a symptom profile of glyphosate exposure that could be explained by that protein's dysfunction

Glyphosate Disrupts Cytochrome P450 (CYP) Enzymes*

- Glyphosate has been shown to severely suppress CYP enzymes in rat liver
- CYP enzymes have a unique **FGXGXRXCXG** motif with two and often three critical glycine residues**

CYP52 (93) 	CYP5035 (129) 	CYP5141 (86) 
CYP61 (70) 	CYP5037 (261) 	CYP5144 (514) 
CYP63 (133) 	CYP5136 (68) 	CYP5150 (336) 
CYP512 (247) 	CYP5139 (181) 	CYP5152 (66) 

↑↑↑ GLYCINES

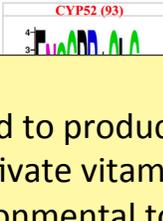
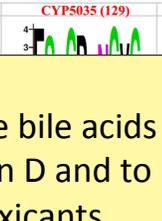
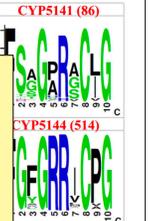
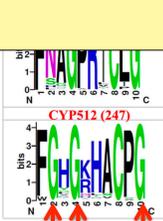
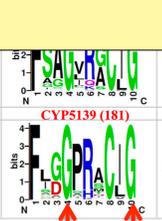
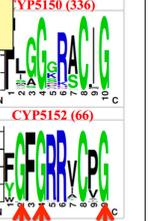
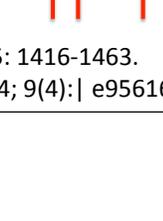
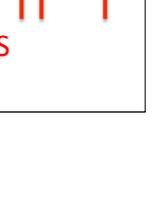
*A Samsel and S Seneff. Entropy 2013; 15: 1416-1463.
**K Syed and SS Mashele. PLOS ONE 2014; 9(4):| e95616.

Glyphosate Disrupts Cytochrome P450 (CYP) Enzymes*

- Glyphosate has been

CYP enzymes are needed to produce bile acids for digesting fats, to activate vitamin D and to detoxify many environmental toxicants

- unique **FGXGXRXCXG** motif with two and often three critical glycine residues**

CYP52 (93) 	CYP5035 (129) 	CYP5141 (86) 
CYP5144 (514) 	CYP5150 (336) 	CYP512 (247) 
CYP5136 (68) 	CYP5139 (181) 	CYP5152 (66) 

↑↑↑ GLYCINES

*A Samsel and S Seneff. Entropy 2013; 15: 1416-1463.
**K Syed and SS Mashele. PLOS ONE 2014; 9(4):| e95616.

Liver disease deaths spike among young Americans *

Posted: Jul 19, 2018 6:22 PM EDT
Updated: Jul 19, 2018 7:52 PM EDT

- Between 1999 and 2016, deaths from liver cirrhosis rose 60% among young adults in America, and deaths from liver cancer doubled
- Impaired CYP activity leads to inability to detoxify toxic chemicals, including both pharmaceutical drugs and pesticides
- Impaired bile acid synthesis leads to fatty liver disease

*<http://www.kpax.com/story/38687909/liver-disease-deaths-spike-among-young-americans>

**Villeneuve JP and Pichette V. Cytochrome P450 and liver diseases. Curr Drug Metab. 2004 Jun;5(3):273-82.

GxxGxxK Motif in Sulfotransferases *

- Sulfotransferases are crucial to attach sulfate ions to multiple bioactive molecules
- **Steroids** (cholesterol, estrogen, testosterone, vitamin D, ...)
- **Glycosaminoglycans** (chondroitin sulfate, heparan sulfate, ...)
- **Polyphenols, aromatics** (curcumin, resveratrol, tryptophan, ...)
- **Neurotransmitters** (dopamine, serotonin, melatonin, ...)

A	Human liver PST-M	G M A G D W K T T F T V A Q N I
	Human liver PST-P	G M A G D W K T T F T V A Q N I
	Human liver AST ₁	G M A G D W K T T F T V A Q N I
	Human brain AST ₂	G M A G D W K T T F T V A Q N I
	Human brain AST ₃	G M A G D W K T T F T V A Q N I
	Human placenta EST	G M A G D W K T T F T V A Q N I
B	Human liver EST	G I T G D W K N H F T V A L N I
	Guinea pig adrenal EST	G I S G D W K N H F T V A L N I
	Bovine placenta EST	G D V G D W K N H F T V A L N I
	Rat liver EST	G I V G D W K N H F P E A L R I
	Rat liver PST	G T T G D W K N T F T V A Q N I
	Mouse liver PST	G T I G D W K N T F T V A Q S I
C	Human liver HST	G V S G D W K N H F T V A Q A I
	Human liver HST	G V S G D W K N H F T V A Q A I
	Human liver HST	G V S G D W K N H F T V A Q A I
	Mouse liver HST	G T I G D W K N H F T V A Q A I
	Rat liver HST	G T V G D W K N H F T V S Q A I
	Rat liver HST	G T T G D W K N H F T V A Q A I
	Guinea pig adrenal HST	G T V G D W K N H F T V A Q A I

*H Chiba et al. Proc. Natl. Acad. Sci. USA 1995; 92:8176-8179.

