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MIT CSAIL
WAPF Wise Traditions Conference
November 6, 2021

Glyphosate, Deuterium
and COVID-19

Grown
for
Biofuel

Hydrogen

Deuterium

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Powerpoint:

https://people.csail.mit.edu/seneff/2021/WAPF_2021_Part1.pptx

PDF:

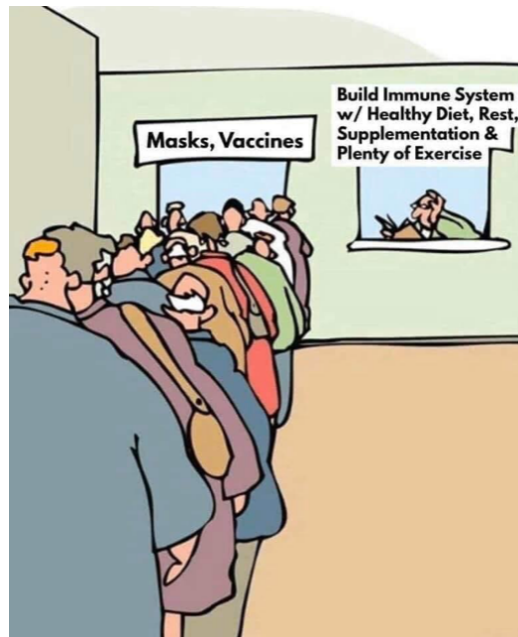
https://people.csail.mit.edu/seneff/2021/WAPF_2021_Part1.pdf

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“Men occasionally stumble over the truth, but most of them pick themselves up and hurry off as if nothing happened.”

-- Winston Churchill

3



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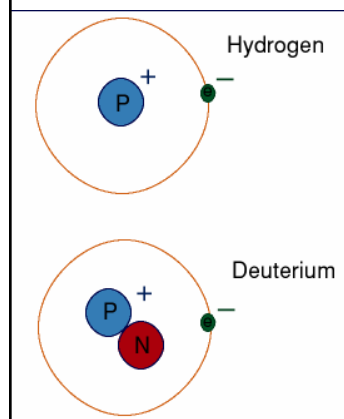
Outline

- Introduction
- Gut Microbes and Hydrogen-Containing Gases
- COVID-19, Glyphosate, Biofuels & Vaping
- Importance of NAD(P)(H) Redox System to Mitochondrial Health
- SARS-CoV-2 Infection in the Lungs: An Extraordinary Response
- Rebooting the Mitochondria
- Tuberculosis and COVID-19
- Vitamin K2!
- Advice for Staying Healthy in a Pandemic
- Summary

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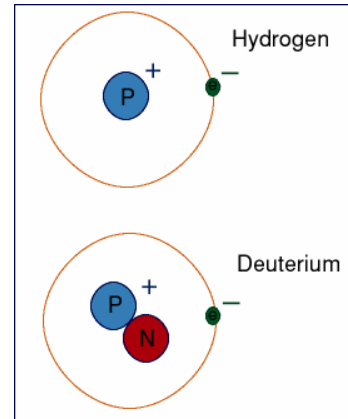
Introduction



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Deuterium = “Heavy” Hydrogen

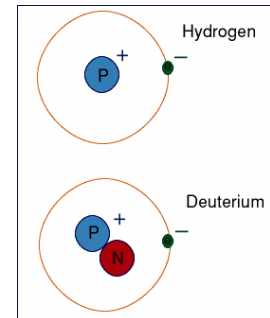
- Hydrogen has one proton and one electron
- Deuterium has one proton, one electron and one neutron
 - ~ Twice as heavy as hydrogen
 - Present in ocean water at 155.8 ppm
 - Has distinct physical and chemical properties compared to hydrogen
- The body has evolved complex mechanisms to deal with deuterium



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The Big Picture

- Deuterium is a natural rare isotope of hydrogen with distinct physical properties
 - Exposure to high concentrations of D_2O is life threatening
- Living organisms have developed sophisticated strategies involving specialized enzymes to deal with it
- Gut microbes recycle hydrogen gas to deplete deuterium
- Mitochondria require low-deuterium water to function properly
- Glyphosate disrupts deuterium homeostasis, causing symptoms of deuterium intoxication



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"The Pathologic Anatomy of Deuterium Intoxication"*

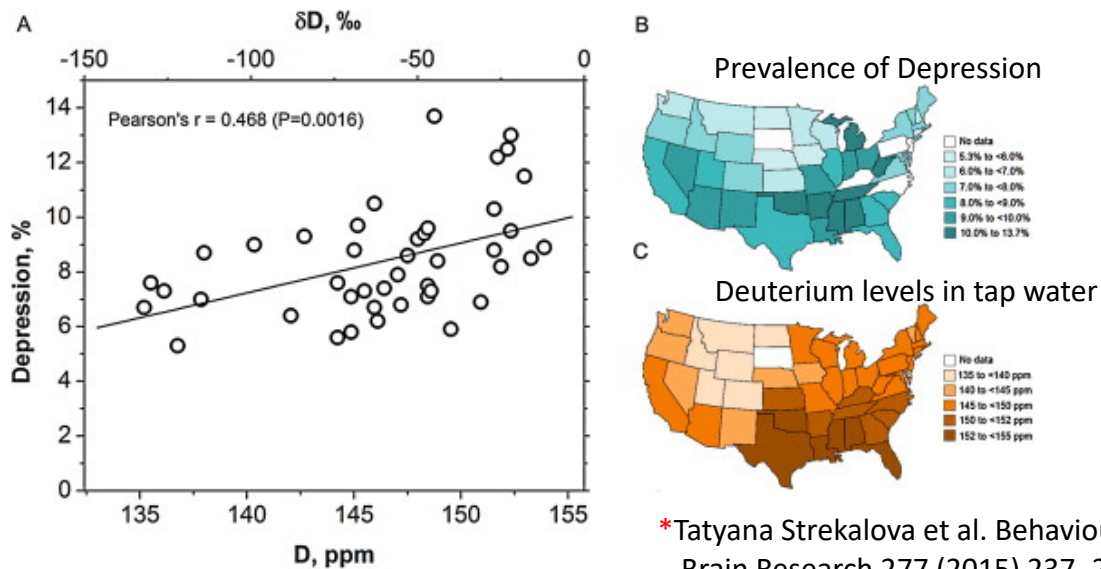
- Mice received 5% dextrose solution in D₂O water
- "Their appetites were voracious, and constant savage attacks upon each other were continually in progress."
- "Eventually, at varying intervals, the animals became hypoactive, lethargic, and dramatically weak."
- "Death occurred in all cases within 6-10 days."



*Paul Bachner et al. PNAS 1964; 51: 464-471.

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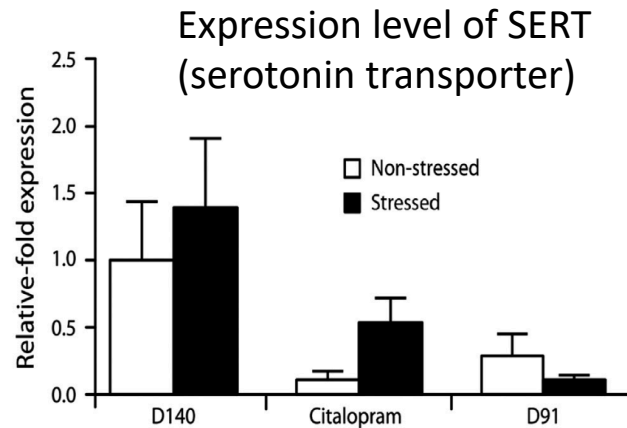
Deuterium in Water and Depression*



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Deuterium-Depleted Water (DDW) Administered to Mice*

- Reduced expression of behaviors characteristic of depression
- Changes in EEG parameters of sleep similar to those associated with noradrenaline and serotonin reuptake inhibitors
- Effects comparable to SSRI citalopram



*Tatyana Strekalova et al. Behavioural Brain Research 277 (2015) 237–244.

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Deuterium Depleted Water to Treat Cancer*

- Deuterium depletion inhibits growth of cancer cells in vitro
- 129 small cell and non-small cell lung cancer patients consumed deuterium-depleted drinking water along with standard cancer therapy
 - Median survival time was 2-4 times longer than generally observed in lung cancer patients
- DDW suppressed expression of oncogenes Bcl2, Kras and Myc in mouse lungs

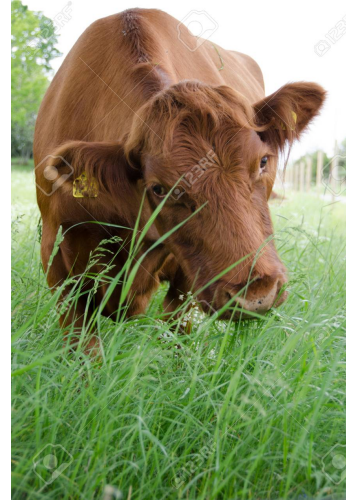


*Z Gyöngyi et al. Nutr Cancer 2013;65(2):240-6.

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Deuterium in Foods and Mast-Cell Activation Syndrome*

- Deuterium increases histamine release from mast cells
- Plants get rid of deuterium by storing it in sugar and starch
 - Fruits, root vegetables (potato) and grains are high in deuterium
 - Meats from grain-fed animals are high in deuterium
- Leafy green vegetables, animal fats (lard, tallow, butter) and plant fats (avocado, coconut, olive oil) are low in deuterium
- Grass-fed beef and dairy products derived from pastured cows are excellent sources of low-deuterium fat



*<https://healinghistamine.com/deuterium-histamine-intolerance/>

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Concentrations of Deuterium in Various Food Items*

ocean water	156 ppb
cottage cheese	151
wheat	150
sugar	146
cheese curds	136
sunflower oil	130
butter	124
pork fat	118



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Deuterium Levels are Variable in Fluids*

- Deuterium in Antarctic glacier water is only 89 ppm. (compared to 156 in sea water)
- Deuterium is higher in rainwater at the equator than at the poles
 - Due to higher evaporation off of descending water droplets
- Deuterium levels are different in different body fluids:
 - Saliva > Blood > Breast milk
- Salivary glands selectively secrete deuterium

*Alexander Basov et al. Nutrients 2019; 11: 1903.

