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**12 pages including this one**

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**Re: carcinogenicity of glyphosate**

## Evidence of the toxicity of glyphosate<sup>1</sup> Is overwhelming

Compiled by Adrienne Samuels, Ph.D.  
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<sup>1</sup> An ingredient found in agricultural material used in conjunction with growing genetically modified (GMO) crops

## First

### Evidence of the toxicity of glyphosate<sup>1</sup> Is overwhelming

#### **Glyphosate is a neurotoxic endocrine disruptor:**

Glyphosate leads to teratogenicity and reproductive toxicity in vertebrates (Antoniou et al., 2012);

An acute exposure to glyphosate-based herbicide alters aromatase levels in testis and sperm nuclear quality (Cassault-Meyer et al., 2014);

Glyphosate is an endocrine disruptor (Gasnier et al., 2009; Paganelli et al., 2010; Antoniou et al., 2012; Thongprakaisang et al., 2013);

#### **Glyphosate alters hormone profiles:**

Prepubertal exposure to commercial formulation of the herbicide glyphosate alters testosterone levels and testicular morphology (Romano et al., 2010)

Chronic exposure to sub-lethal concentration of a glyphosate-based herbicide alters hormone profiles and affects reproduction of female *Jundia* (*Rhamdia quelen*) (Soso et al., 2007.)

**There are no safe levels of endocrine disruptors** (Vandenberg et al., 2012; Bergman et al., 2013).

#### **Imbalances and malfunctions of the endocrine system are known to lead to a host of disease conditions and disabilities:**

Imbalances and malfunctions of the endocrine system can lead to diabetes, hypertension, obesity, kidney disease, cancers of the breast, prostate, liver, brain, thyroid, non-Hodgkin's lymphoma (Marc et al., 2004; Thongprakaisang et al., 2013), osteoporosis, Cushing's syndrome, hypo- and hyperthyroidism, infertility, birth defects, erectile dysfunction, Soto & Sonnenschein, 2010), sexual development problems and neurological disorders such as: learning disabilities, attention deficit disorder (de Cock et al., 2012), autism (Schulkin, 2007), dementia (Ghosh, 2010), Alzheimer's (Merlo et al., 2010), Parkinson's and schizophrenia (MacSweeney et al., 1978);

Endocrine disruptors are especially damaging to organisms undergoing hormonal changes: fetuses, babies, children, adolescents and the elderly (Bergman et al., 2013).

**Glyphosate is a patented anti-microbial & biocide (U.S. patent number 20040077608 A1 and U.S. patent number 7771736 B2) that preferentially kills beneficial bacteria in our intestines leading to nutrient deficiency, chronic intestinal diseases, inflammation, and autoimmune diseases** (Samsel & Seneff, 2013; Kruger, 2013; Shehata et al., 2012; Carman et al., 2013).

**Glyphosate has been shown to be toxic to the liver and kidneys** (Cattani et al., 2014; Jayasumana et al., 2014; Lushchak et al., 2009; El-Shenawy, 2009; de Liz Oliveira Cavalli et al., 2013; Séralini et al.,

2011).

**Glyphosate and its degradation product, aminomethylphosphonic acid (AMPA) have been detected in the environment, in food, and in organs and tissue:**

Glyphosate and its degradation product, aminomethylphosphonic acid (AMPA) have been detected in air (Majewski et al., 2014; Chang et al., 2011), rain (Scribner et al., 2007; Majewski, 2014), groundwater (Scribner, 2007), surface water (Chang, 2011; Scribner, 2007; Coupe et al., 2012), soil (Scribner, 2007) and sea water (Mercurio et al., 2014), showing that glyphosate and AMPA persist in the soil and water and the amounts detected are increasing over time with increasing agricultural use;

Glyphosate & AMPA residues are high in our food (residues as high as 15 parts per million have been detected in GM soybeans with no residues detected in organic or conventionally grown soy (Bohn et al., 2014);

Glyphosate bioaccumulates in organs and tissue (Kruger et al, 2014).

**There are compositional differences between GMO and Non-GMO crops:**

There are compositional differences between GMO and Non-GMO crops (Bohn et al., 2014; Agapito-Tenfen et al., 2013; Abdo EM, Barbary OM, Shaltout OE., 2013; Abdo EM, Barbary OM, Shaltout OE., 2014).

**A June, 2014 search of the National Library of Medicine for “glyphosate toxicity human” produced 126 studies, 15 of which were published in 2013 and 2014. A search for “glyphosate toxicity” produced 505 studies.** (<http://www.ncbi.nlm.nih.gov/pubmed>):

The following are examples of those studies:

Use of a glyphosate-based herbicide-induced nephrotoxicity model to investigate a panel of kidney injury biomarkers (Wunnapuk et al., 2014);

Exposure to sublethal concentration of glyphosate or atrazine-based herbicides alters the phagocytic function and increases the susceptibility of silver catfish fingerlings (*Rhamdia quelen*) to *Aeromonas hydrophila* challenge (Kreutz et al., 2010);

Predicting acute complicated glyphosate intoxication in the emergency department (Moon, Chun, 2010);

Exposure to glyphosate- and/or Mn/Zn-ethylene-bis-dithiocarbamate-containing pesticides leads to degeneration of  $\gamma$ -aminobutyric acid and dopamine neurons in *Caenorhabditis elegans* (Negga et al., 2012);

Glyphosate induced cell death through apoptotic and autophagic mechanisms (Gui et al., 2012);

Effect of intravenous lipid emulsion in patients with acute glyphosate intoxication (Gil et al., 2013);

Effects of the glyphosate-based herbicide Roundup WeatherMax® on metamorphosis of wood frogs (*Lithobates sylvaticus*) in natural wetlands (Lanctôt et al., 2013).