Cationic antimicrobial peptides: naturally occurring antibiotics that are actively being explored as a new class of anti-infective agents*



```

Fowlicidin-1  -----PVRVKRVWPLVIRTVIAGI-YNL-YRAIKKK-----
Melittin      -----GIGAVLKVLTTGLPAL-ISWIKRRRQQ-
Cecropin-A1  GWLKKIGKKIERVGQHTRD-ATIQGLGIAQQAANVAATAR-
Cecropin-P1  -----SWLSKTAKKLENSAKKRISEGIAIA-IQGGPR-----
CRAMP        -----GLLRKGGEKIGEKLKKIGQKIKNFFQKLVPQEC
CAP18       ----GLRKRLRKFRNKIKEKLKKIGQKIQGFVPKLAPRTDY
BMAP34      GLFRRLRDSIRRGQQKILEKARRIGERIKDI---FRG----
SMAP34      GLFGRLRDSLQRGGQKILEKAERIGDRIKDI---FRG----
PMAP37      GLLSRLRDFLSDRGRRLGEKIERIGQKIKDLSEFFQS----
BMAP28      -----GGLRSLGRKILRAWKKYGPIIVPIIR-IG-----
SMAP29      -----RGLRRLGRKIAHGVKKYGPTVLRIIR-IAG-----

```

“The C-terminal helix from Gly16 to Ile23 is indispensable for antibacterial, cytolytic and lipopolysaccharide (LPS)-binding activities.”

*Y Xiao et al., FEBS Journal 273 (2006) 2581–2593

Glycines in Aquaporin 4*

Human

Human AQP-4 207-232: **Y**T**G**A**S**M**N**P**A**R**S**F**G**P**A**V**I**M**G**N**W**E**N**H**W**I
 Soy AQP-4 193-218 : **F**D**G**A**S**M**N**P**A**V**S**F**G**P**A**V**V**S**W**T**W**S**N**H**W**V

Various plants

Human AQP-4 207-232: **Y**T**G**A**S**M**N**P**A**R**S**F**G**P**A**V**I**M**G**N**W**E**N**H**W**I
 Corn AQP-4 196-221: **F**T**G**A**S**M**N**P**A**R**S**F**G**P**A**L**A**T**G**D**W**T**N**H**W**V

Human AQP-4 207-232: **Y**T**G**A**S**M**N**P**A**R**S**F**G**P**A**V**I**M**G**N**W**E**N**H**W**I
 Spinach AQP-4 216-241: **I**T**G**T**G**I**N**P**A**R**S**F**G**A**A**V**I**F**N**S**N**K**V**W**D**D

Human AQP-4 207-232: **Y**T**G**A**S**M**N**P**A**R**S**F**G**P**A**V**I**M**G**N**W**E**N**H**W**I
 Tomato AQP-4 194-219: **F**S**G**S**M**N**P**A**R**S**F**G**P**A**V**A**G**D**F**S**Q**N**W**I

*Aristo Vojdani

Molecular Mimicry as a Mechanism for Food Immune Reactivities and Autoimmunity
 Alternative Therapies 21, Suppl. 1, 30-41.

Glycines in Aquaporin 4*

Human Human AQP-4 207-232: YTGASMNPARSF~~GP~~AVIMGNWENHWI

Autoantibodies to Aquaporin 4 lead to neuromyelitis optica (NMO), which is a severe neuroautoimmune disorder that affects the gray and white matter in the brain and spinal cord, causing demyelination, axonal damage, and necrosis and resulting in sensory loss and paralysis.

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Molecular Mimicry as a Mechanism for Food Immune Reactivities and Autoimmunity
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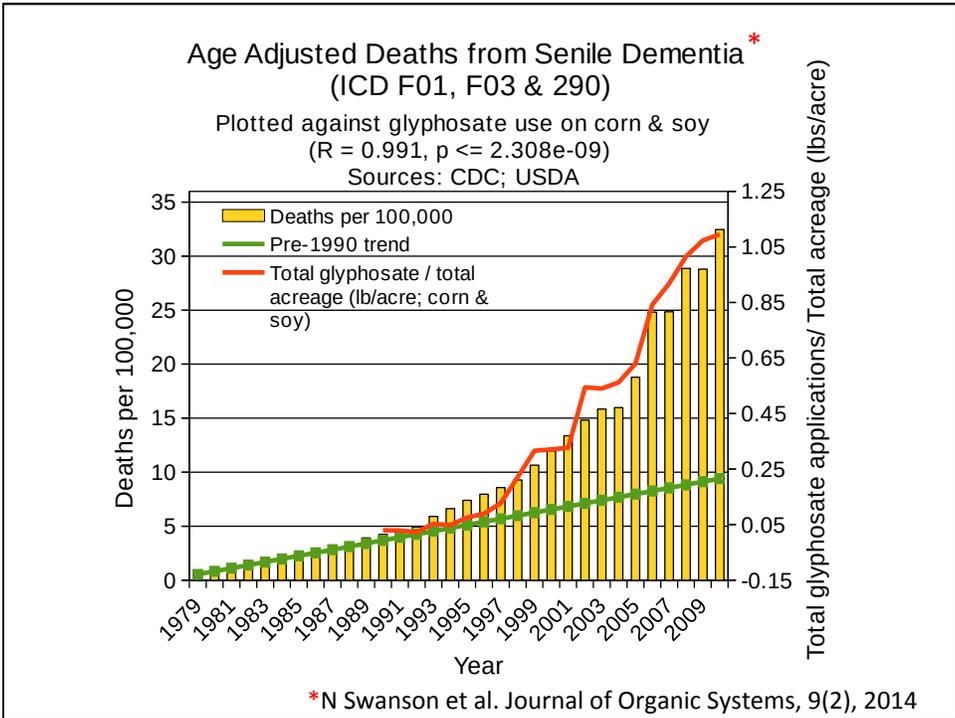
Lactose Intolerance*