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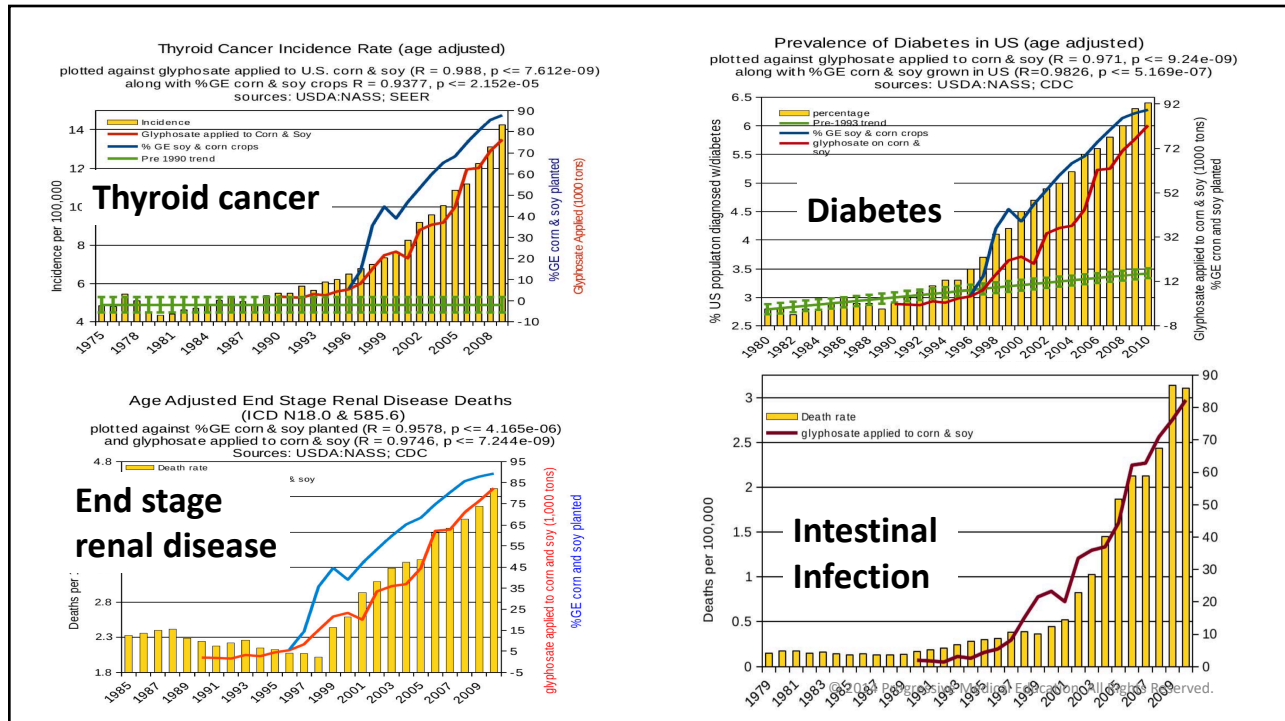
Glyphosate: The Big Picture

- Glyphosate is the active ingredient in the herbicide Roundup
 - Pervasive in the food supply
 - Considered to be safe for humans but there is increasing doubt that this is true
- Glyphosate is an amino acid analogue of the coding amino acid glycine
 - *My research suggests that it is getting inserted into certain proteins by mistake in place of glycine, and that this is very disruptive*
- There are strong correlations between the rise in glyphosate usage in the US and the rise in multiple neurological, oncological, autoimmune and metabolic diseases*

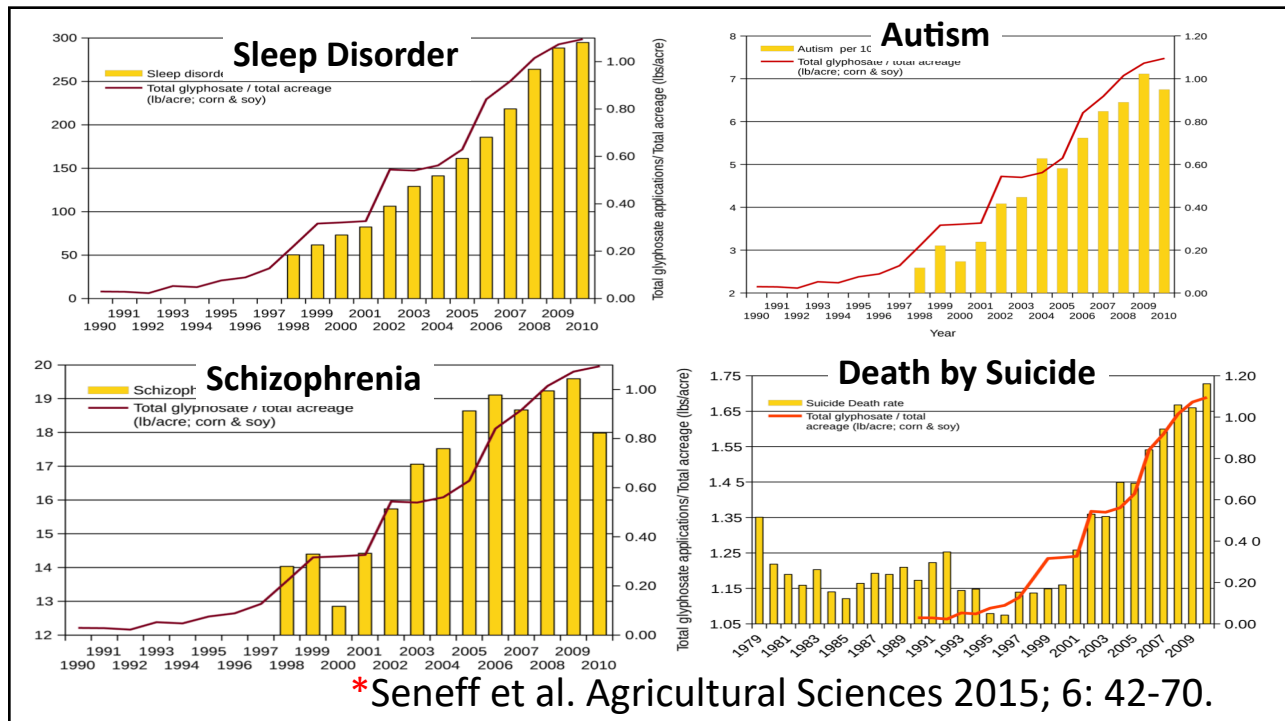


*NL Swanson et al. J Org Systems 2014; 9: 6-37.

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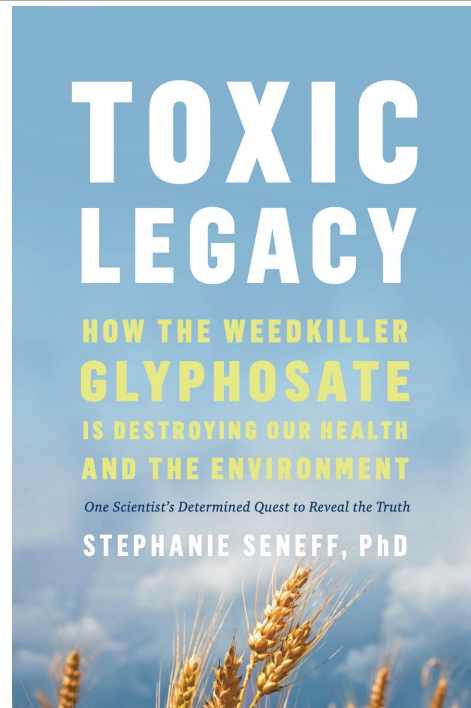
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My New Book!

- Released on July 1, 2021, by Chelsea Green publishers
- Presents extensive data on glyphosate toxicity to animals and humans
- Provides compelling arguments that glyphosate is insidiously, cumulatively toxic through its diabolical insertion into proteins by mistake in place of the coding amino acid glycine
- This unique feature explains why it is causal in so many diseases



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Gut Microbes and Hydrogen-containing Gases



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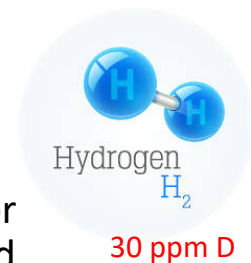
The Big Picture

- Gut microbes produce hydrogen gas that is remarkably depleted in deuterium
 - This gas is recycled back into organic nutrients by other microbes → the nutrients are also deuterium depleted
- The enzymes involved have strong dependencies on glycine residues that could be substituted by glyphosate
 - Intestinal bloating and gas pain may be caused by impaired hydrogen recycling due to glyphosate exposure
- Hydrogen enriched water and other hydrogen therapies show therapeutic promise
 - Is the benefit due to the low deuterium in the hydrogen gas?

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Hydrogen gas produced by microbes anaerobically from glucose or formate is depleted down to 30 ppm deuterium*

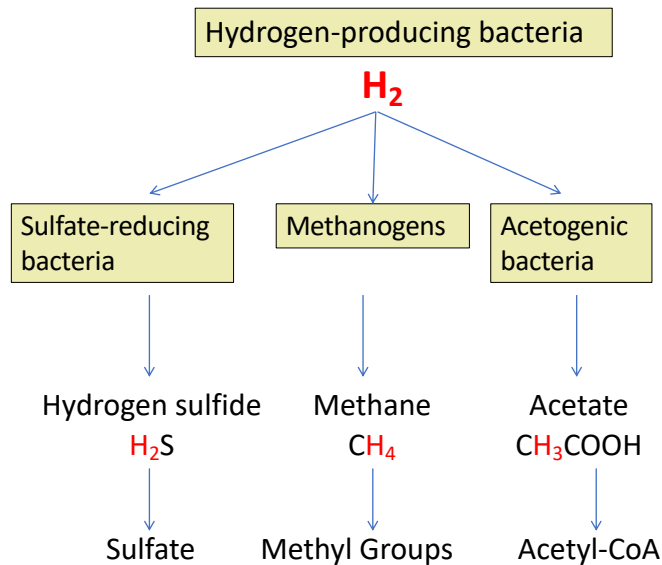
“Mass spectrometric analyses of the hydrogen produced by growing cells showed a deuterium content of about 30 ppm. (i.e. depleted by a factor of 4.4 to 5.1...). The same was true whether glucose or formate was the substrate. The intracellular water and cellular hydrogen were not significantly depleted in deuterium.”



*MI Krichevsky et al. JBC 1961 236(9): 2520-2525.

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What happens to the hydrogen gas?



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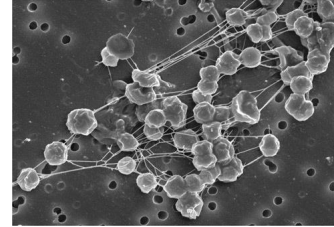
NAD and FAD: Essential Molecules

- NAD (nicotinamide adenine dinucleotide) and FAD (flavin adenine dinucleotide) are biologically essential molecules for maintaining low deuterium in the mitochondria
 - NAD is derived from the B vitamin niacin (vitamin B3)
 - FAD is derived from the B vitamin riboflavin (vitamin B2)
 - Both are synthesized from products of the shikimate pathway (disrupted by glyphosate)
- NADP is a phosphorylated NAD molecule essential for synthesis of fatty acids and cholesterol, and for antioxidant defenses
- *Many enzymes are involved in transferring H to and from NAD(P)*

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Methanogens and Methanotrophs

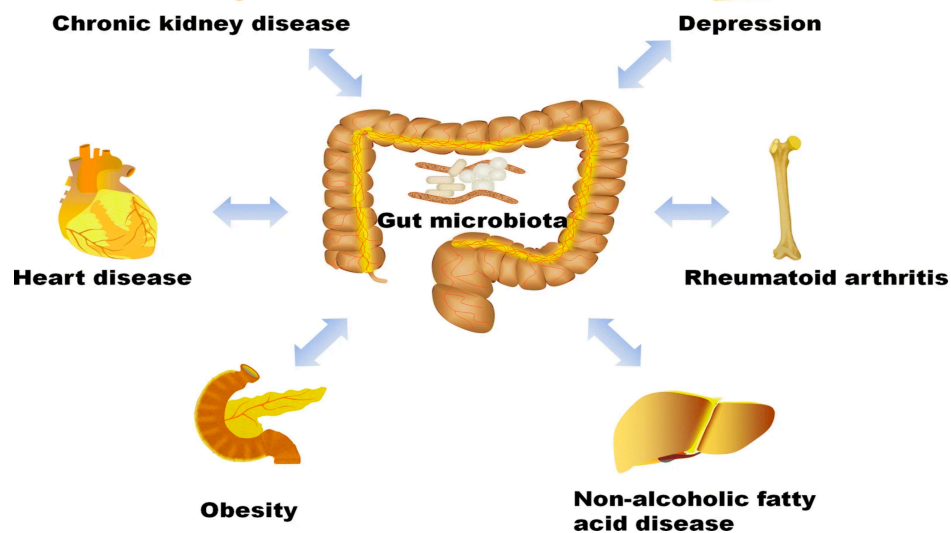
- *Methanogens* (archaea) convert carbon dioxide and hydrogen gas to methane (CH₄)
- *Methanotrophs* convert methane to useful organic molecules
 - methane → methanol → formaldehyde → formate
- Methanol dehydrogenase:
 - methanol + NAD⁺ ⇌ formaldehyde + NADH + H⁺
- Formaldehyde dehydrogenase:
 - formaldehyde + NAD⁺ + H₂O ⇌ formate + NADH + H⁺



