

## Evidence from independent scientists that Roundup and other Glyphosate-based herbicides (GBH) are toxic to humans, vertebrates and invertebrates

Monsanto and the pesticide regulators claim that Roundup is only toxic to plants, fungi and bacteria, but humans and animals have trillions of bacteria in their gut – the gut microbiome.

### Toxicity to humans

**Breast cancer cell proliferation:** The level of glyphosate in one Welsh river draining from areas of Japanese knotweed spraying was 190 parts per trillion (ppt) and local tap water was 30 ppt. These were of the order of concentrations found in a study in 2013 which showed that breast cancer cell proliferation is accelerated by glyphosate in extremely low concentrations: *“The present study used pure glyphosate substance at log intervals from  $10^{-12}$  to  $10^{-6}$  M. These concentrations are in a crucial range which correlated to the potential biological levels at part per trillion (ppt) to part per billion (ppb) which have been reported in epidemiological studies.”*<sup>1</sup>

### **Glyphosate-induced cell death: associations with neurodegenerative disorders in humans**<sup>2</sup>

Ya-xing Gui *et al.* [Glyphosate induced cell death through apoptotic and autophagic mechanisms.](#) *Neurotoxicology and Teratology* 2012, **34 (3)**: 344–349

*Herbicides have been recognized as the main environmental factor associated with human neurodegenerative disorders such as Parkinson's disease (PD). Previous studies indicated that the exposure to glyphosate, a widely used herbicide, is possibly linked to Parkinsonism, however the underlying mechanism remains unclear. We investigated the neurotoxic effects of glyphosate in differentiated PC12 cells and discovered that it inhibited viability of differentiated PC12 cells in dose- and time-dependent manners. Furthermore, the results showed that glyphosate induced cell death via autophagy pathways in addition to activating apoptotic pathways. Interestingly, deactivation of Beclin-1 gene attenuated both apoptosis and autophagy in glyphosate treated differentiated PC12 cells, suggesting that Beclin-1 gene is involved in the crosstalk between the two mechanisms.*

### **Republished study: long-term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize**<sup>3</sup> (Published 24 June 2014)

#### Abstract: Background

The health effects of a Roundup-tolerant NK603 genetically modified (GM) maize (from 11% in the diet), cultivated with or without Roundup application and Roundup alone (from 0.1 ppb of the full pesticide containing glyphosate and adjuvants) in drinking water, were evaluated for 2 years in rats. This study constitutes a follow-up investigation of a 90-day feeding study conducted by Monsanto in order to obtain commercial release of this GMO, employing the same rat strain and analyzing biochemical parameters on the same number of animals per group as our investigation. Our research represents the first chronic study on these substances, in which all observations including tumors are reported chronologically. Thus, it was not designed as a carcinogenicity study. We report the major findings with 34 organs observed and 56 parameters analyzed at 11 time points for most organs.

#### Results

<sup>1</sup> <https://www.ncbi.nlm.nih.gov/pubmed/23756170>

<sup>2</sup> <http://www.sciencedirect.com/science/journal/08920362>

<sup>3</sup> <https://enveurope.springeropen.com/articles/10.1186/s12302-014-0014-5>

Biochemical analyses confirmed very significant chronic kidney deficiencies, for all treatments and both sexes; 76% of the altered parameters were kidney-related. In treated males, liver congestions and necrosis were 2.5 to 5.5 times higher. Marked and severe nephropathies were also generally 1.3 to 2.3 times greater. In females, all treatment groups showed a two- to threefold increase in mortality, and deaths were earlier. This difference was also evident in three male groups fed with GM maize. All results were hormone- and sex-dependent, and the pathological profiles were comparable. Females developed large mammary tumors more frequently and before controls; the pituitary was the second most disabled organ; the sex hormonal balance was modified by consumption of GM maize and Roundup treatments. Males presented up to four times more large palpable tumors starting 600 days earlier than in the control group, in which only one tumor was noted. These results may be explained by not only the non-linear endocrine-disrupting effects of Roundup but also by the overexpression of the EPSPS transgene or other mutational effects in the GM maize and their metabolic consequences.

### Conclusion

Our findings imply that long-term (2 year) feeding trials need to be conducted to thoroughly evaluate the safety of GM foods and pesticides in their full commercial formulations.

### Differential impact of pure glyphosate and glyphosate-based herbicide in a model of peripheral nervous system myelination <sup>4</sup>

In 2018 a scientific paper was published by two neurologists in Germany showing that Glyphosate-based herbicides cause demyelination.

### Neurotransmitter changes in the brain from exposure to Glyphosate-based herbicides

Many papers come from Latin American countries where they grow almost exclusively GM Roundup Ready Crops that Monsanto forced on them in 1996. Here are three papers. The European Glyphosate Task Force excluded scientific papers from South America in their re-assessment of glyphosate.