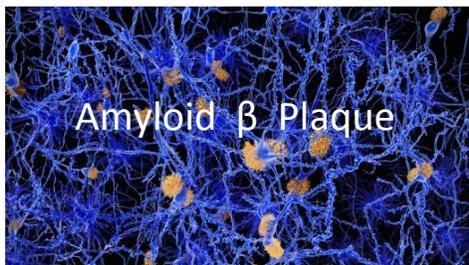
A)							
Human	AAFCFSTFGDRVKLWVTFHEPWVMSYAGYGTGQHPPGISDPGVASFKVAHL						
Mut_V565fsX567	AAFCFSTFGDRVKLWVTFHEPWVMSYAGYGTGQHPPGISDPGLFX-----						
Erinaceus	ADFCFSTFGDRVKLWVTFHEPWVMSYAGYGTGQHPPGVTDPGVASFKVAHV						
Rattus	AAFCFSTFGDRVKLWVTFHEPWVMSYAGYGTGQHAPAI SDPGMASFKVAHL						
Mus	AAFCFSTFGDRVKLWVTFHEPWVISYAGYGTGQHAPAI SDPGVASFKVAHL						
Gallus	ADFCFTTFGDRVKFWVTFHEPWVISYAGYGTGEHPPGISDPGLASFKVAHL						
Gasterosteus	ADFCFSRFGDRVKTWNTFSSPWVSSHAGYGTGEHPPGVKDYVVASYQATHNMIKSHAEAW						566
B)							
Human	ATLRTQIQMNRQCS-HPVAQLPEFTEAEKQLLKGSADFLGLSHYTSRLISNAPQNTCIP	701					
Mut_R1587H	ATLRTQIQMNRQCS-HPVAQLPEFTEAEKQLLKGSADFLGLSHYTERLISNAPQNTCIP	132					
Erinaceus	DLPEFTKAEKQLLKGSADFLGLSHYTSRLISKAQHHTCTP	489					
Rattus	DLPEFTEAEKRLLKGSADFLGLSHYTSRLISKAGRQTCTS	703					
Mus	DILKAQIQEVMNQCS-TTVAQLPVFTEEEKTVVKGTDADFFGLSHYTSRLISKAGQQTCTP	703					
Gallus	DILKAQIQEVMNQCS-TTVAQLPVFTEEEKTVVKGTDADFFGLSHYTSRLVAVTNGTCTP	706					
Gasterosteus	STLTKIEQKRNACSLSEPARLPVFTAERQRIHGTADFLGLNHYTARLVNNSVGG-CTP	685					
C)							
Human	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPSNQEDVEAAR	1618					
Mut_R1587H	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPSNQEDVEAAR	1618					
Mut_E1612X	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWA	1618					
Erinaceus	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPSHQEDVEAAR	1406					
Rattus	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPTNQGDVEAAR	1597					
Mus	RPGTAPYIVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPSNQEDVEAAR	1622					
Gallus	RPGRAPYVVGHNLIKAAHAEAWHLNDVYRASQGGVISITISSDWAEPDPSNQEDFDAAR	1626					
Gasterosteus	RPGTLPYIVGHTLIKAAHAEAWHLNDVYRATQKGIISILNSDWTPEPRNPFYKQEDIDAAR	1603					

*S Torniainen et al. BMC Gastroenterology 2009; 9:8.

Amyloid Beta, Dementia and Macular Degeneration



The Cost of Alzheimer's Disease*



“The current \$259 billion cost of Alzheimer's care in the U.S. will reach an `unsupportable' \$1 trillion annually by 2050, according to the Alzheimer's Association.”

*<https://www.cnn.com/2018/07/06/biogen-alzheimer-drug-success-and-the-long-tail-of-dementia-drug-fails.html>

The Big Picture*

- Alzheimer's disease is associated with accumulation of amyloid- β plaque in the brain
- The plaque is formed from insoluble fibers derived from multiple β -sheet strands that precipitate out of solution
- The amyloid- β protein normally folds as α -helices and forms transmembrane pores
 - The helices are stabilized by glycine residues
 - Substitution of other amino acids for glycine causes misfolding that eventually leads to the precipitated plaque
- Glyphosate substitution for glycine disrupts protein folding
- Glyphosate's negative charge attracts aluminum which also accumulates in the plaque

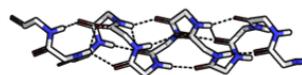
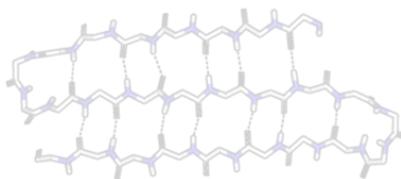
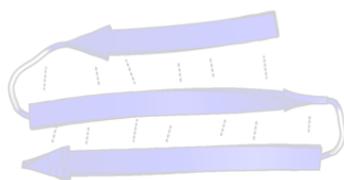
*A Samsel and S Seneff Journal of Biological Physics and Chemistry 2016;16:9-46.

Aluminum [Al] and Alzheimer's*

“The hypothesis that Al significantly contributes to AD [Alzheimer's disease] is built upon very solid experimental evidence and should not be dismissed. Immediate steps should be taken to lessen human exposure to Al, which may be the single most aggravating and avoidable factor related to AD.”

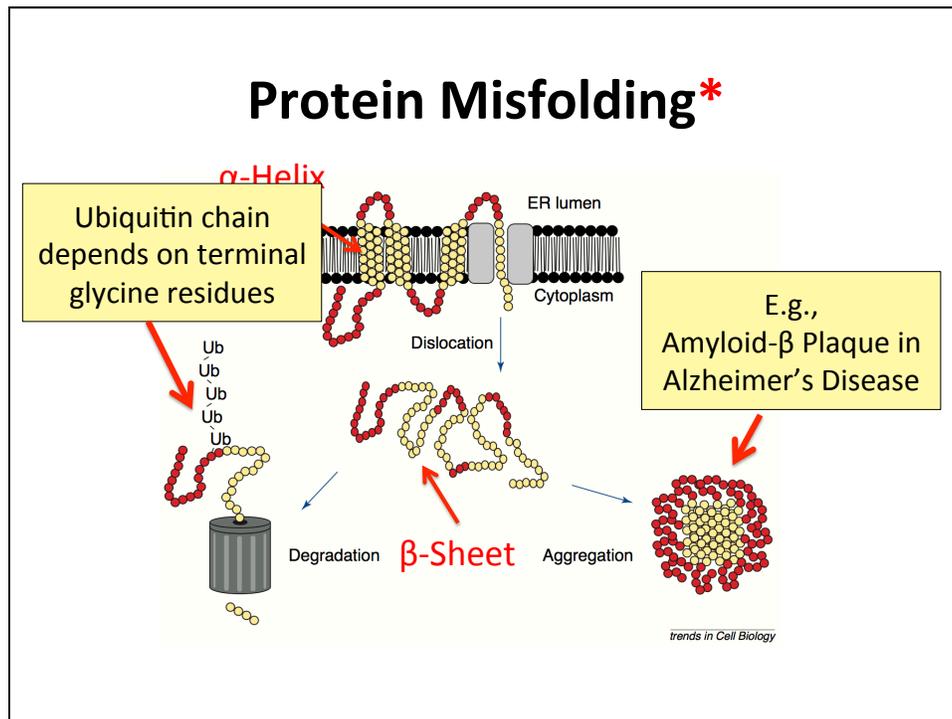
*L Tomljenovic. J Alzheimers Dis. 2011;23(4):567-98.