The H's are very unlikely to be deuterium

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Gut Dysbiosis Linked to Many Diseases*



*Chen et al. J Transl Med 2019; 17:5

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Hydrogen Gas as a Therapy*

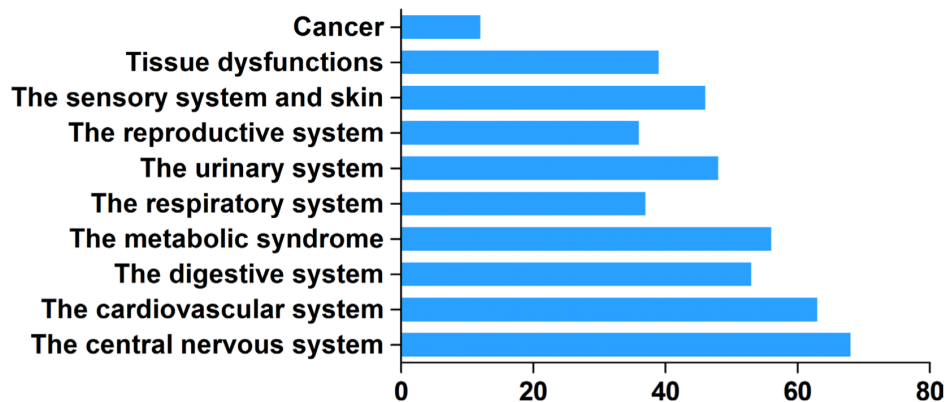


Figure 2: Number of publications on H₂ biological effects in various organ system diseases since 2007.

*L Ge et al. Oncotarget 2017; 8(60): 102653-102673.

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COVID-19, Glyphosate, Biofuels & Vaping

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The Big Picture

- Air pollution appears to be a risk factor for COVID-19 only in countries where glyphosate is heavily used
- Glyphosate could be causal in a vaping lung disease
 - Glyphosate would disrupt surfactant proteins through substitution for glycine in their collagen-like stalks
 - Glyphosate has been shown to cause fatty liver disease – fatty deposits in macrophages in the liver
- Many preconditions associated with higher risk to bad outcome with COVID-19 are increasing in prevalence exactly in step with the rise in glyphosate usage

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COVID-19 Pathology: Hypothesis

- Innate immune system in the lungs is impaired due to chronic exposure to glyphosate (and other toxic chemicals)
 - Macrophages can't trap viruses due to defective surfactant proteins
- Viruses proliferate and cause a strong reaction from the *adaptive* immune system
 - Inflammatory response leads to complex cascade causing a cytokine storm, eventually damaging the systemic circulatory system
 - Heme oxygenase is upregulated and would normally tame inflammation, but glyphosate turns it into a rogue version of itself
 - *This planned response has a goal of temporarily shutting down the mitochondria so that they can be supplied with deuterium depleted water obtained through direct assistance of the viruses*
 - It backfires when the proteins are disrupted by glyphosate

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Air Pollution and COVID-19

- Harvard study found strong correlation between nanoparticle levels and deaths from COVID-19 across the United States*
- Three studies from Europe also link air pollution to COVID-19 death rate
- Biodiesel has been shown in multiple studies to have higher levels of nitrogen oxides and nanoparticles than diesel and to induce a stronger inflammatory response in humans**



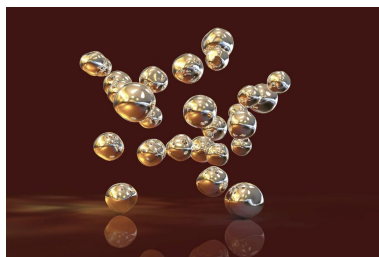
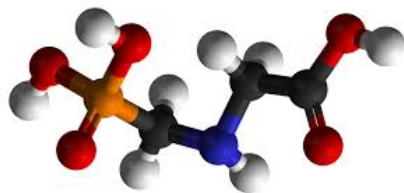
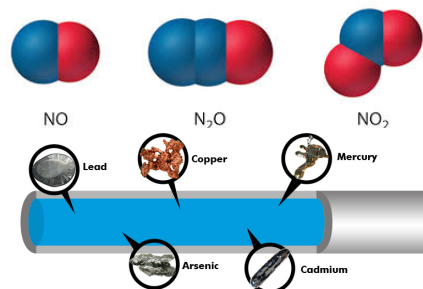
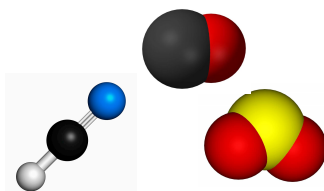
*X Wu et al. Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study. medRxiv preprint, April 7, 2020

**NK Fukagawa et al. Environ Sci Technol 2013; 47(21): 12496-504.

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What Might be the Toxic Substances?

- Nitrogen oxides? Sulfur dioxide?
- Carbon monoxide?
- Cyanide?
- Nanoparticles?
- Lead and other toxic metals?
- **Glyphosate??**



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Glyphosate found in nanoparticles in the air in Brazil*

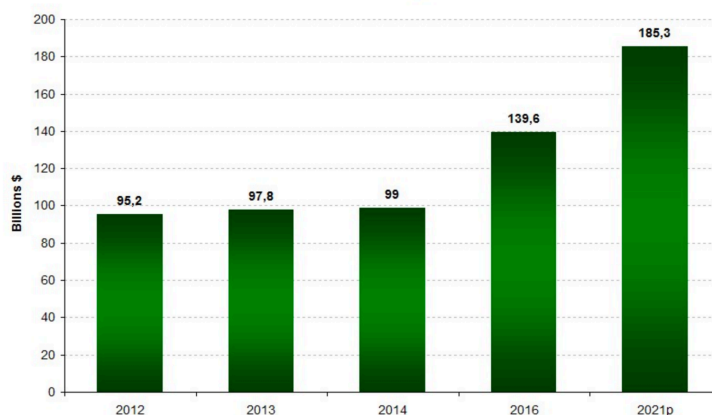
- Mean of 41 micrograms/cubic meter in the rural zone and 38 micrograms/cubic meter in the urban zone
- Remarkable that levels were almost as high in the city as in the countryside where glyphosate was used on crops
- Conclusion of abstract:
"These values can be considered high and dangerous to human health and the environment."



*Maria Gizeuda de F Sousa et al. Environ Monit Assess 2019; 191(10): 604

33

Global Biofuels Market, 2012-2021



p: projections
Source : Pike Research, 2011; Lucintel, february 2012; Research and Markets, november 2016;
Statista. [https://fr.statista.com/statistiques/559443/energie-propre-caille-du-marche-mondial-des-biocarburants-2005/]. (Consulted on december 22 2016)

- Crops are sprayed with glyphosate right before harvest
- After the harvest, the stubble is shipped to a processing plant and converted into biofuels
 - Biogas, bioethanol, biodiesel, bio home heating oil, aviation biofuel

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Biofuels Consumption by Country (thousand barrels per day)*

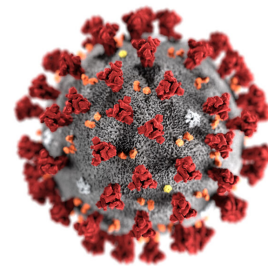
	2016	2015	2014	2013	2012	2011	2010	2005	2000
1 United States	1,055.27	1,033.79	1,005.44	991.17	938.87	881.63	834.00	270.92	108.00
2 Brazil	523.00	527.12	418.22	370.43	321.88	326.09	348.66	181.90	166.85
3 China	76.77	70.88	88.01	84.55	65.56	56.89	52.35	23.10	0.00
4 France	73.22	71.00	70.34	64.69	65.22	58.86	58.80	13.31	8.08
5 Germany	68.50	68.57	73.08	71.42	77.34	74.36	75.52	41.44	4.96
6 Canada	55.87	56.52	58.23	57.05	52.40	47.25	33.31	5.80	4.50
7 Indonesia	51.83	14.82	27.57	18.06	11.55	6.17	3.79	0.00	0.00
8 Thailand	43.31	41.74	38.48	34.44	24.11	18.78	18.94	1.22	0.00
9 Argentina	34.25	32.04	29.65	25.00	21.50	18.10	12.38	0.00	0.00
10 Spain	28.19	24.02	23.74	22.49	49.81	41.10	34.75	7.25	1.60
11 United Kingdom	26.79	25.96	30.88	27.45	24.52	27.58	29.41	2.08	0.00
12 Italy	26.72	27.97	25.66	29.37	31.65	32.66	33.16	4.15	0.00
13 Sweden	23.60	23.43	20.51	14.20	13.16	11.71	11.28	4.46	0.00

*<https://knoema.com/atlas/topics/Energy/Renewables/Biofuels-consumption>

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Total deaths from COVID-19 up to October 6, 2021, normalized by population*

- US:
2,179 per million
- Brazil:
2,795 per million
- Bhutan – mostly small family farms, natural whole foods
4 per million
- Worldwide average
620.7 per million



*https://www.worldometers.info/coronavirus/?utm_campaign=homeAdvegas1?

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Nigeria: High Air Pollution; Low COVID Mortality

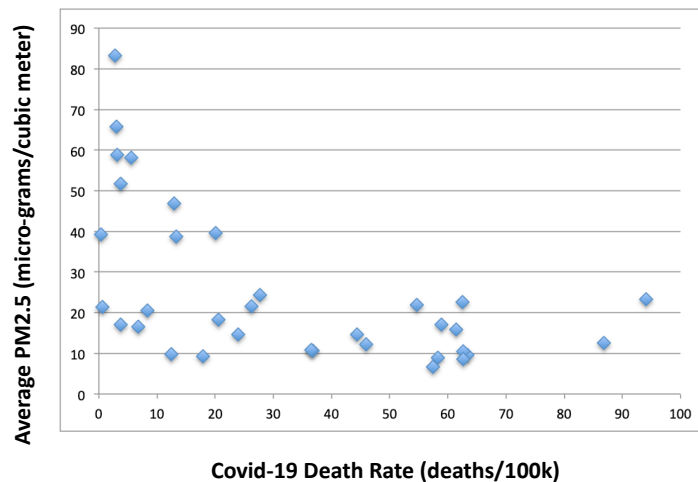
- **“Dirtied by success? Nigeria is home to the city with worst PM10 levels”***
 - Four of the worst cities singled out worldwide for air pollution are in Nigeria, including the top-ranking city in the world: Onitsha
 - World Bank reported in 2015 that 94% of the Nigerian population experiences air pollution levels above the safe limits set by WHO
- **Nigeria has a very low death rate from COVID19****
 - As of August 6, 2020, only 5 people per million in Nigeria had died from COVID19
 - At the same time 485 people in the US per million had succumbed and 469 per million in Brazil

*<https://www.cnn.com/2016/05/31/africa/nigeria-cities-pollution/index.html>

**European Centre for Disease Prevention and Control . COVID-19 situation up- date worldwide, as of 6 August 2020.
<https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

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Effect of Air Pollution on Covid-19 Death Rate*



