GlobalResearch
Center for Research on Globalization

New Study finds Monsanto's Roundup Herbicide 125 Times More Toxic Than Regulators Say

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Global Research, July 10, 2014
Green Med Info 14 April 2024

Region: USA
Theme: Biotechnology and GMO, Environment

A highly concerning new study published in the journal Biomedical Research International reveals that despite the still relatively benign reputation of agrochemicals such as Roundup herbicide, many chemical formulations upon which the modern agricultural system depend are far more toxic than present regulatory tests performed on them reveal. Roundup herbicide, for instance, was found to be 125 times more toxic than its active ingredient glyphosate studied in isolation.

Titled, "Major pesticides are more toxic to human cells than their declared active principles," the study evaluated to what extent the active principle (AP) and the so-called 'inert ingredients,' i.e. adjuvants, in globally popular formulations account for the toxicity of 9 major pesticides: 3 herbicides, 3 insecticides, and 3 fungicides.

The Deceptive Semantics of Pesticide Formulations And Their Regulation

The paper describes how the agrochemical industry conceals the true toxicity of their chemical formulations by focusing on the health risks associated with only one so-called 'active principle' (AP) in their complex formulations, and sets the public up for mass poisoning through the determination of an 'acceptable level of harm' via the calculation of the so-called 'acceptable daily intake (ADI)' based on the toxicological risk profile of only a single ingredient:

> "Pesticides are used throughout the world as mixtures called formulations. They contain adjuvants, which are often kept confidential and are called inerts by the manufacturing companies, plus a declared active principle (AP), which is the only one tested in the longest toxicological regulatory tests performed on mammals. This allows the calculation of the acceptable daily intake (ADI)—the level of exposure that is claimed to be safe for humans over the long term—and justifies the presence of residues of these pesticides at "admissible" levels in the environment and organisms. Only the AP and one metabolite are used as markers, but this does not exclude the presence of adjuvants, which are cell penetrants."

The problem of underestimated toxicological risk is so severe that the researchers describe previous research which found unexpected toxicity in so-called 'inert' adjuvants that were up to 10,000 times more toxic than the so-called active principle glyphosate itself, revealing them to be a greater source for secondary side effects than the main ingredient itself. [i] They also note that this 'synergistic toxicity' may explain the results of previous long-term animal research where glyphosate-based formulations showed toxicity in the parts-per-trillion range (.1 part per billion) that could not be explained by glyphosate alone.[ii] [iii]

Dr. Kelly Brogan, MD, commented on this phenomena in connection with the study recently on her blog: "Similar to the non-placebo-controlled trials on vaccines, adjuvants and preservatives are considered innocent bystanders in the consideration of risk profile." According to Dr. Brogan, an understanding of "Toxicant synergy has exploded the simplistic notion of "the dose makes the poison.""

The Test Method and Results

In order to ascertain the toxicity of various chemical formulations and their ingredients, the researchers used embryonic (HEK293), placental (JEG3), and hepatic (HepG2) human cell lines, "because they are well characterized and validated as useful models to test toxicities of pesticides, corresponding to what is observed on fresh tissue or primary cells." They noted, "these cells lines are even in some instances less sensitive than primary cells, and therefore do not overestimate cellular toxicity."

The researchers describe the their method of determining toxicity:

> We assayed their mitochondrial succinate dehydrogenase (SD) activity (MTT assay) after 24h pesticide exposure, which is one of the most accurate cytotoxicity assays for measuring the toxicity of pesticide adjuvants such as surfactants [26]. Cytotoxicity was confirmed by the measurement of apoptosis and necrosis, respectively, by caspases 3/7 activation [27] and adenylate kinase leakage after membrane alterations [28]

The results of the study were clear. Except for one pesticide (Matin), "All formulations were cytotoxic and far more toxic than their APs [active principles]."

Key findings included:

- On human cells, among the tested products, fungicides were the most toxic (Figure 1), being cytotoxic from doses 300–600 times lower than agricultural dilutions, followed by herbicides (except Matin) and then insecticides.
- In all cell types, fungicides were the most toxic (mean LC50 12ppm).
- The herbicide Roundup (LC50 63ppm) was next in toxicity to fungicides, twice as toxic as Starane, and more than 10 times as toxic as the 3 insecticides, which represent the less toxic group (mean LC50 720ppm).

Discussion

The researchers noted that theirs was the first study to test all these formulated pesticides on human cells at concentrations well below agricultural dilutions – indicating the relevance of their results to every day human exposures.