α -helices and β -sheets



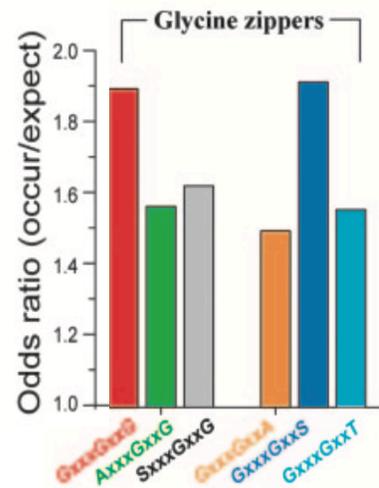
β -Sheet (3 strands)

α -helix



GxxxGxxxG: Glycine Zippers*

“We suggest that the membrane pores formed by the amyloid- β peptide *in vitro* are constructed by glycine zipper packing and find that mutations in the glycine zipper motif block channel formation.”



*S Kim et al. PNAS 2005; 102(4): 14278–14283

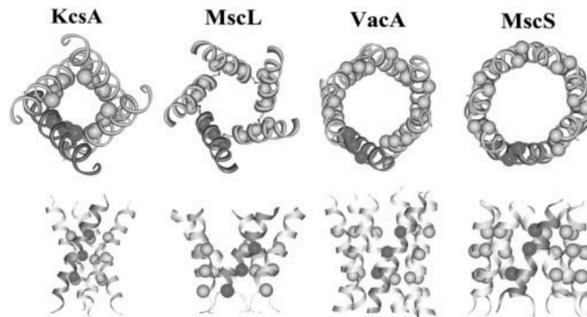
Glycine Zipper Motif*

GxxxGxxxGxxxG motif Human *amyloid beta* A4 protein precursor

Sequence with transmembrane domain	Annotation (potential function of products)
69 G SN K G AI I G LM V G GVV I ATV I VITL V M 722	Human amyloid beta A4 protein precursor (o, p, c, v)
112 MAGAAA G AV V G GL G Y M L S AM S R P I 138	Human major prion protein precursor (o, p, c, v)
345 GL F G AI A G F IE G W P G LV A GW Y GF Q HS 371	Influenza A virus Hemagglutinin precursor (o, p, c, f)
39 V I I P AI V G IA T G T A V G T V S G LL G W G L 65	Helicobacter vacuolating cytotoxin precursor (o, p, c, v)
228 K L AAL P V A G AL I G M V G P I G LL A CF K 254	Human Syntaxin 17 (a, o, v, f)
154 Y G V V L G AV I G V L G V V LLLL L FF V V Y 180	Human myelin protein zero protein precursor (a, o)
231 I G M V A G AV T G I V A G L L I FL L V W LL I R 257	Human coxsackie & adenovirus receptor-like membrane protein, CLMP (a, o, p, e)
127 Q G Y P P V G V P V G F A P G M V V G Y H Q G 153	Dictyostelium Annexin A7 (a, o, c, v, f)
676 A S G T S P G L S A G A T V G I M I G V L V G V A L I 702	Human carcinoembryonic antigen-related cell adhesion molecule 5, CEACAM5 (a)
422 S E G A I A G I V I G S V A G V A L I A A L A Y F L Y 448	Mouse Ecto-ATPase precursor (a, v, f)
20 A L L A P A V L L G A L G L G L W L G C R A G R 46	Human Ellis-van Creveld syndrome protein, defects cause autosomal recessive skeletal dysplasia
261 N V G A I V G V V G V V G V A V A I A L C I L L I V 287	Yeast SLG1 protein precursor, cell wall integrity and stress response component
714 V H G S V L G M V I G T A G V I F L T F S I I A I L 740	Human Meprin A α -subunit precursor, membrane-bound zinc metalloprotease (o)
288 G E M L G L G V G I L A G C L C L L L A V Y F I A Q K 314	Mouse Carbonic anhydrase XIV, role in carbon dioxide and ion transport across synaptic membrane
50 G K G Q L V G V G A L L G A V L G G V G A G M D 76	Rickettsia 17 kDa surface antigen precursor (a, v)

*S Kim et al. PNAS 2005; 102(40): 14278-14283.

GxxxG Motif forms a Transmembrane Channel*



MscS	<i>E. coli</i>	95 SVIAVL G AA G LAV G LAL Q GSLS 116	heptamer
	<i>C. tepidum</i>	98 SLTVLS G TI G LG I GFGLQNIAD 119	
	<i>S. enterica</i>	95 SVIAVL G AA G LAV G LAL Q GSLS 116	
VacA	<i>H. pylori</i>	9 PAIV G GIAT G TAV G TVS G LLGW 30	hexamer
MscL	<i>M. tuberculosis</i>	15 VDLAV A V V I G TAF T ALVTKFTD 36	pentamer
	<i>B. subtilis</i>	15 VDLAI G V V I G GAF G KIVTSLVN 36	
	<i>E. coli</i>	17 VDLAV G V I I G A F G KIVSSLVA 36	
KcsA	<i>S. lividans</i>	95 VMVAGITS F GLV T AALAT W FG 116	tetramer
	<i>T. volcanium</i>	85 IMVSGIG L GT L TATIS A YLFQ 106	
	<i>S. coelicolor</i>	213 LMLSGIAL L GV V T A NI A W F IS 234	

*S Kim et al. PNAS 2005; 102(4): 14278-83

A glycine zipper motif mediates the formation of toxic β -amyloid oligomers in vitro & in vivo*

“Our results demonstrate a critical role for C-terminal *glycine residues* in the formation of toxic A β oligomers”

“An alternative explanation for the enhanced toxicity of the double mutant A β is that it is the *total number of glycine residues* in the C-terminal region of A β that is the key determinant of toxicity. Although we cannot exclude this possibility, it is *difficult to develop a molecular model* that would account for this explanation.”