*Sources: <https://coronavirus.jhu.edu/data/mortality>

<https://www.iqair.com/us/world-most-polluted-countries>

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Vaping Lung Disease*

- E-cigarette or vaping product use-associated lung injury (EVALI)
- The most common respiratory symptoms:
 - shortness of breath (85%),
 - cough (85%), and
 - chest pain (52%)
- Gastrointestinal symptoms:
 - nausea (66%),
 - vomiting (61%),
 - diarrhea (44%),
 - abdominal pain (34%).
- All patients had one or more constitutional symptoms, with the most common being subjective fever (84%).
- *Upper respiratory symptoms such as rhinorrhea, sneezing, or congestion were not commonly reported*



* JE Layden et al. N Engl J Med 2020; 382: 903-916

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 - diarrhea (44%),
 - abdominal pain (34%).
- All patients had one or more constitutional symptoms, with the most common being subjective fever (84%).
- *Upper respiratory symptoms such as rhinorrhea, sneezing, or congestion were not commonly reported*

These symptoms are remarkably similar to the symptoms of COVID-19



* JE Layden et al. N Engl J Med 2020; 382: 903-916

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Glycerol in E-Cigarettes*

- E-cigarettes work on the principle of burning glycerol and propylene glycol (derived from glycerol)
- Glycerol is a **by-product of biodiesel fuel production** and is very cheap because the market is glutted
- An experiment where humans were asked to smoke E-cigarettes containing only the glycerol and propylene glycol (no nicotine) revealed increased inflammation in the lungs

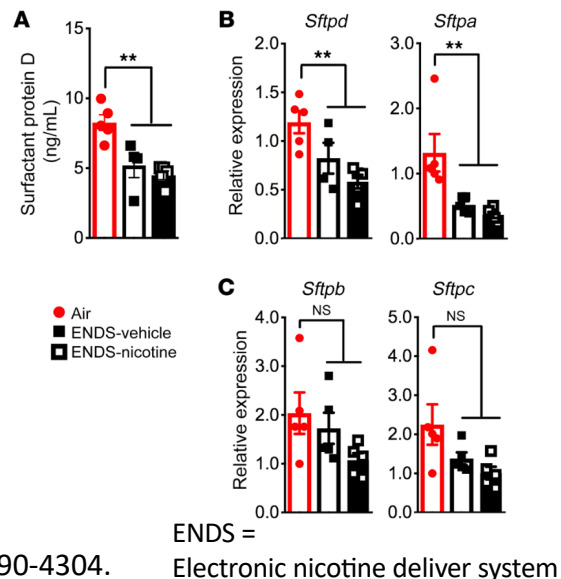
People who smoke E-cigarettes have a
five-fold increased risk to COVID-19

*Min-Ae Song et al. Cancer Prev Res. Feb. 2020 [Epub ahead of print]

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Mice Exposed to Vaping Fumes*

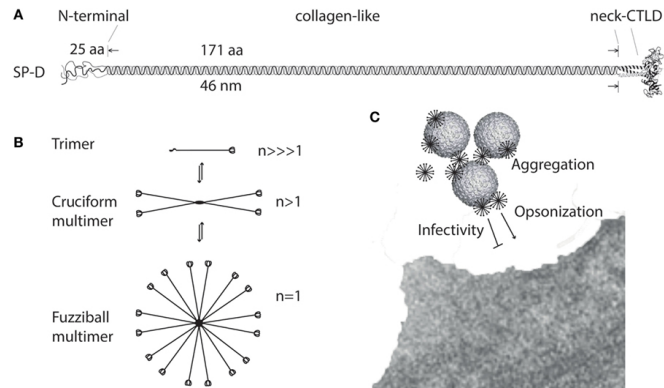
- Mice exposed for four months to vaping fumes
- Following infection with influenza virus, exposed mice had dramatically higher levels of inflammatory cytokines in their lungs (over-responsive immune system)
- Examination of lungs revealed **suppressed surfactant proteins A and D** and **accumulation of fatty lipid deposits** in lung macrophages



*MC Madison et al. J Clin Invest 2019; 129(10): 4290-4304.

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Lung surfactant protein SP-D has collagen-like stalks: GxyGxyGxy...*



“Binding of multimeric SP-D to microbe-associated glycans may block interaction of the microbe with its receptors, aggregate the microbes, or SP-D may act as an opsonin, enhancing endocytic uptake of the microbe in host cells.”

*Grith L. Sorensen. Frontiers in Medicine 2018; 5: 18.

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GxyGxyGxy... sequence in SP-D

... GLP GRD GRD GRE GPR GEK GDP GLP GAA GQA GMP GQA GPV GPK
 GDN GSV GEP GPK GDT GPS GPP GPP GVP GPA GRE GPL GKQ GNI GPQ
 GKP GPK GEA GPK GEV GAP GMQ GSA GAR GLA GPK GER GVP GER GVP
 GNT GAA GSA GAM GPQ GSP GAR GPP GLK GDK GIP GDK GAK GES GVE
 ...



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Collagen & Glyphosate?

- SP-A and SP-D are members of a class of proteins produced by immune cells called **collectins**
 - They play a powerful role in trapping viruses and other pathogens
 - They contain a classic collagen-like region that forms their stalk
- Collagen is the most abundant protein in the body (25% of the total proteins are collagen)
 - It makes up a significant component of skin, bones, joints, etc.
- Multiple glycine mutations in collagen lead to genetic disease
 - Ehler's Danlos Syndrome
 - Osteogenesis imperfecta
- Is glyphosate causal in the epidemic we are seeing today in joint pain and bone fractures?

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Is Glyphosate Causing an Epidemic in Fatty Liver Disease?

- Worldwide epidemic in fatty liver disease today*
- "Multiomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide" **
- Glyphosate causes fatty liver disease in humans ***

* Chris Estes et al. Hepatology 2018; 67(1): 123-133.
 ** Robin Mesnage et al. Sci Rep 2017; 7: 39328.
 *** PJ Mills et al. Clinical Gastroenterology and Hepatology
 2020;18(3):741-743.

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“Glyphosate Excretion is Associated With Steatohepatitis and Advanced Liver Fibrosis in Patients With Fatty Liver Disease”*

- Patients with liver disease at UC San Diego were carefully screened for non-alcoholic steatohepatitis (NASH)
- Glyphosate excretion was significantly higher in patients with NASH than in patients without NASH
 - Patients with advanced fibrosis had significantly higher glyphosate than patients with less fibrosis
- This is reminiscent of the “fatty lung disease” observed in people with the lung vaping disease

* PJ Mills et al. Clin Gastroenterol Hepatol 2020; 18(3): 741-743.

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Chronic Disease in the United States*

- Chronic disease affects more than 40% of the US population
 - Half of all adults and 8% of children aged 5-17
- 1/3 of the population has more than one chronic disease
- In 2009, 7 out of 10 deaths were attributable to chronic disease
- Chronic disease accounts for more than 75% of all health care costs
- Seven chronic diseases – cancer, diabetes, hypertension, stroke, heart disease, pulmonary conditions, and mental illness – cost the economy \$1.3 trillion each year

*<https://nationalhealthcouncil.org/wp-content/uploads/2019/12/AboutChronicDisease.pdf>

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Pre-existing conditions lead to death from COVID

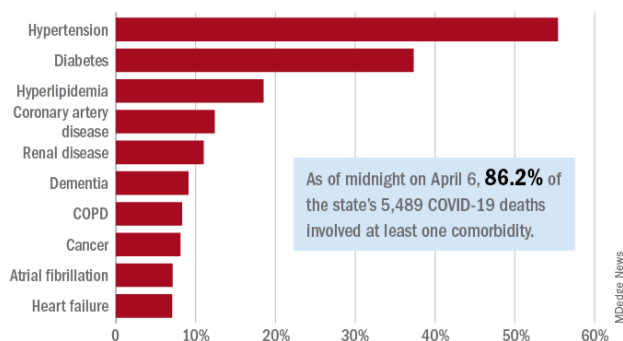
According to the CDC, 94% of death certificates for COVID-19 victims in the U.S. were in people with pre-existing health conditions including diabetes, obesity, heart disease, lung disease, kidney disease, dementia and hypertension.

-- Most of these conditions are rising dramatically in prevalence in the United States in step with the rise in glyphosate usage on core crops

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Comorbidities for COVID-19 in New York State*

Leading comorbidities among COVID-19 deaths in New York



As of midnight on April 6, **86.2%** of the state's 5,489 COVID-19 deaths involved at least one comorbidity.

Note: Data reported on a daily basis by hospitals, nursing homes, and other health care facilities.
Source: New York State Department of Health

*<https://www.the-hospitalist.org/hospitalist/article/220457/coronavirus-updates/comorbidities-rule-new-yorks-covid-19-deaths>

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Correlations over time between Glyphosate Usage and Disease in the US*

Condition	Correlation Coefficient	Probability (<i>p</i> -value)
Hypertension (deaths)	0.923	1.6E-7
Diabetes (prevalence)	0.971	9.2E-9
Hyperlipidemia/Hypercholesterolemia (death)	0.973	7.9E-9
End stage renal disease (deaths)	0.975	7.2E-9
Dementia (deaths)	0.994	1.8E-9
Liver cancer (incidence)	0.960	4.6E-8
Obesity	0.962	1.7E-8

*Nancy L Swanson et al. J Org Syst 9 (2014) 6-37.

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Comorbidities: Obesity and Diabetes*

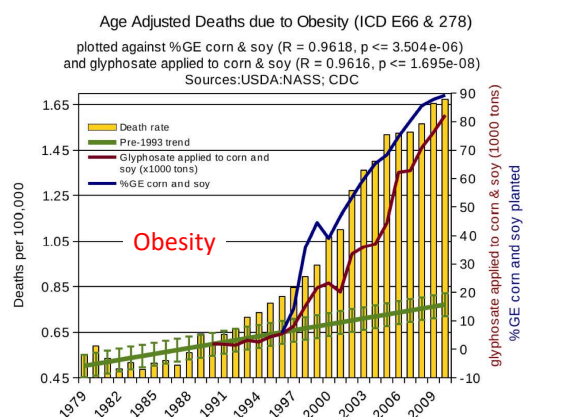


Figure 13. Correlation between age-adjusted obesity deaths and glyphosate application and percentage of US corn and soy crops that are GE.

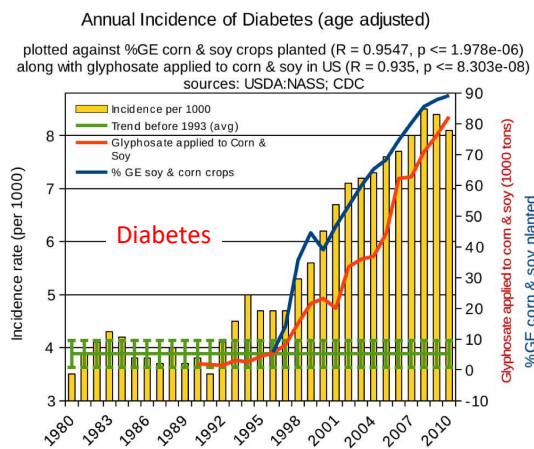


Figure 14. Correlation between age-adjusted diabetes incidence and glyphosate application and percentage of US corn and soy crops that are GE.