The researchers noted that in the present study, the cells were exposed to the chemicals for no longer than 48 hours, but in previous research they observed increased toxicity with time (i.e. "time-amplifying effect"), such that, "the differential toxicity between the AP [active principle] glyphosate and Roundup is increased by 5 times in 72h." In accordance with this phenomena, they provide the example:

> For instance, in this experiment, after 24h, 63ppm of Roundup was found to be toxic to cells, but in our previous experiment, after two years in rats, only

> 0.1ppb of Roundup was found to be sufficient to provoke pathologies [2].

The study discussion also addressed the profound problem in semantics indicated by the use of the term “inert” to describe chemical adjuvants that amplify the toxicity of the active principle (AP) in a herbicidal formulation by up t 1,000 times:

> “Adjuvants in pesticides are generally declared as inerts, and for this reason they are not tested in long-term regulatory experiments. It is thus very surprising that they amplify up to 1000 times the toxicity of their APs in 100% of the cases where they are indicated to be present by the manufacturer (Table 1). In fact, the differential toxicity between formulations of pesticides and their APs now appears to be a general feature of pesticides toxicology. As we have seen, the role of adjuvants is to increase AP solubility and to protect it from degradation, increasing its half-life, helping cell penetration, and thus enhancing its pesticidal activity [32] and consequently side effects. They can even add their own toxicity [1]. The definition of adjuvants as “inerts” is thus nonsense; even if the US Environmental Protection Agency has recently changed the appellation for “other ingredients,” pesticide adjuvants should be considered as toxic “active” compounds.”

According to the researchers, Roundup herbicide is emblematic of the cognitive dissonance between scientific fact and industrial claim to the still widely held belief that many of the chemicals routinely applied to our food and feed crops are relative safety:

> It is commonly believed that Roundup is among the safest pesticides. This idea is spread by manufacturers, mostly in the reviews they promote [39, 40], which are often cited in toxicological evaluations of glyphosate-based herbicides. However, Roundup was found in this experiment to be 125 times more toxic than glyphosate. Moreover, despite its reputation, Roundup was by far the most toxic among the herbicides and insecticides tested. This inconsistency between scientific fact and industrial claim may be attributed to huge economic interests, which have been found to falsify health risk assessments and delay health policy decisions [41].

The researchers conclude their study by proposing their experimental results challenge the ultimate relevance of the acceptable daily intake (ADI), “because it is calculated today from the toxicity of the AP alone in vivo.” They go further and suggest that the ADI’s should be revised taking into account an “adjuvant factor,” which would require a reduction by at least 100 be applied to ADIs, especially if their preliminary cell research is confirmed through future animal studies. This would mean that the present ADI for glyphosate which is .3 ppm should be reduced to 3 parts per billion or less. They note, however, that this will not replace direct study of the commercial formulation with its adjuvants in regulatory tests. They conclude the study with the following remarks:

> “[A]n exposure to a single formulated pesticide must be considered as coexposure to an active principle and the adjuvants. In addition, the study of combinatorial effects of several APs together may be very secondary if the toxicity of the combinations of each AP with its adjuvants is neglected or unknown. Even if all these factors were known and taken into account in the regulatory process, this would not exclude an endocrine-disrupting effect below the toxicity threshold. The chronic tests of pesticides may not reflect relevant environmental exposures if only one ingredient is tested alone.”

Clearly, research like this represents a paradigm shift in the way we look at agrochemical toxicity and the risk of exposure. If the harm's associated with pesticidal or herbicidal contamination of our food, water, or air, are up to 1,000 times higher than the present regulatory system believes, we can no longer label as 'an acceptable level of harm' the mass poisoning we are experiencing at the hands of the industrial, biotech and chemical-industry driven agricultural system.

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Notes:

[i] Ethoxylated adjuvants of glyphosate-based herbicides are active principles of human cell toxicity. Mesnage R, Bernay B, Séralini GE Toxicology. 2013 Nov 16; 313(2-3):122-8. [PubMed] [Ref list]

[ii] Seralini GE, Mesnage R, Defarge N, et al. Answers to critics: why there is a long term toxicity due to NK603 Roundup-tolerant genetically modified maize and to a Roundup herbicide. Food and Chemical Toxicology. 2013;53:461–468. [PubMed] [Ref list]

[iii] Roundup inhibits steroidogenesis by disrupting steroidogenic acute regulatory (StAR) protein expression. Walsh LP, McCormick C, Martin C, Stocco DM Environ Health Perspect. 2000 Aug; 108(8):769-76. [PubMed] [Ref list]