*Fonte et al. Molecular Neurodegeneration 2011, 6:61

A glycine zipper motif mediates the formation of toxic β -amyloid oligomers in vitro & in vivo*

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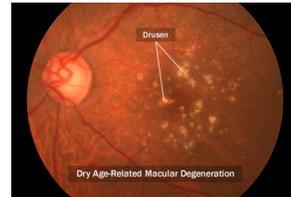
Glyphosate substitution for glycine?

“An alternative explanation for the enhanced toxicity of the double mutant A β is that it is the *total number of glycine residues* in the C-terminal region of A β that is the key determinant of toxicity. Although we cannot exclude this possibility, it is *difficult to develop a molecular model* that would account for this explanation.”

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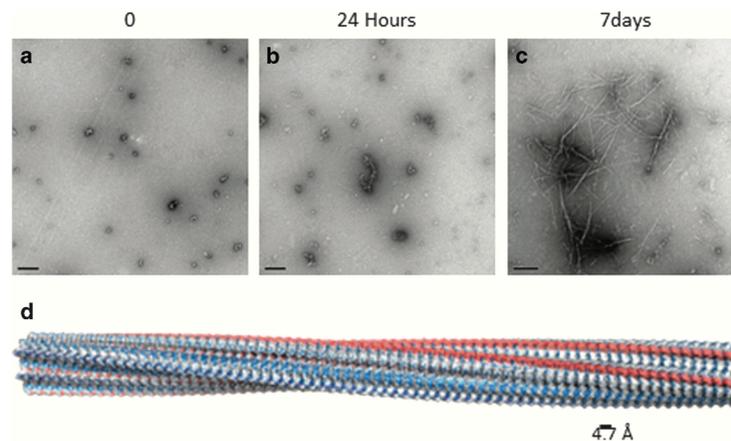
Age-related Macular Degeneration*

- Age-related macular degeneration (AMD) causes blindness in nearly 50 million people worldwide
- Amyloid- β is elevated in the aging retina and may be a key factor in the pathology
- AMD drusen and senile plaques show similarities, arguing for shared molecular mechanisms in AMD and dementia



*JA Ratnayaka et al. Eye 2015; 29: 1013-1026.

Dementia of the Eye*



Amyloid- β : cross- β structure with slow twist

*Figure 1. JA Ratnayaka et al. Eye 2015; 29: 1013-1026.

Experiment Exposing Rabbit Retina to Glyphosate*



- Topical exposure to eyes twice a day of 100 microliters of glyphosate in 3 concentrations of 0.12, 0.97, and 7.8 mg/kg for one week.

At the two highest concentrations:

"The β -turns and α -helix content significantly decreased ($P < 0.05$). On the other hand, the content of β -sheet significantly increased."

*SA Morsy et al. Journal of The Arab Society for Medical Research 2017; 12:92-98.

Results on Protein Secondary Structure changes in Rabbit Retina Exposed to Glyphosate*

Table 4 Protein secondary structure changes of retina expressed as percentage area of β -turn, α -helix, and β -sheet for control and all groups receiving topical glyphosate

	β -Turn	α -Helix	β -Sheet
Control group I	21.5 \pm 2.3	66.5 \pm 3	11.7 \pm 4
Group II (0.12 mg/kg)	23.5 \pm 3.7	62.7 \pm 2	13.7 \pm 1.8
Group III (0.97 mg/kg)	14.9 \pm 1.6 [†]	46.8 \pm 0.8 [†]	38.3 \pm 2.7 [†]
Group IV (7.8 mg/kg)	15.5 \pm 2 [†]	55.5 \pm 2 [†]	28.8 \pm 3 [†]

[†]Statistically significant.

* Table 4. SA Morsy et al., Journal of the Arab Society for Medical Research 2017; 12: 92-98.

Results on Protein Secondary Structure changes in Rabbit Retina Exposed to Glyphosate*

Table 4. Protein secondary structure changes of retina

Glycine residues are critical for reinforcing α -helices and β -turns. Glyphosate substitution can be expected to convert α -helices into β -sheets and disrupt β -turns, consistent with these results

Group III (0.97 mg/kg)	14.9 \pm 1.6 [†]	46.8 \pm 0.8 [†]	38.3 \pm 2.7 [†]
Group IV (7.8 mg/kg)	15.5 \pm 2 [†]	55.5 \pm 2 [†]	28.8 \pm 3 [†]

[†]Statistically significant.

* Table 4. SA Morsy et al., Journal of the Arab Society for Medical Research 2017; 12: 92-98.