* N Swanson et al. Journal of Organic Systems, 9(2), 2014

52

Importance of NAD(P)(H) Redox System to Mitochondrial Health

53

The Big Picture

- NAD (Nicotinamide Adenine Dinucleotide) is an essential cofactor in oxidation/reduction reactions

It exists in four forms: with and without hydrogens and with and without phosphate

NAD⁺ (no H, no P)

NADH (with H, no P)

NADP⁺ (no H, with P)

NADPH (with H, with P)

The enzymes that supply NAD⁺ and NADP⁺ with H are specially designed to avoid deuterium

- Mitochondria are organelles inside cells that supply energy in the form of ATP
- Mitochondria depend critically on a proton-ATPase pump to make ATP
 - Protons derived from NADH and NADPH are pumped into the intermembrane space
- Deuterium “gums up” the pump (like sugar in the gas tank)
- Glyphosate interferes with the supply of NADH and NADPH to the organism

54

Flavoproteins

- Flavoproteins are a large class of enzymes with many roles
- They exhibit strong kinetic isotope effects (favor H over D)
 - Greatly prefer H over D during hydride (H⁻) transfers
 - Use water wires to fractionate out deuterium
- Many steal H from substrate to restore NAD(P)H from NAD(P)⁺
- Others provide *D-depleted protons* to the mitochondria and for fatty acid and nucleotide synthesis
- They have strong glycine dependencies for binding to phosphate at flavin binding sites
 - Susceptible to suppression through glyphosate substitution

55

Glyphosate Impairs NAD(P)(H) Pathways*

- Glyphosate is the active ingredient in the pervasive herbicide Roundup
 - It kills weeds by suppressing EPSP synthase in the shikimate biological pathway
- Tryptophan is a major product of this blocked pathway
 - Tryptophan is produced by gut microbes depending on EPSP synthase
 - *NAD(P)(H) is derived from tryptophan*
- Glyphosate induces ROS in mitochondria and depletes glutathione (antioxidant)
 - Also increases ratio of GSSG/GSH
- Glyphosate inhibits *glucose 6 phosphate dehydrogenase* (G6PD), which restores NADPH from NADP⁺
- Glyphosate inhibits *succinate dehydrogenase*, an essential enzyme in both the citric acid cycle and oxidative phosphorylation in the mitochondria

*S Seneff, Toxic Legacy, Chelsea Green Publishers, July 2021.

56

“COVID-19: NAD⁺ deficiency may predispose the aged, obese and type2 diabetics to mortality through its effect on SIRT1 activity”*

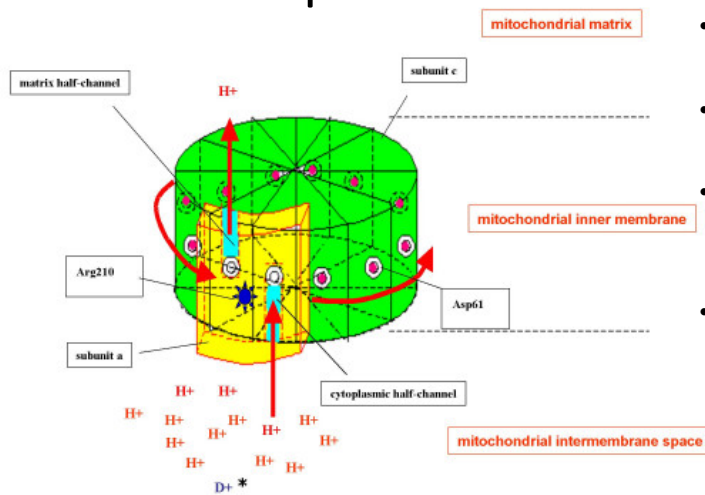
- NAD⁺ is a cofactor heavily involved in proton-coupled electron transfer (PCET)
- Sirtuins are an ancient family of 7 NAD⁺-dependent signaling proteins that regulate metabolism
- Intracellular NAD⁺ levels are depleted in association with diabetes and obesity, risk factors for bad outcome in COVID-19
 - Diabetes and obesity rates have been rising dramatically in the United States in step with the rise in glyphosate usage on core crops**
- Depletion of SIRT1 causes uncontrolled increases in inflammatory markers TNF- α , IL-6 and IL-1 β
 - Increased risk to cytokine storm due to inability to activate SIRT1

*R Miller et al. Medical Hypotheses 2020; 144: 110044

**N Swanson et al. Journal of Organic Systems, 9(2), 2014

57

Deuterons Disrupt the ATPase Pump*



- There are around 15,000 ATPase pumps in a single mitochondrion
- Proton force rotates the ATPase pumps at a rate of 1,000 cycles per second
- Deuterons resist letting go and stall the pump, producing a stutter
- Deuterons also disrupt proton-coupled electron transport (PCET) which is based on proton tunneling
- This causes decreased production of ATP and increased production of reactive oxygen species, damaging the pumps.

*Abdullah Olgun. Theoretical Biology and Medical Modelling 2007, 4: 9.

58

G6PD & Fatty Acids*

- Glucose 6 phosphate dehydrogenase (G6PD) converts NADP^+ to **NADPH** (has strong preference for **H** over **D**)**
- **NADPH** is the largest source of hydrogen in fatty acid biosynthesis
- E coli and Bacillus subtilis produce *depleted fatty acids (FAs)*
 - Due to high dependency on G6PD to restore H in NADPH



Photosynthetic organisms (e.g., algae (chlorella)) produce highly deuterium-depleted FAs



*RS Wijker et al. PNAS 2019; 116(25): 12173-12182.

**Xinning Zhang et al. PNAS 2009; 106: 12580-12586.

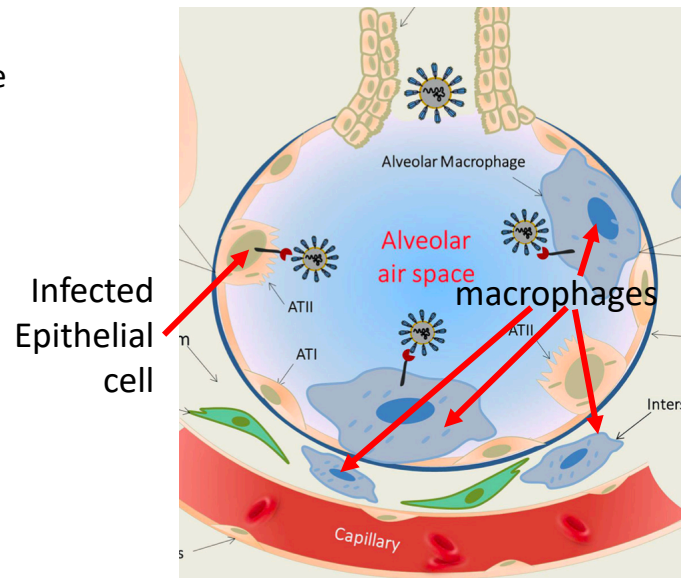
59

SARS-CoV-2 Infection in the Lungs: An Extraordinary Response

60

Initial COVID-19 Events

- SARS CoV-2 viruses enter through the bronchioles and infect epithelial cells lining the lung's alveoli
- Residential macrophages fail to clear the virus because they are defective
- Viruses proliferate wildly
- Macrophages send out alarm signals which draw in more macrophages
- Capillary wall becomes leaky to support invasion
- Blood pressure drops; fluid begins to fill the alveolar space
- Person feels as if they are drowning



*Frank L van de Veerdonk et al. eLife 2020; 9: e5755.

61

Is a Bradykinin Storm Brewing in COVID-19?*

- Hypertension is a risk factor for COVID-19, but *hypotension* develops instead during the disease process
 - ACE2 receptor is upregulated by 199-fold in the lungs in severe COVID-19 patients, and ACE is downregulated (8-fold)
 - ACE degrades (clears) bradykinin
 - Bradykinin receptors are upregulated by nearly 3000-fold!
 - Bradykinin induces vasodilation and hypotension
- Inflammatory cytokines induce capillary leakage and inhibit alveolar fluid reabsorption leading to alveolar flooding**

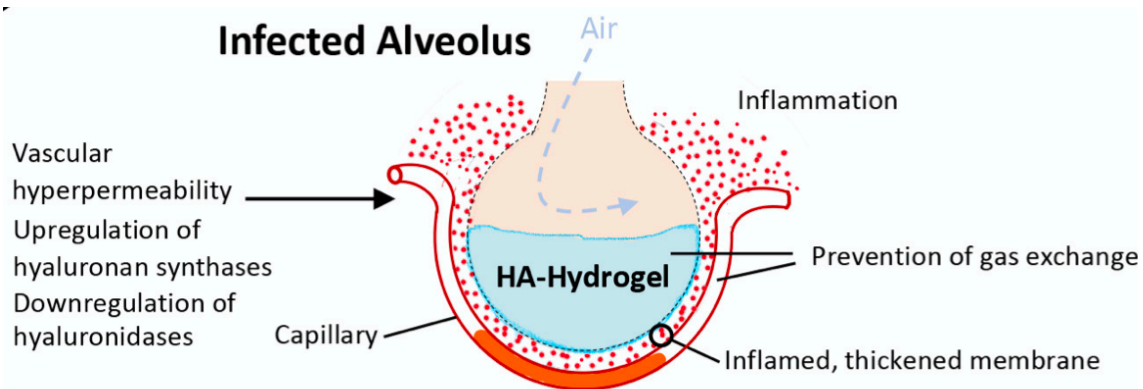
*<https://www.the-scientist.com/news-opinion/is-a-bradykinin-storm-brewing-in-covid-19—67876>

Michael R Garvin et al. eLife 2020; 9: e59177.

**Andrew M Luks and Erik R Swenson. Ann Am Thorac Soc 2020 Apr 24 [Epub ahead of print]

62

Bradykinin-induced hyperpermeability of the lung capillaries causes formation of hyaluronic-acid hydrogel that inhibits gas exchange*



*Michael R Garvin et al. eLife 2020; 9: e59177.

63

SARS CoV-2 causes massive over-production of hyaluronic acid in the lungs*

- "Hyaluronic acid can trap roughly 1000 times its weight in water and when bound to water the resulting hydrogel obtains a stiff viscous quality similar to 'Jello' "
- Multiple enzymes that synthesize hyaluronic acid are massively upregulated in COVID-19 lungs: HAS1 (9,113 fold), HAS2 (493 fold), and HAS3 (32 fold)
- Excess hyaluronic acid is associated with pulmonary thrombosis, ground glass opacities, and acute respiratory distress syndrome
- "Hyaluronic acid in the bronchoalveolar space of the lungs could form a *viscous hydrogel* that would negatively impact gas exchange"

*Michael R Garvin et al. eLife 2020; 9: e59177.

64

Heme Oxygenase-1 (HO-1) and COVID-19*

- Some cases of COVID-19 cascade into a hyper-inflammatory state leading to thrombosis and multiple organ failure
 - Inflammation upregulates HO-1 which normally tames the inflammation
- “Replacement of the Distal Glycine 139 Transforms Heme Oxygenase-1 into a Peroxidase”**
- Glyphosate substitution in HO-1 would convert it to a pro-inflammatory enzyme
 - Fails to metabolize heme to bilirubin and biliverdin
 - Releases ferryl iron that reacts with ROS to damage the vascular wall

*S Seneff. Glyphosate, Deuterium and COVID-19. Masters of Health <https://joom.ag/xCOC>

**Y Liu et al. JBC 2000; 275(44): 34501-34507

65

Rebooting the Mitochondria

66

How the Virus Facilitates Repair of the Deuterium Problem- Hypothesis

- Hydrogel traps deuterium leaving DDW in the fluid water in the lungs
- SARS-CoV-2 virus contains lipids such as linoleic acid in its membrane (stolen from host cell)
- Inflammatory response due to weak innate immunity causes release of lipoxygenase
 - Lipoxygenase extracts protons from lipids in viral membrane and converts oxygen into deuterium depleted water (DDW)
- Produces leukotrienes which induce further reaction
 - Arterioles constrict access to capillary
 - Venules open up leaks
- *Macrophages “drink the sweet nectar” – and supply their mitochondria with much-needed deuterium depleted water ??*
 - This empowers them to clear the virus

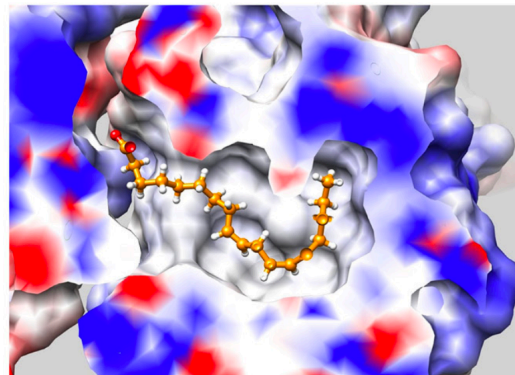
Lipoxygenase has a fantastic ability to select hydrogen over deuterium in its product (water)*

*Pengfei Li et al. J Phys Chem Lett 2018; 9(22): 6444-6449.