### Behavioral impairments following repeated intranasal glyphosate-based herbicide administration in mice. <sup>5</sup>

*Taken together, our findings demonstrate that intranasal (IN) exposure to commercial Gly-BH produces alterations in locomotor activity, anxiety and memory in adult mice. These observations could be a consequence of alterations in neurotransmission systems comprising the GABAergic, dopaminergic, serotonergic and/or cholinergic systems.*” In this research paper there are references to many papers from around the world that confirm the glyphosate-based herbicides are damaging to the development of the foetal brain and that repeated exposure is toxic to the adult human brain and may result in alterations in locomotor activity, feelings of anxiety and memory impairment.

Martínez, M. A., Ares, I., Rodríguez, J. L., Martínez, M., Martínez-Larrañaga, M. R., & Anadón, A. (2018). Neurotransmitter changes in rat brain regions following glyphosate exposure. *Environmental Research*, 161, 212-219. <sup>6</sup>

### Highlights:

- Glyphosate oral exposure caused neurotoxicity in rats.
- Brain regions were susceptible to changes in CNS monoamine levels.
- Glyphosate reduced 5-HT, DA, NE levels in a brain regional- and dose-related manner.
- Glyphosate altered the serotonergic, dopaminergic and noradrenergic systems.

<sup>4</sup> <http://link-springer-com-443.webvpn.jxutcm.edu.cn/article/10.1007%2Fs00401-018-1938-4>

<sup>5</sup> <https://www.sciencedirect.com/science/article/pii/S0892036217301526>

<sup>6</sup> <https://www.sciencedirect.com/science/article/pii/S0013935117316730>

Mechanisms underlying the neurotoxicity induced by glyphosate-based herbicide in immature rat hippocampus: Involvement of glutamate excitotoxicity.<sup>7</sup>

**This is why there are so many mental health and psychiatric disorders, depression, suicides, anxiety and violence among children and adults.**

**Séralini's team finds heavy metals in chemical formulants of GBH that are in our diet**

*Extract: "As with other pesticides, 10–20% of GBH consist of chemical formulants. We previously identified these by mass spectrometry and found them to be mainly families of petroleum-based oxidized molecules, such as POEA, and other contaminants. In this work, we also identified by mass spectrometry the heavy metals arsenic, chromium, cobalt, lead and nickel, which are known to be toxic and endocrine disruptors, as contaminants in 22 pesticides, including 11 G- based ones."*<sup>8</sup>

**Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines.**<sup>9</sup>

**A glyphosate-based herbicide induces necrosis and apoptosis in mature rat testicular cells in vitro, and testosterone decrease at lower levels.**<sup>10</sup>

**Birth defects in frog & chicken embryos and in humans**<sup>11</sup>

**In vitro evaluation of genomic damage induced by glyphosate on human lymphocytes**<sup>12</sup>

**Glyphosate-Based Herbicides Cause Significant Changes in Rats' Intestinal Microbiome**<sup>13</sup>

**Multimomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide.**<sup>14</sup>

Overall, metabolome and proteome disturbances showed a substantial overlap with biomarkers of non-alcoholic fatty liver disease and its progression to steatohepatosis and thus confirm liver functional dysfunction resulting from chronic ultra-low dose Glyphosate-Based Herbicide (GBH) exposure. The study is the first ever to show a causative link between consumption of Roundup at a real-world environmentally relevant dose and a serious disease. NAFLD currently affects **25% of the US population** and **similar numbers of Europeans**. Risk factors include being overweight or obese, having diabetes, or having high cholesterol or high triglycerides (a constituent of body fat) in the blood. However, some people develop NAFLD even if they do not have any of these known risk factors.

**Roundup caused a 50% decrease in sperm count in males between 1973 and 2011**

Researchers from Brazil where babies who are lactose intolerant drink GM soy milk found that in rats fed soy milk it elicits endocrine-disrupting effects, by decreasing serum testosterone levels, decreased Sertoli cell numbers and increased percentage of degenerated Sertoli and Leydig cells.<sup>15</sup> Prof Hagai Levine from the Hebrew University of Jerusalem undertook a rigorous and comprehensive meta-analysis of data collected between 1973 and 2011 finds that among men from Western countries, sperm concentration declined by more than 50 percent, with no evidence of a 'leveling

<sup>7</sup> <https://www.sciencedirect.com/science/article/pii/S0300483X14000493>

<sup>8</sup> [https://www.gmoeralini.org/wp-content/uploads/2018/01/Defarge-et-al\\_TOXREP\\_2018.pdf](https://www.gmoeralini.org/wp-content/uploads/2018/01/Defarge-et-al_TOXREP_2018.pdf)