Recapitulation

- Amyloid- β is a key factor in Alzheimer's
- Amyloid- β depends on glycine residues in a GxxxGxxxGxxxG motif to stabilize trans-membrane helices
- Glyphosate substitution for glycine disrupts protein folding, leading to β -sheets precipitating out as toxic fibrils
 - Negatively charged glyphosate binds to aluminum
- Amyloid- β also plays a significant role in macular degeneration in the eye

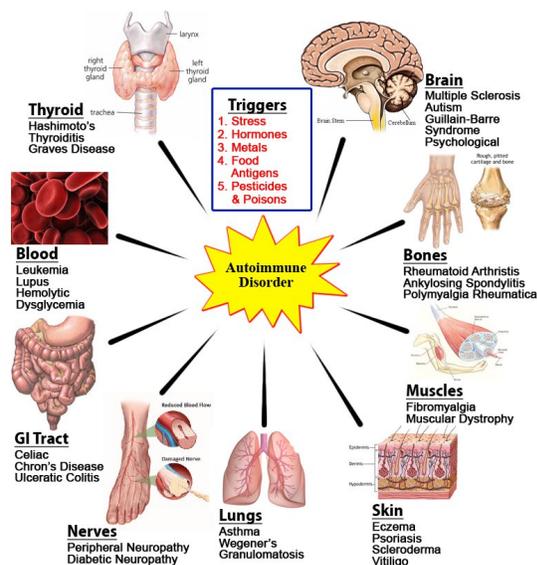
Autoimmune Disease Epidemic

Autoimmune Disease: An Invisible Epidemic*

“Taken together, the number of people suffering from autoimmune diseases is 24–50 million Americans, 16% of the US population. To put it in perspective, autoimmune disease prevalence equals heart disease and cancer combined.”

*Feldman B, Martin EM, Simms T. An Invisible Epidemic — When your body attacks itself — Autoimmune Disease; How Reframing the Data Unveils a Public Health Crisis Bigger than Cancer and Heart Disease Combined. www.tincture.io.

Tissues of The Body Affected By Autoimmune Attack *



*Graphic provided by Gary Kohls, MD

Autoimmune Disease Statistics *

- Autoimmune Disease (AD) is a major health problem
- Annual direct health care costs for AD in US estimated to be ~\$100 billion
- At least 23.5 million Americans suffer from one or more autoimmune diseases
- Among the top-10 causes of death in females under 64 years old
- Immunosuppressant treatments have devastating side effects



*<https://www.aarda.org/autoimmune-information/autoimmune-statistics/>

Autoimmune disease preceding amyotrophic lateral sclerosis

An epidemiologic study

Martin R. Turner, PhD
Raph Goldacre, BA
Sreeram Ramagopalan,
DPhil
Kevin Talbot, DPhil
Michael J. Goldacre,
FFPH

Correspondence to
Dr. Turner:
martin.turner@ndcn.ox.ac.uk

ABSTRACT

Objective: To study whether the risk of amyotrophic lateral sclerosis (ALS) is increased in people with prior autoimmune disease.

Methods: An all-England hospital record-linkage dataset spanning 1999–2011 was used. Cohorts were constructed of people with each of a range of autoimmune diseases; the incidence of ALS in each disease cohort was compared with the incidence of ALS in a cohort of individuals without prior admission for the autoimmune disease.

Results: There were significantly more cases than expected of ALS associated with a prior diagnosis of asthma, celiac disease, younger-onset diabetes (younger than 30 years), multiple sclerosis, myasthenia gravis, myxedema, polymyositis, Sjögren syndrome, systemic lupus erythematosus, and ulcerative colitis.

Conclusions: Autoimmune disease associations with ALS raise the possibility of shared genetic or environmental risk factors. *Neurology*® 2013;81:1222–1225

Autoimmune disease preceding

"Results: There were significantly more cases than expected of ALS associated with a prior diagnosis of asthma, celiac disease, younger-onset diabetes (younger than 30 years), multiple sclerosis, myasthenia gravis, myxedema, polymyositis, Sjögren syndrome, systemic lupus erythematosus, and ulcerative colitis."

Why do we have an epidemic in autoimmune disease in America today?

Hypothesis

- Glyphosate exposure sets up a *weakened immune system*, a leaky gut barrier and a leaky brain barrier
- Glyphosate contamination in *proteins* makes them hard to break down
 - Proteolysis enzymes are also defective
- Person develops *overactive antibody response* to foreign protein contaminated with glyphosate and, through molecular mimicry, this leads to autoimmune disease
- This easily explains gluten intolerance and other *food allergies*
- And it eventually leads to more serious problems like *ALS*

Does Glyphosate Acting as a Glycine Analogue Contribute To ALS?

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Abstract

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease involving several protein mutations in glycine-rich regions with limited treatment options. 90 - 95% of all cases are non-familial with epidemiological studies showing a significant increased risk in glyphosate-exposed workers. In this paper, we propose that glyphosate, the active ingredient in Roundup®, plays a role in ALS, mainly through mistakenly substituting for glycine during protein synthesis, disruption of mineral homeostasis as well as setting up a state of dysbiosis. Mouse models of ALS reveal a pre-symptomatic profile of gut dysbiosis. This dysbiotic state initiate a cascade of events initially impairing metabolism in the gut, and, ultimately, through a series of intermediate stages, leading to motor neuron axonal damage seen in ALS. Lipopolysaccharide, a toxic by-product of dysbiosis which contributes to the pathology, is shown to be statistically higher in ALS patients. In this paper we paint a compelling view of how glyphosate exerts its deleterious effects, including mitochondrial stress and oxidative damage through glycine substitution. Furthermore, its mineral chelation properties disrupt manganese, copper and zinc balance, and it induces glutamate toxicity in the synapse, which results in a die-back phenomenon in axons of motor neurons supplying the damaged skeletal muscles.

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Food Allergies



"In our study, with the largest case number reported thus far, the results supported the significant association between ASDs [autism spectrum disorders] and allergic diseases."*

*J Chen et al. Int J Dev Neurosci. 2014 Jun;35:35-41.

Drugs and Autoimmune Disease*

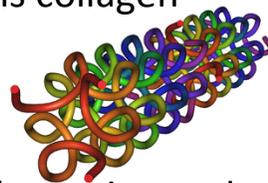
- Drugs that treat autoimmune disease have a huge problem with side effects
 - They suppress the immune system, and increase risk to tuberculosis, invasive fungal infections and lymphomas (cancers of the immune system)
- Humira is a TNF-alpha inhibitor, which blocks the immune response
 - It costs about \$3,100 per month
 - U.S. prescriptions for Humira have taken off in recent years: 1.5 million in 2011; 2.4 million in 2015.
 - It was linked to more than 209,000 adverse event reports since 2013, including more than 4,200 deaths.