67

Virus traps linoleic acid in its membrane which then gets oxidized by lipoxygenase to make DDW

- Linoleic acid fits perfectly in three binding pockets of SARS CoV-2 membrane S glycoprotein*
- Patients with severe COVID-19 show reduced levels of fatty acids**



*Christine Toelzer et al. Science Sept 21 2020 [Epub ahead of print]

**Bo Shen et al. Cell 2020; 182: 59-72.

68

Viruses are stabilized by excess deuterium!

- The nucleocapsid protein in SARS-CoV-2 starts to unfold at 35 degrees Centigrade (95 degrees Fahrenheit) and is completely denatured at 55 degrees Centigrade (131 degrees Fahrenheit)*
 - A fever is a natural defense against the virus
- Viruses take up deuterium and trap it in their protein coat and in their internal single strand of RNA**
 - Deuterium stabilizes the viral protein and RNA and protects from temperature denaturation
 - *The virus removes deuterium from the body fluids*
- When the deuterium level in the body fluids is high, the virus becomes more stable

*Milan Surjit and Sunil K Lal. Infection, Genetics and Evolution 8 (2008) 397-405.

**Jiangsen MAO et al., Chinese Science Bulletin 2004 Vol. 49 No. 3 253-257.

69

“Mitochondrial Transfer via *Tunneling Nanotubes* is an Important Mechanism by which Mesenchymal Stem Cells Enhance Macrophage Phagocytosis in the *In Vitro* and *In Vivo* Models of ARDS”*

“In conclusion, MSC [mesenchymal stem cells] *transfer their mitochondria to macrophages* both *in vitro* and *in vivo*. Mitochondrial donation results in enhancement of macrophage phagocytosis potentially through improvement in bioenergetics and presents a novel mechanism of the antimicrobial effect of MSC.”

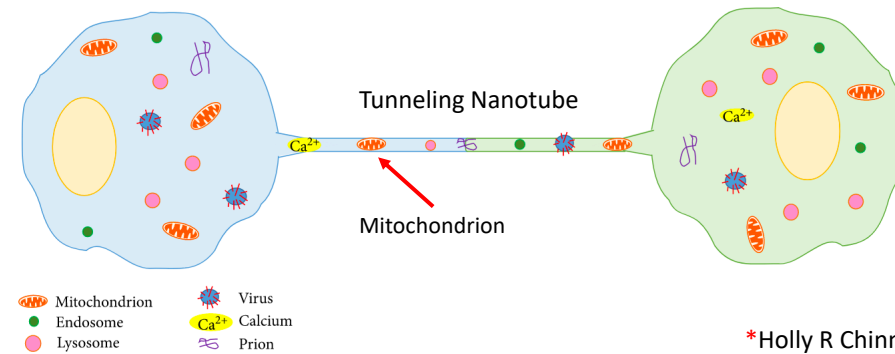
ARDS = Acute Respiratory Distress Syndrome

*Megan V Jackson et al. Stem Cells 2016;34:2210–2223

70

Do the mitochondria and lysosomes get repaired in transit?

“Tunneling nanotubes (TNTs) transport cellular organelles such as mitochondria, endosomes, and lysosomes, as well as other cargoes such as viruses, prions, and Ca^{2+} signals.”*



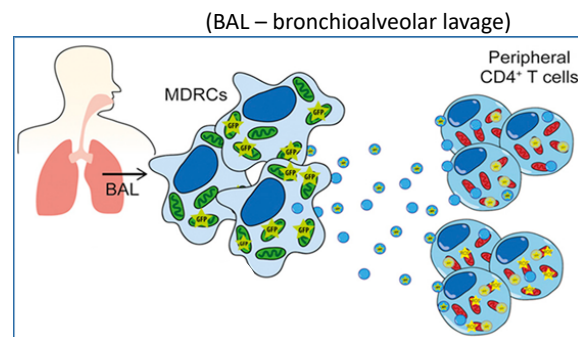
*Holly R Chinnery and Kate E Keller.

BioMed Research International 2020; 2020: Article ID 7246785.

71

“Exosomal transfer of mitochondria from airway myeloid-derived regulatory cells to T cells”*

- Myeloid-derived regulatory cells (MDRCs) are cells that emerge from the bone marrow and infiltrate inflammatory sites, e.g., in asthma
- MDRCs in the airways transfer mitochondria to T cells via *exosomes*
 - These mitochondria have been shown to be functional in the recipient cell



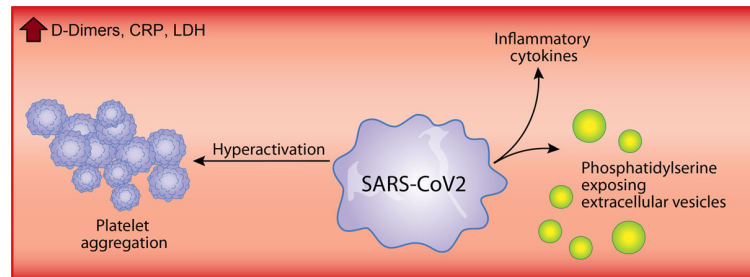
- Hypothesis: Immune cells (e.g., T cells, macrophages, dendritic cells, ...) can sweep up DDW and mitochondria via macropinocytosis
- *Intercellular communication is essential for resolving inflammation*

*Kenneth P. Hough et al. Redox Biol 2018; 18: 54-64.

72

A Role for Platelets!*

- Each platelet contains 7 or 8 mitochondria
- Platelet mitochondria are very susceptible to oxidative stress
- Activated platelets form blood clots that can lead to disseminated intravascular coagulation (DIC) or multiple organ failure



- *Mitochondria get released into the extracellular space from the platelets either free or embedded in exosomes*

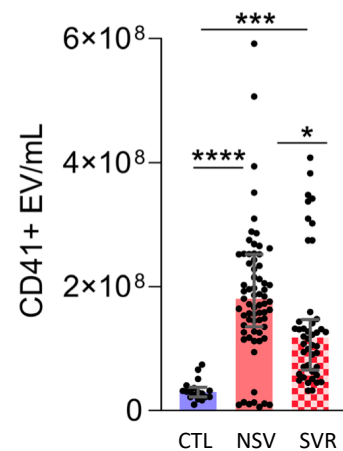
*Jumana Saleh et al. Mitochondrion 2020; 54: 1-7.

73

Megakaryocytes and Platelets in the Lungs*

- Megakaryocytes localized to the lungs are a source of new platelets
- Both megakaryocytes and platelets release extracellular vesicles in response to inflammation
- CD41 is a marker for megakaryocytes and platelets
- CD41 expression as well as extracellular vesicle release were highest in *non-severe COVID-19*

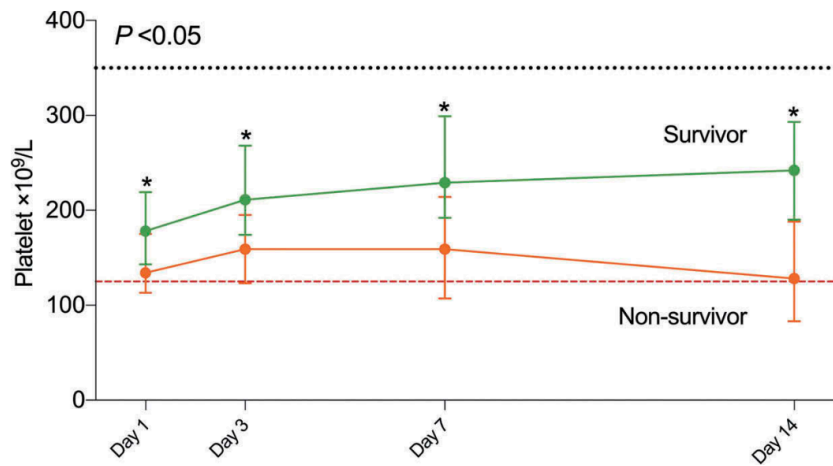
CTL – Control; NSV – non-severe; SVR = severe COVID



*Younes Zaid et al. Circulation Research 2020;127:1404–1418.

74

Platelet Counts Over Time: Survivors and Nonsurvivors of COVID-19*



*Yanli Liu et al., Platelets 2020; 31(4): 490-496.

75

Recapitulation

- COVID-19 affects different countries to different degrees and the primary discriminator could be glyphosate exposure
- Glyphosate disrupts the body's ability to properly manage deuterium
 - Deuterium toxicity results in impaired innate immune function
- The process that unfolds during acute COVID-19 aims to restore mitochondrial and lysosomal health to the immune cells
 - Inflammation, swelling and alveolar hydrogel reflect mechanisms that produce deuterium depleted water
 - Platelets and mesenchymal stem cells supply fresh mitochondria to macrophages via tunneling nanotubes and exosomes
 - Macrophages use macropinocytosis to acquire DDW and mitochondria
 - Eventually reboots the mitochondria to support viral clearance

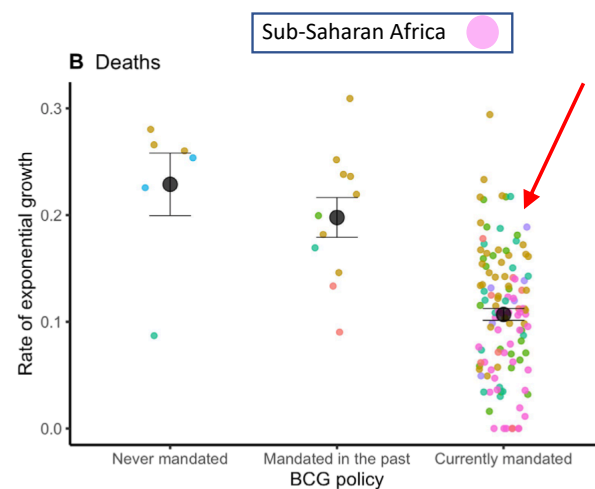
76

Tuberculosis and COVID-19

77

“Mandated Bacillus Calmette-Guérin (BCG) vaccination predicts flattened curves for the spread of COVID-19”*

- BCG vaccine immunizes against tuberculosis
- Countries that currently mandate the vaccine have on average lower rates of death from COVID-19
- However, there is a huge variance in this group that can be explained by the rate of *infection* with tuberculosis pathogen



*Martha K Berg et al., Sci Adv 2020; 6: eabc1463.

78

Study in Israel*

- Israel required the BCG vaccine prior to 1982, and then eliminated the requirement
- Study compared two age groups: those born between 1979 and 1981 and those born between 1983 and 1985
 - Similar ages but very different exposure to BCG vaccine
 - Nearly 6000 people in the study
 - One severe case in each group; no deaths

“In conclusion, this study does not support the idea that BCG vaccination in childhood has a protective effect against COVID-19 in adulthood.”

*Chiara Sartini et al. JAMA 2020; 323: 22.