<sup>9</sup> <https://www.ncbi.nlm.nih.gov/pubmed/19539684>

<sup>10</sup> <https://www.ncbi.nlm.nih.gov/pubmed/22200534>

<sup>11</sup> <https://www.gmoerevidence.com/buenos-aires-university-glyphosate-causes-birth-defects-in-chickens-frogs/>

<sup>12</sup> <https://link.springer.com/article/10.1007/s11356-018-3417-9>

<sup>13</sup> <https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0394-x>

<sup>14</sup> <http://www.nature.com/articles/srep39328>

<sup>15</sup> <http://www.sciencedirect.com/science/article/pii/S0278691516304896>

off' in recent years.<sup>16</sup> Prof Levine suggested endocrine disruption from chemical exposures “during critical windows of male reproductive development may play a role in prenatal life” and “exposure to pesticides may play a role in adult life. Thus, a decline in sperm count might be considered as a ‘canary in the coal mine’ for male health across the lifespan.”

### Fish and vertebrates exposed to glyphosate-based herbicides

The endocrine disruptor effect of the herbicides atrazine and glyphosate on *Biomphalaria alexandrina* snails<sup>17</sup>

Roundup exposure promotes gills and liver impairments, DNA damage and inhibition of brain cholinergic activity in the Amazon teleost fish *Colossoma macropomum* Chemosphere 2015<sup>18</sup>

Glyphosate as an Acetylcholinesterase Inhibitor in *Cnesterodon decemmaculatus*<sup>19</sup>

Effects of glyphosate on cholinesterase activity of the mussel *Perna perna* and the fish *Danio rerio* and *Jenynsia multidentata*: In vitro studies<sup>20</sup>

Evaluation of biochemical markers in the golden mussel *Limnoperna fortunei* exposed to glyphosate acid in outdoor microcosms<sup>21</sup>

### Action on microbiota of various species

Glyphosate perturbs the gut microbiota of honey bees<sup>22</sup>

Sex-dependent impact of Roundup on the rat gut microbiome<sup>23</sup>

### Toxic effects on animals fed with GM Soy and Corn

The first study to measure glyphosate residues in Danish dairy cattle and its impact on blood parameters. Field Investigations of Glyphosate in Urine of Danish Dairy Cows<sup>24</sup>

**Abstract:** In the present study, thirty dairy cows from each of eight Danish dairy farms were investigated for excretion of glyphosate in urine. Blood serum parameters indicative of cytotoxicity as alkaline phosphatase (AP), glutamate dehydrogenase (GLDH), glutamate oxaloacetate transaminase (GOT), creatinine kinase CK, nephrotoxicity, (urea, creatine), cholesterol and the trace elements as manganese (Mn), cobalt (Co), selenium (Se), copper (Cu) and zinc (Zn) were investigated. All cows excreted glyphosate in their urine but in varying concentrations. Increased levels of GLDH, GOT and CK in cows from all farms demonstrate a possible effect of glyphosate on liver and muscle cells. High urea levels in some farms could be due to nephrotoxicity of glyphosate. Also, the unexpected very low levels of Mn and Co were observed in all animals which could be explained due to a strong mineral chelating effect of glyphosate. In contrast the mean levels of Cu, Zn and Se were within the normal

<sup>16</sup> <https://academic.oup.com/humupd/article/doi/10.1093/humupd/dmx022/4035689/Temporal-trends-in-sperm-count-a-systematic-review>

<sup>17</sup> <https://journals.sagepub.com/doi/abs/10.1177/0748233713506959>

<sup>18</sup> <https://www.sciencedirect.com/science/article/pii/S0045653515002635>

<sup>19</sup> <https://www.ncbi.nlm.nih.gov/pubmed/22002176>

<sup>20</sup> <https://www.sciencedirect.com/science/article/pii/S0166445X13000088>

<sup>21</sup> <https://www.sciencedirect.com/science/article/pii/S0147651313002157>

<sup>22</sup> <https://www.pnas.org/content/115/41/10305>

<sup>23</sup> <https://www.sciencedirect.com/science/article/pii/S2214750017301129>

<sup>24</sup> <http://dx.doi.org/10.4172/2161-0525.1000186>

reference range. In conclusion, this study gives the first documentation to which extent Danish dairy cattle are exposed to Glyphosate and its impact on blood parameters.