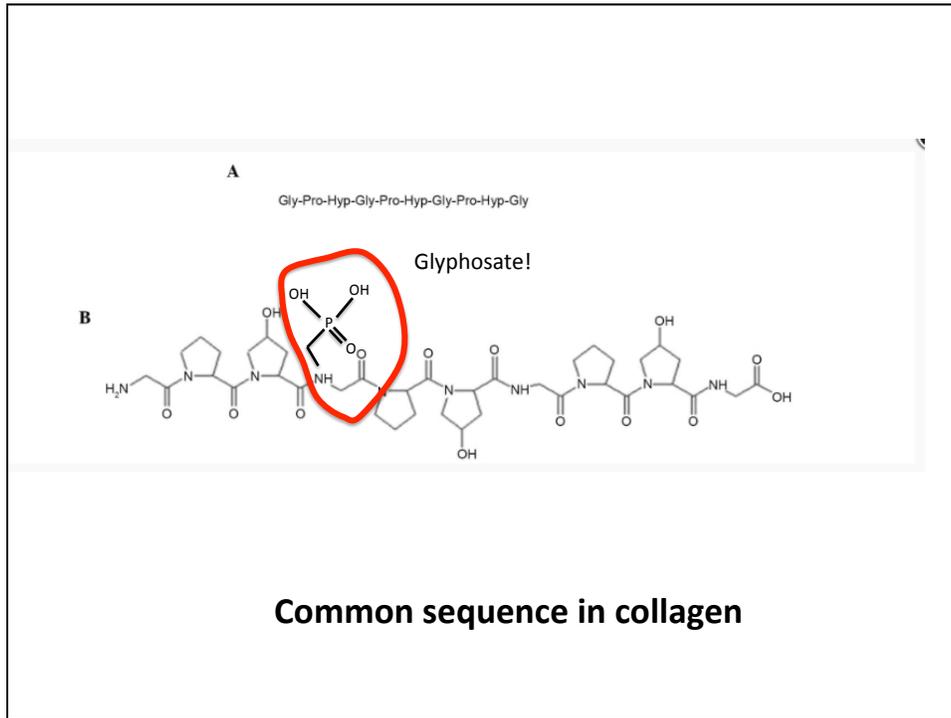
* usatoday.com/story/news/nation-now/2017/03/19/analysis-reports-drug-side-effects-increase-fivefold-12-years/99384190/

Collagen, Chronic Pain, and Opioid Drugs

Collagen and Gelatin

- 25% of the protein in our body is collagen
- 25% of the amino acids in collagen are glycines
- Glyphosate substitution for glycine will disrupt triple-helix formation and lead to diseases of the vasculature, joints and bones
- Gelatin is derived from collagen in bones and ligaments sourced from cows and pigs fed glyphosate-contaminated GMO Roundup-Ready feed





Chronic Pain*

“The list of different types of chronic pain syndrome seems to be growing every day, including complex regional pain syndrome, failed back syndrome, fibromyalgia, interstitial cystitis, myofascial pain syndrome, postvasectomy pain, vulvodynia, pelvic pain syndrome – and on and on.”



*P. 42, Anna Lembke, Drug dealer, MD
John's Hopkins U Press, Baltimore, MD

Chronic Pain*

“The list of different types



Could the epidemic in bone and joint pain be due to glyphosate's disruption of collagen's tensile strength, elasticity and ability to hold water?

pain, vulvodynia, pelvic pain syndrome –
and on and on.”

*P. 42, Anna Lembke, Drug dealer, MD
John's Hopkins U Press, Baltimore, MD

US Department of Health and Human Services Data on Pain-Killer Drug Abuse*

- Drug overdose is the leading cause of injury death in the United States
 - Heroin, morphine, and prescription pain relievers
- More people died from drug overdoses in 2014 than in any previous year on record
- More than 6 out of 10 involved an opioid drug
- More than 650,000 opioid prescriptions are dispensed every day



*<http://www.hhs.gov/opioids/about-the-epidemic/>

US Department of Health and Human Services Data on Pain-Killer Drug Abuse*

According to PBS Evening News (Sept. 29, 2017), 64,000 deaths in the U.S. were attributed to opioid drug overdose in 2016.

This number increased to 72,000 in 2017 (up 10% from previous year) (Reported August 16, 2018).

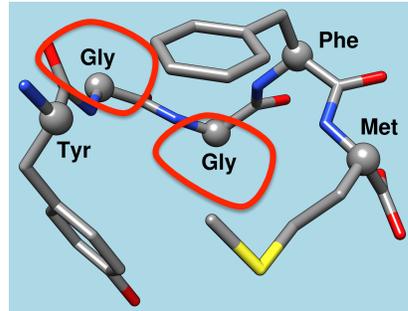
dispensed every day

*<http://www.hhs.gov/opioids/about-the-epidemic/>

Enkephalins! Endogenous Opioid Ligands

Opioid receptors are distributed widely in the brain, and are also found in the spinal cord and digestive tract

All of the amino acids in enkephalin are compromised by glyphosate



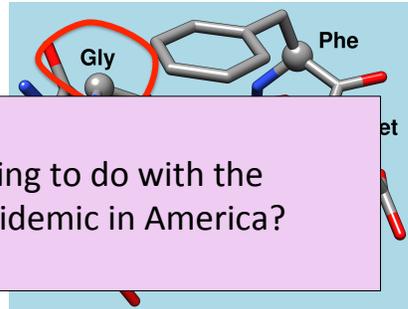
Morphine stimulates opioid receptors with subsequent upregulation of enkephalin, leading to a 340% increase in enkephalin expression in the nucleus accumbens following morphine exposure to rats*

*MM Nieto et al. The Journal of Neuroscience 2002; 22(3):1034-1041.