79

LIVING

Scientists can't explain puzzling lack of coronavirus outbreaks in Africa

By Chris Smith, BGR

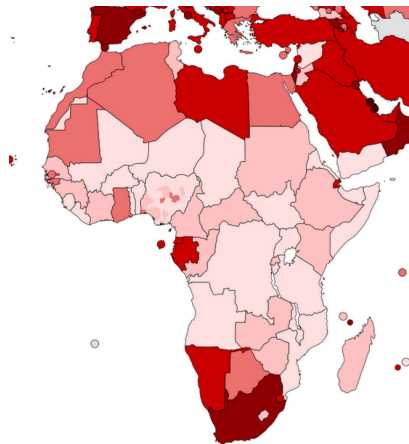
September 4, 2020 | 3:51pm | Updated

- “The US surprised the world when it rose to the top spot in multiple COVID-19 statistics, both for the total number of confirmed cases and the number of deaths. Since then, no other country has surpassed America.”
- “Africa is doing better than any other continent, both when it comes to cases and casualties.”

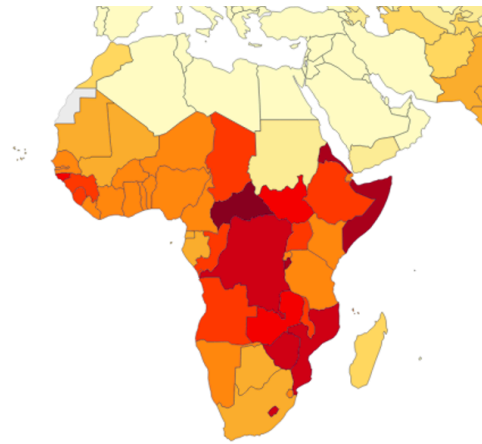
*<https://nypost.com/2020/09/04/scientists-cant-explain-puzzling-lack-of-coronavirus-outbreaks-in-africa/>

80

Inverse relationship between COVID-19 and Tuberculosis in Africa



COVID-19 rates in Africa (Sep. 21, 2020)



Tuberculosis death rates in Africa (1990-2017)*

*<https://ourworldindata.org/grapher/tuberculosis-death-rates>

81

Some Interesting Facts about Tuberculosis*

- As of 2018, 25% of the world's population was infected with latent tuberculosis
 - Most are without symptoms for their entire life
- In 2018, there were more than 10 million cases of active TB which resulted in 1.5 million deaths
- In Asia and Africa, about 80% of the population test positive, while only 5-10% of the US population tests positive
- More than half of diagnosed cases are in eight countries:
 - India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (6%), Nigeria (4%) and Bangladesh (4%)

*<https://en.wikipedia.org/wiki/Tuberculosis>

82

Countries with mandates with and without high infection rate

Country	death*	obesity**	Country	death	obesity
India	6.15	3.9	United Kingdom	62.86	27.8
Philippines	4.49	6.4	France	46.43	21.6
Indonesia	3.45	6.9	Portugal	18.36	20.8
Pakistan	3.02	8.6	Ireland	36.86	25.3
Bangladesh	3.01	3.6			
Nigeria	0.56	8.9			
China	0.34	6.2			

Mandates; high infection rate **Mandates; low infection rate**

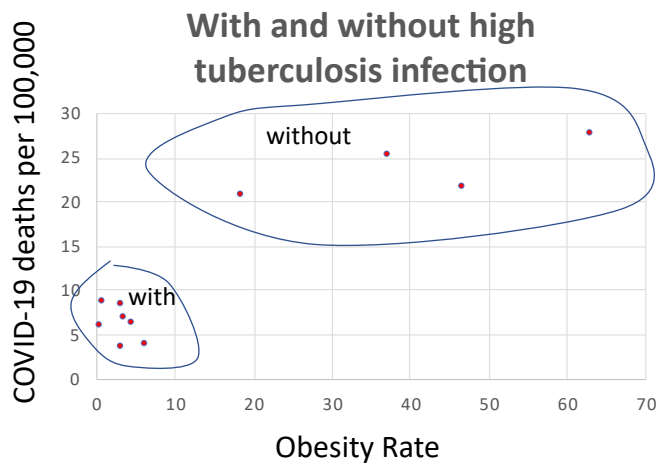
*number of COVID-19 deaths per 100,000 population

**Obesity rate (percent of population)

*Martha K Berg et al., Sci Adv 2020; 6: eabc1463.

83

Does Tuberculosis Protect from Obesity and from COVID-19?? *



*All data shown are countries requiring a tuberculosis vaccine

84

Monsanto Patent: “Glyphosate formulations and their use for the inhibition of 5-enolpyruvylshikimate-3-phosphate synthase”*

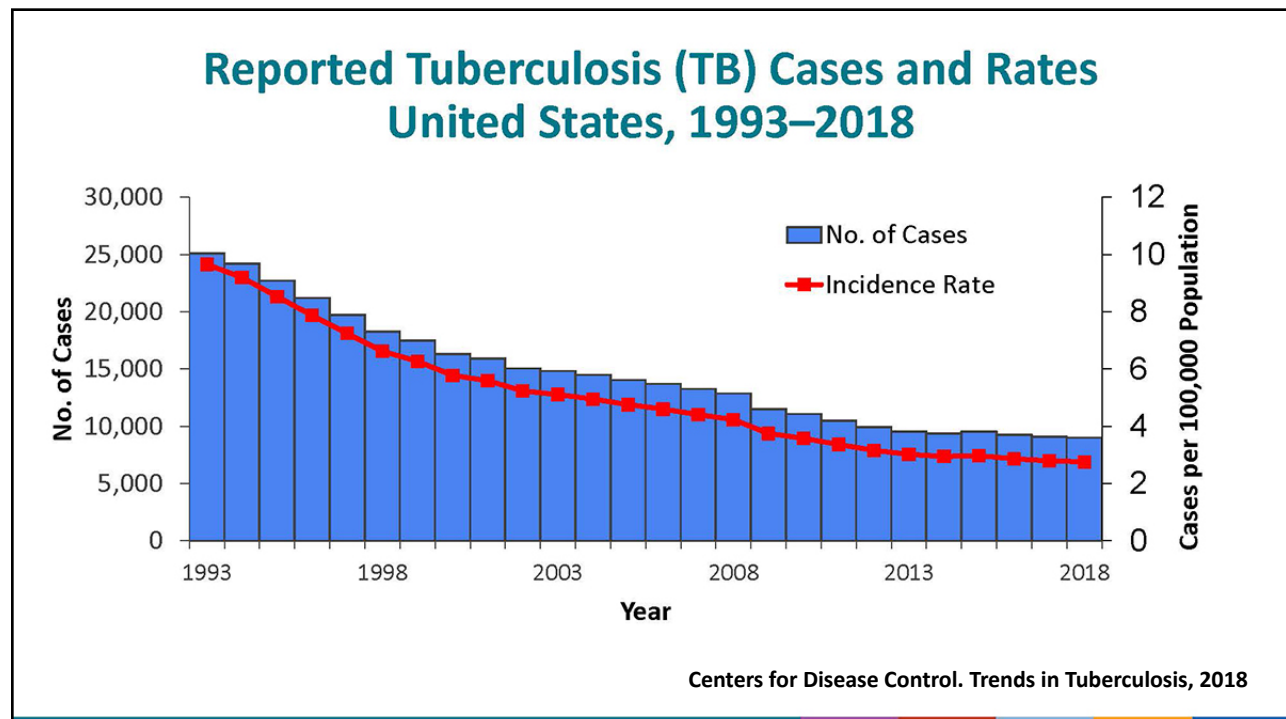
“Among the various aspects of the present invention is a method for treating a Subject infected or Susceptible to an infection by a pathogen containing the enzyme 5-enolpyruvylshikimate-3-phosphate synthase [EPSP synthase]”

“The present invention discloses the use of the herbicidal agent glyphosate in combination with the polyvalent anion oxalic acid for the prevention and therapy of these pathogenic infections.”

“Susceptible organisms include, but are not limited to, all species of the Family Mycobacteriaceae, including but not limited to *M. tuberculosis*, *M. bovis*, *M. africanum*, ...”

*US Patent #US7771736B2. August 10, 2010. Assignee: Monsanto Technology LLC

85

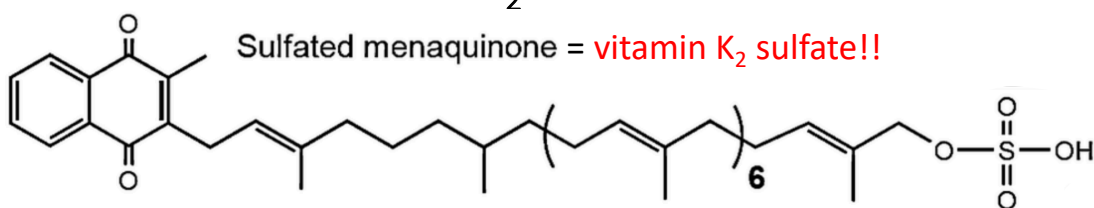


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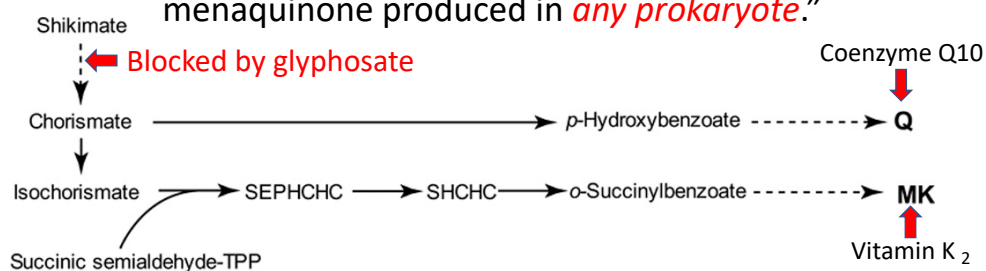
Vitamin K₂!

87

Unusual molecules produced by *Mycobacterium tuberculosis*: Vitamin K₂ sulfate*



“To our knowledge, this is the first example of a sulfated menaquinone produced in *any prokaryote*.”



*CM Holsclaw et al. ACS Chem Biol 2008; 3(10): 619-624.

88

“Menaquinone Synthesis is Critical for Maintaining Mycobacterial Viability During Exponential Growth and Recovery from Non-Replicating Persistence”*

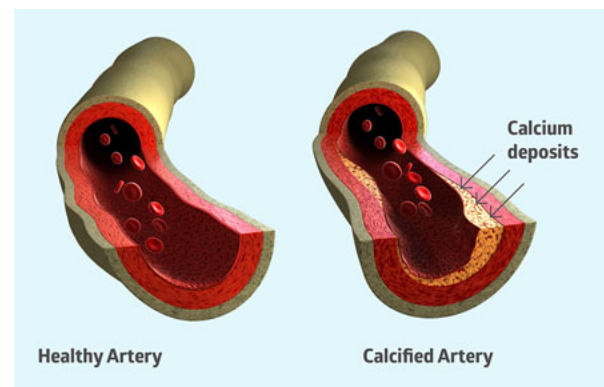
- It is estimated that more than one-third of the world’s population is infected with tubercle bacilli (bacteria that cause tuberculosis)
- Mycobacterium tuberculosis can persist inside the host without causing clinical symptoms (latent infection)
 - Many people harbor the microbe throughout their lifespan with no symptoms
 - Active disease appears only when the immune system is compromised
- M tuberculosis synthesizes menaquinone and it is essential for its electron transport chain to work to generate ATP
 - It uses vitamin K₂ instead of coenzyme Q10 for electron transport
 - The synthesis of both of these is disrupted by glyphosate

*Rakesh K. Dhiman et al. Mol Microbiol. 2009; 72(1): 85-97.