### **Glyphosate in human urine<sup>25</sup>**

A study conducted by the Heinrich Böll Foundation discovered that 99.6% of German people have glyphosate residues in urine. Most of them are those who eat meat, because of animal feed containing GM soy and corn. Glyphosate entered the humans' food chain, studies demonstrate. According to the Italian Organic Agriculture Association (AIAB), in order to prove the presence of the controversial weed killer in our daily life, bread was analysed in the United Kingdom, water in France and breast milk as well as tampons in the United States. Germany chose to analyse glyphosate residues in 2,009 German people's urine. The study reveals that 75% of the target group displayed levels that were five times higher than the legal limit of drinking water. One third of the people contaminated with glyphosate even showed levels that were between 10 and 42 times higher than what is generally admissible. Only 0.4% of the 2,009 samples was completely free from glyphosate residues, so almost all Germans (99.6%) have residues of the weed killer in their body. The most significant levels were found in children aged 0 to 9, teenagers aged 10 to 19, and farmers. *"The investigation confirmed the findings of the Federal Environment Agency, in regards to the majority of the population having glyphosate residue in their urine. The investigation was the largest of its kind ever carried out and volunteers from all over Germany participated in it. The findings exemplify that further research must be conducted in order to grasp the link between glyphosate exposure through food, drinking water or air and serious diseases"*, said veterinarian Professor Monika Krüger, author of the study.

Those who eat meat showed higher levels of glyphosate than vegetarians and vegans. Also, those who consume organic products are less intoxicated than people who eat non-organic food.

### **Analysis of glyphosate residues in malformed piglets**

Glyphosate residues in different organs and tissues as lungs, liver, kidney, brain, gut wall and heart of malformed euthanized one-day-old Danish piglets (N= 38) were tested using ELISA. All organs or tissues had glyphosate in different concentrations. The highest concentrations were seen in the lungs (Range 0.4-80 µg/ml) and hearts (Range 0.15-80 µg/ml).<sup>26</sup> The authors gave an overview of reports of malformations in children of families living few meters from where this herbicide was sprayed. The risk of malformation in human embryos is very high when their mothers are contaminated at 2 to 8 weeks of pregnancy.

### **How did the US EPA and IARC reach diametrically opposed conclusions on the genotoxicity of glyphosate-based herbicides?<sup>27</sup>**

An important paper by Charles Benbrook was published on line on 14 January 2019 in *Environmental Sciences Europe*.

Many people around the world still struggle to understand how and why the [US EPA](#) and the European Food Safety Authority ([EFSA](#)) concluded that the herbicide active ingredient glyphosate is not genotoxic (damaging to DNA) or carcinogenic, whereas the World Health Organisation's cancer agency IARC came to the opposite conclusion. IARC stated that the evidence for glyphosate's genotoxic potential is "[strong](#)" and that glyphosate is a probable human carcinogen.

While IARC referenced only peer-reviewed studies and reports available in the public literature, [EPA](#) relied heavily on unpublished regulatory studies commissioned by pesticide manufacturers. In fact, 95 of the 151 genotoxicity assays cited in EPA's evaluation were from industry studies (63%), while IARC cited 100% public literature sources.

<sup>25</sup> <https://www.lifegate.com/people/lifestyle/glyphosate-almost-all-germans-intoxicated>

<sup>26</sup> <http://www.omicsonline.org/open-access/detection-of-glyphosate-in-malformed-piglets-2161-0525.1000230.pdf>

<sup>27</sup> <https://www.gmwatch.org/en/news/archive/2019/18699>

Another important difference is that EPA focused its analysis on glyphosate in its pure chemical form, or “glyphosate technical”. The problem with that is that almost no one is exposed to glyphosate alone. Applicators and the public are exposed to complete herbicide formulations consisting of glyphosate plus added ingredients (adjuvants). The formulations have repeatedly been shown to be more toxic than glyphosate in isolation.

Further support for many of these measures comes from the European Parliament’s PEST Committee, which was set up in response to the concerns raised by the European Citizens’ Initiative to ban glyphosate, the Monsanto Papers (internal Monsanto documents disclosed in cancer litigation in the USA revealing how industry has subverted science), and the discrepancies in the cancer assessments of glyphosate between the European institutions and the IARC.

In an unusual step, the editor-in-chief of *Environmental Sciences Europe*, Prof Henner Hollert, and his co-author Prof Thomas Backhaus, weighed in with a strong statement in support of the acceptance of Dr Benbrook’s article for publication.<sup>28</sup> In a commentary published in the same issue of the journal, they wrote, “*We are convinced that the article provides new insights on why different conclusions regarding the carcinogenicity of glyphosate and GBHs [glyphosate-based herbicides] were reached by the US EPA and IARC. It is an important contribution to the discussion on the genotoxicity of GBHs.*”

### **Conclusions**

Extracts: In the case of glyphosate-based herbicides, the world’s most widely-used pesticide ever, such relatively high-exposure episodes occur tens of thousands of times on a daily basis in the US and hundreds of thousands, if not millions of times globally.

IARC’s evaluation relied heavily on studies capable of shedding light on the distribution of real-world exposures and genotoxicity risk in exposed human populations, while EPA’s evaluation placed little or no weight on such evidence.

Rosemary Mason 12 February 2019

---

<sup>28</sup> <https://link.springer.com/article/10.1186/s12302-018-0184-7>