Enkephalins! Endogenous Opioid Ligands

Opioid receptors are distributed widely in the brain,

by glyphosate



Does this have something to do with the opioid drug overdose epidemic in America?

Morphine stimulates opioid receptors with subsequent upregulation of enkephalin, leading to a 340% increase in enkephalin expression in the nucleus accumbens following morphine exposure to rats*

*MM Nieto et al. The Journal of Neuroscience 2002; 22(3):1034-1041.

“Expecting mothers' opioid use may stunt kids' learning”*,**

- Children exposed to opioid drugs in utero suffer from "newborn abstinence syndrome" (withdrawal symptoms)
 - Tremors, hard-to-soothe crying, diarrhea and difficulty feeding and sleeping
- Nearly 2,000 out of 7,200 children enrolled in Tennessee's Medicaid program were affected
 - 1 in 7 require special classroom services for developmental delays and speech or language difficulties (compared to 1 in 10 in controls)



*www.nbcnews.com/health/health-news/expecting-mothers-opioid-use-may-stunt-kids-learning-n905051

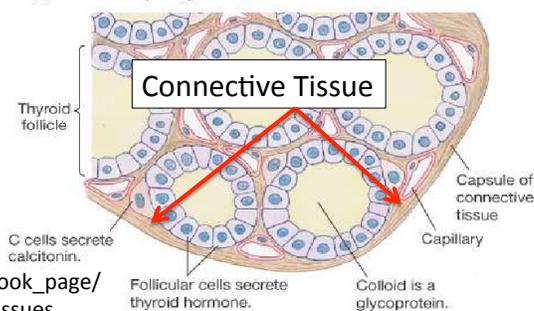
**M-M Fill et al. Pediatrics 2018 [Epub ahead of print]

Collagen Damage → Thyroid Disease*

“Anything that destroys connective tissue or collagen, or prevents its proper formation in the first place, would probably increase the risk of thyroid damage and AITD (Autoimmune Thyroid Disease).”

Thyroid Gland: Hormones and Iodine Metabolism

(b) Section of thyroid gland



*http://fluoroquinolonethyroid.com/book_page/thiodine-problems-were-not-the-only-issues/thyroid-damage-due-to-collagenconnective-tissue-damage/

Alpha-Gal Antibodies: Allergy to Meat!*

"Meat allergy was first observed in the 1990s and formally described in 2009, which makes it a relatively recent arrival to the compendium of allergic conditions. Its most curious quality may be that it is seemingly triggered by a tick bite."

- The tick releases a protein called dipeptidyl peptidase that works as an adjuvant



*"What the Mystery of the Tick-Borne Meat Allergy Could Reveal". NY Times July 24,2018.



Dipeptidyl Peptidase Alignments*

Human	
HOMSAP	HELIIGSGGKLFVQDEFGAFNFDQETVINPETGEQIQSWYRSGET
MUSMUS	HELIIGSGGKLFVQDEFGAFNFDKETVINPETGEQIQSWYRSGET
CALJAC	HELIIGSGGKLFVQDEFGAFNFDQETVINPETGEQIQSWYRTGET
PANTIG	HELIIGSGGKLFVQDEFGAFNFDQETVINPETGEQIQSWYRSGET
EQU CAB	HELIIGSGGKLFVQDEFGAFNFDQDTVINPETGEQIQSWYRSGET
DANRER	HELIIGSGGKLFVQDDFGKFNFDQTAVRNPETGELISSWYKQSET
PANGUT	HELIIGSGGKLFVQDDSGAFNFDKAAVINPETGELIRSWYQCGET
XENLAE	HELIIGSGGKLFVQDEFGAFNFDKETVINPETGELVKSWYKTGET
CROADA	HELIIGSGGKLFVQDDSGAFNFDKAAVTNPETGELIRSWYQFGET
SALSAL	HELIIGSGGKLFVQDEFGTFNFEQDNVRNPETGEQITTWYKQNET

- Alpha-gal is a kind of sugar that binds to the dipeptidyl peptidase from the saliva of the tick
- It also binds to proteins found in meats

*I Sabljic et al. PLoS ONE 12(11): e0187295.

Dipeptidyl Peptidase Alignments*

Human

← HOMSAA...EQIQSWYRSGET
 MUSMUS...EQIQSWYRSGET
 CALJAC...EQIQSWYRTGET
 PANTIC...EQIQSWYRSGET
 EQUCAE...EQIQSWYRSGET
 DANRE...ELISSWYKGET
 PANGUT...HELIGGSGKLFVQDDSGAFNFDKAAVINPETGELIRSWYQGET
 XENLAE...HELIGGSGKLFVQDEKGFNFDKETVINPETGELVKSWEYKTGET
 CROADA...HELIGGSGKLFVQDDSGAFNFDKAAVTNPETGELIRSWYQFGET
 SALSAL...HELIGGSGKLFVQDEKGFNFEQDNVRNPETGEQITTWYKNET

Is glyphosate contamination in dipeptidyl peptidase making it more allergenic than before?

- Alpha-gal is a kind of sugar that binds to the dipeptidyl peptidase from the saliva of the tick
- It also binds to proteins found in meats

*I Sabljic et al. PLoS ONE 12(11): e0187295.

Ehlers Danlos Syndrome

- Hypermobile spectrum disorders are common, but often remain misdiagnosed or under-diagnosed
 - They can be caused genetically by a mutation in one of the glycine residues in collagen
 - They can also be caused/aggravated (I suspect) by glyphosate substituting for glycine during collagen synthesis.
- Symptoms include loose joints, stretchy skin, and abnormal scar formation.
- Complications include aortic dissection, joint dislocations, scoliosis, chronic pain, or early osteoarthritis.



What's Coming in Part II

- Immunity, Inflammation and Cancer
- Prescription Drugs
- Glyphosate and Vaccines
- How Much More Evidence Do We Need?
- Fighting Back
- How to Stay Healthy in a Toxic World