In addition to being modified to withstand direct applications of herbicides that contain neurotoxic, endocrine disrupting glyphosate, certain crops have been genetically modified to produce (in the plant itself) a toxic insecticide Bt toxin designed to protect the plant by rupturing the stomach of any insect that feeds on it (Swanson, 2013).

## Second

### Evidence of the safety of glyphosate is non-existent

#### The toxicity studies

The GMO-industry claim that GMOs and glyphosate are safe for human and animal consumption, are largely based on studies wherein researchers find no difference between reactions of people or animals that have ingested or come in contact with glyphosate or crops treated with glyphosate, and those who have not. While such information may prove to be interesting, it **proves** nothing about the safety of glyphosate or GMO crops treated with glyphosate. Finding no difference between two groups does not prove that there is no difference between them.

Review of the few possibly relevant industry-sponsored studies available demonstrate that the inadequate numbers of subjects studied, the characteristics of those subjects (age and species, for example), and misuse of statistics used to analyze data, will have made it virtually impossible to come up with results that suggested that GMO's are anything other than safe. Through careful reading of each industry-sponsored study, the reader will become aware that none meet the assumptions of the statistical tests used and cited, and on that basis alone, find that the conclusions drawn from each and every study are invalid.

Less obvious purposeful rigging of studies may only be apparent to those professionals intimately familiar with the subject being researched, or to consumers or journalists who either observe or participate in these studies (Institute for Responsible Technology).

A second approach to concluding that a product is safe is to study the one or two things that the product is actually safe for, and from that limited study, have industry spin-artists conclude that the product is universally safe (Duke SO, Lydon J, Koskinen WC, Moorman TB, Chaney RL, Hammerschmidt R., 2012; Edge CB, Gahl MK, Thompson DG, Houlahan JE., 2013).

Statisticians understand something that the general public does not. Statisticians know that certain assumptions have to be met if the tests are to be used appropriately, i.e., if the tests are to be valid.

Using statistics, one cannot **prove** that there is no difference between two groups or conditions. Finding no difference between two groups or conditions may provide useful information for further study, but never provides **proof**. In statistics, proof is demonstrated when data show that

an experimental group (the group being exposed to GMO's, for example) is 95% or 99% more likely to suffer a toxic reaction than a control group (not exposed to the experimental substance).

The following examples illustrate the reasoning.

Example 1: Suppose it is known unequivocally from space missions that there is life on Mars, and that all Martians (group 1) have 2 heads. On Thursday an alien spacecraft lands in your back yard, and several aliens emerge (group 2). If the visiting aliens had three heads, we would know that the three-headed aliens were not from Mars, and that there must be life on other planets. (There is clearly a difference between the two groups of aliens.) However if the visiting aliens had two heads (just like the Martians), they might be from Mars, or they might come from another planet. Perhaps there are 2-headed aliens on another planet.

Example 2: Suppose that subjects are given purple dye number 12 or a placebo, and that the number of headaches reported by each group are the same. If reports of headache had been significantly greater in the group given purple dye, we could have concluded, with a certain amount of confidence, that purple dye caused headaches. But since reports of headaches were approximately the same for both groups, we would not know what to conclude. It might be that purple dye does not cause headaches. It might have been that subjects were eating something with purple dye in it during the studies, giving the placebo group headaches; or that purple dye only causes headaches in females and all of the subjects were males.

Drawing conclusions based on failure to find a difference is grossly inappropriate (Ferguson GA, 1959; Weinberg GH, Schumaker JA, 1962; McNemar Q, 1949). Given the assumptions underlying all statistical models, rigorous demonstration of the truth of the null hypothesis (that there is no difference between groups) is a logical impossibility (Ferguson GA, 1959).

Again, failure to find a statistically significant difference between groups may provide useful information for planning one's next experiment, but it proves nothing. If you find something, then you find it. If you don't find something, it might be because it's hiding, because you don't look in the right place, because you are inept, or because someone paid you not to find it.

There is another fact that needs to be considered. You may be shown **published** studies produced by industry that conclude that GMOs are safe, but there may be countless other industry-sponsored studies wherein GMO's have been found to be toxic that are simply not published.

Then there are studies such as "Genetically Modified Soy Linked to Sterility, Infant Mortality," by Alexy Surov (2010) that were announced but never published (Suov AV, Unpublished).

### The rest of the story

According to Monsanto and friends, there are hundreds of studies that prove that GMOs are safe. And in truth, there are hundreds of such documents (not necessarily studies) listed by the EPA, EU, and the World Health Organization (EPA, 1993; European Commission, 2001; Joint FAO/WHO Meeting on Pesticide Residues, 2004).

Few of those hundreds of documents are either peer-reviewed or published. Many are simply corporate project reports.

Having found nothing that speaks to the safety of GMOs, and not being satisfied that I had been thorough in my search, I called Monsanto and asked if they could direct me to the alleged hundreds of studies that show that GMOs cause no harm; and I was indirectly directed to a paper titled "600 + Published Safety Assessments" (Tribe D, undated).

And, by golly, there they were -- 600 or so studies that discussed GMOs. Some discussed the various factors that might be taken into consideration when designing GMOs ("Identifying food proteins with allergenic potential: evolution of approaches to safety assessment and research to provide additional tools," for example). Many were studies that produced negative results (discussed previously), from which one can never conclude safety. But not one was a study of the toxic effects, or lack thereof, of GMO products fed to animals or humans.

How sneaky-clever is that?

### Third

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