89

Vitamin K₂ Protects from Heart Disease

- Cardiovascular disease rates are much lower in sub-Saharan Africa than in the industrialized world*
- Vitamin K₂ protects from arterial calcification**
- Coronary arterial calcification is an excellent predictor of future heart attack***



*Churchill Lukwiya Onen et al., Cardiovascular Journal of Africa 2013; 24(2): 34-42.

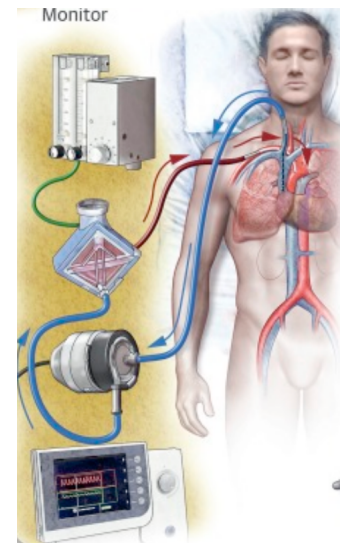
**M. Geleijnse, et al., J Nutr 2004; 134: 3100-3105.

***Marie Henrike Geisel et al., European Heart Journal 2017; 38(23): 1815-1822.

90

COVID-19 and Heart Disease*

- 209 consecutive patients, median age 62, hospitalized in France with COVID-19
- “The presence and extent of CAC [coronary artery calcification] on chest CT [computed tomography] is associated with a worse prognosis in hospitalized COVID-19 patients”
- “CAC is associated with increase in requirement of ventilators, ECMO [extracorporeal membrane oxygenation], and death independent of age and major atherosclerotic CVD risk factors”



*Jean Guillaume Dillinger et al. JACC: Cardiovascular Imaging July 2020 [Epub ahead of print]
DOI: 10.1016/j.jcmg.2020.07.004

91

On the Trail of the Elusive X-Factor: A Sixty-Two-Year-Old Mystery Finally Solved*

- Weston Price identified a mysterious “activator X” which seemed to be present in animal-derived fats like butter and beef tallow and in organ meats
- Dr. Chris Masterjohn, through excellent sleuthing, figured out that this mysterious factor is vitamin K₂

“Whereas K₁ is preferentially used by the liver to activate blood clotting proteins, K₂ is preferentially used by the other tissues to place calcium where it belongs, in the bones and teeth, and keep it out of where it does not belong, in the soft tissues.”

*<https://www.westonaprice.org/health-topics/abcs-of-nutrition/on-the-trail-of-the-elusive-x-factor-a-sixty-two-year-old-mystery-finally-solved/>

92

“Study links better vitamin K status with improved COVID-19 outcomes”*

- Patients with severe COVID-19 are more likely to have comorbidities such as type 2 diabetes, hypertension and cardiovascular disease
 - These are all associated with reduced Vitamin K₂ levels
- Matrix Gla protein depends on vitamin K₂ and is reduced in association with K₂ deficiencies
 - It protects from arterial calcification
- A study on 123 patients with COVID-19 compared to controls showed that patients had reduced levels of Matrix Gla protein and that those with a worse outcome had even lower levels than those with milder disease symptoms

*www.nutritioninsight.com/news/study-links-better-vitamin-k-status-with-improved-covid-19-outcomes.html

93

Advice for Staying Healthy in a Pandemic

94

A High-Fat Diet is a Low-Deuterium Diet

- Butter, lard and coconut oil were among the foods with the lowest detected levels of deuterium among foods tested
- The synthesis of fats involves transfer of hydrogen from NADPH into the growing fatty acid chain



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Foods High in Niacin → NAD(P)

- Many foods are rich in niacin, especially animal products like meat, fish and poultry.
- Vegetarian sources include avocado, peanuts, whole grains, mushrooms, green peas and potatoes.



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Riboflavin: Source for FAD in Flavoproteins

Foods high in riboflavin include beef, tofu, milk, fish, mushrooms, pork, spinach, almonds, avocados, and eggs

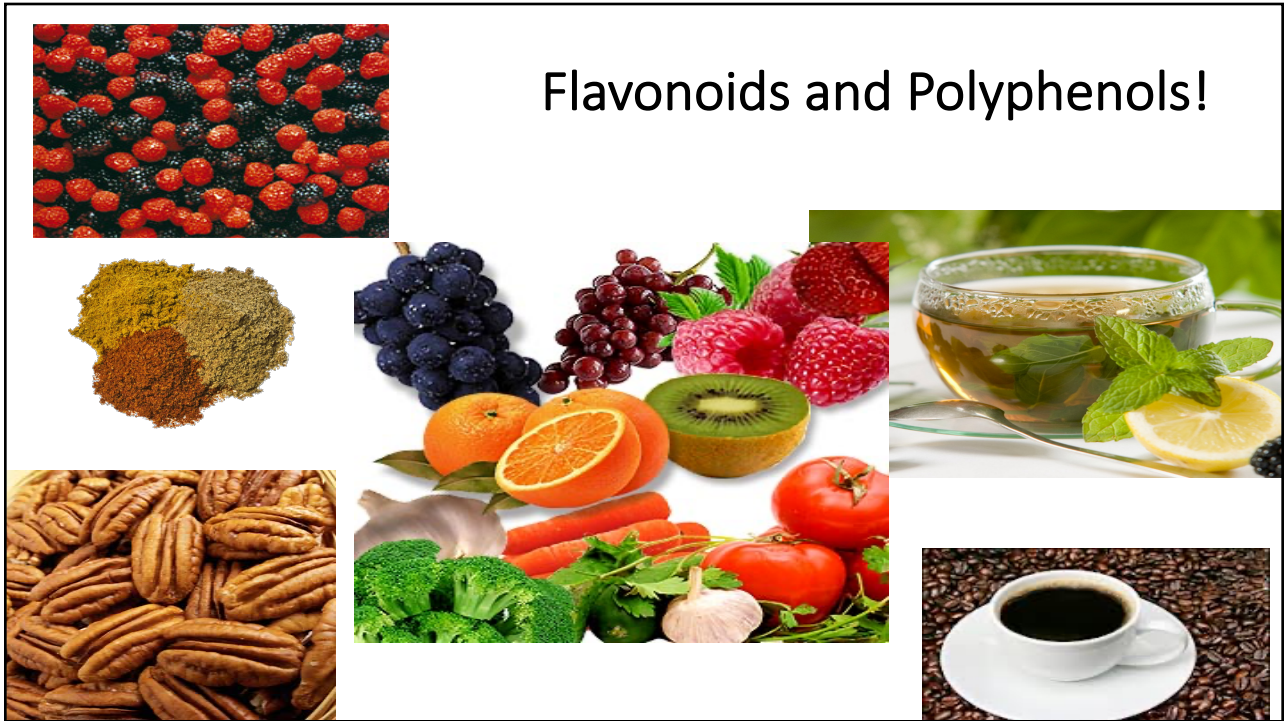


97

DDW, Glacier Water and Hydrogen Water

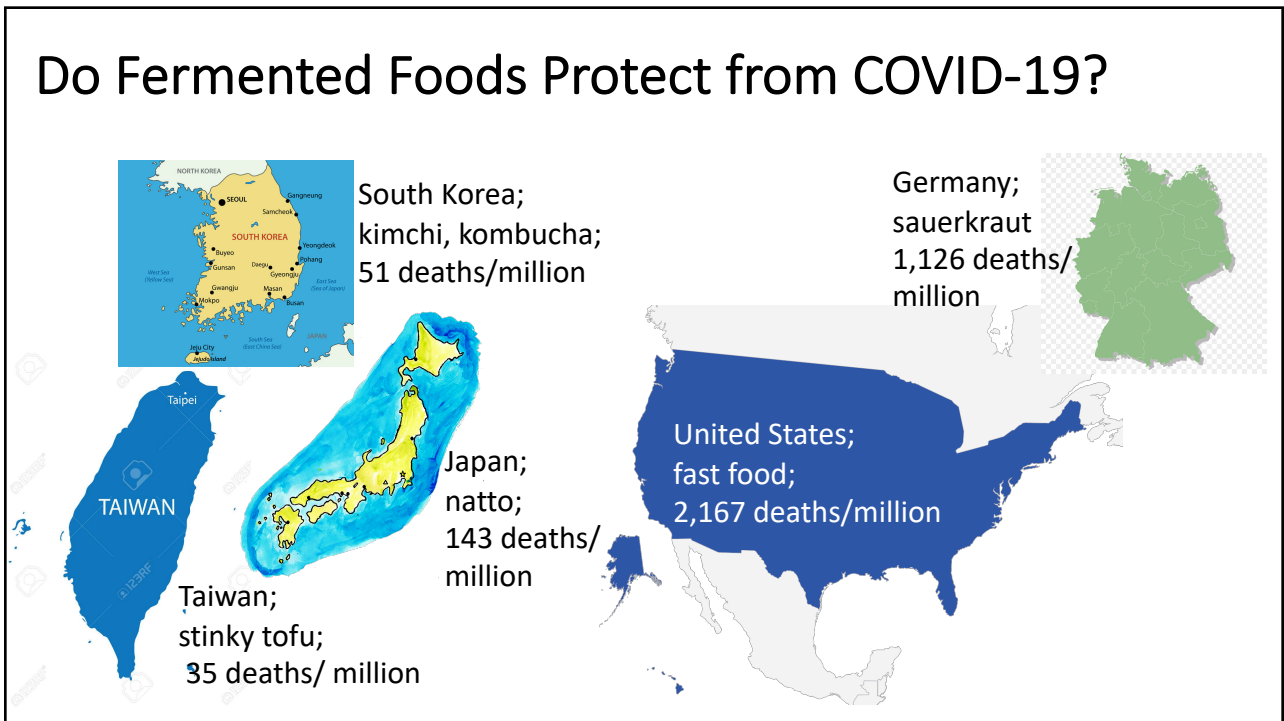


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Flavonoids and Polyphenols!

99



100

Dietary Sources of Vitamin K₂*



*<https://www.healthline.com/nutrition/foods-high-in-vitamin-k>

101



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Environmental Research

journal homepage: www.elsevier.com/locate/envres




Organic diet intervention significantly reduces urinary glyphosate levels in U.S. children and adults

John Fagan^a, Larry Bohlen^a, Sharyle Patton^b, Kendra Klein^{c,*}

- 16 participants and a total of 158 urine samples
- 5 days non-organic diet and 5 days organic diet
- Rapid reduction in glyphosate and AMPA levels in urine following adoption of organic diet even after just a few days


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Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Environmental Research

journal homepage: www.elsevier.com/locate/envres



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"This study demonstrates that diet is a primary source of glyphosate exposure and that shifting to an organic diet is an effective way to reduce body burden of glyphosate and its main metabolite, AMPA."

adoption of organic diet even after just a few days

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Conclusions

- Flavoproteins are essential for maintaining healthy mitochondria by supplying them with deuterium depleted water
- Glyphosate is causing an epidemic in chronic diseases due in part to inhibition of flavoproteins, leading to systemic disruption of DDW supply to mitochondria
- COVID-19 disease is caused by SARS-CoV-2, which infects the lungs and induces a concerted effort to restore mitochondrial health to the lungs, the immune system and to the organism as a whole
 - The viral response critically involves oxidation of membrane lipids by lipoxygenase
 - In acute cases, the viral response gets derailed by further poisoning by glyphosate
- The path towards good health includes eating a certified organic whole foods diet that is rich in fermented foods (vitamin K2), sulfur and the B vitamins niacin and riboflavin

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