PESTICIDES AND HUMAN HEALTH

The Missing Toxicants

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There are 'invisible' toxicants in the commercial formulations of pesticides, which could be a major public health threat because they are not fully disclosed or regulated. This is the conclusion of multiple studies investigating the effects of pesticide ingredients as sold and used commercially. We reveal that the presence of these compounds in glyphosate-based herbicides could contribute to toxic effects at low concentrations relevant to human real-world exposures.

The U.S. Center for Disease Control and Prevention's fourth national report on human exposure to environmental chemicals reveals that human tissues are impregnated with pesticide residues.[1] Some pesticides may cause cancer and affect the nervous system, or even interfere with endocrine functions, resulting in metabolic and reproductive defects.[2] Regulatory studies have often been unsuccessful at predicting the toxic effects of these pesticides based on the multiple tests conducted prior to commercial approval.[3] A number of pesticides were initially approved but were later banned because certain unexpected toxic effects were found to occur in human populations following major accidents or contamination events, or after decades of exposure highlighted by epidemiological studies. Unregulated toxicants present in commercial formulations of pesticides could provide a missing link between observed negative health outcomes and pesticide exposure, even at low doses.

Commercial formulations of pesticides are invariably not single ingredients. Instead they are cocktails of chemicals, composed of an active principle accompanied by "other ingredients." Sometimes also called "inerts," these additional ingredients are specifically added to influence the absorption and stability of the active principle, and thus promote its pesticidal action. The identity of these "inert" additional ingredients, also collectively referred to as "adjuvants," are frequently undisclosed as they are considered to be confidential commercial information. As they are proffered as "inert," they are ignored by regulatory agencies in the determination of acceptable levels of daily intake, a threshold of value of exposure to a pesticide below which it is deemed unlikely that the dose received will result in any negative health effects. Tests conducted for regulatory purposes are thus performed with the industry-stated active principle alone. Commercial formulations of pesticides as used in both agricultural and urban/domestic environments are never tested for their chronic effects on mammals. Nonetheless, exposure to environmental levels of some of these adjuvant mixtures has been associated with human disease. For example, in epidemiological studies of farming populations, people exposed to supposedly inert ingredients such as solvents or petroleum distillates present a higher risk of developing hypospadias and present more allergic and non-allergic wheeze.[4,5] Effects in the general population are not characterized because these substances are not monitored in human biological fluids.

We have extensively studied the composition and the toxicity of the different ingredients that constitute glyphosate-based herbicides (GBHs), which are the most heavily applied pesticides in the world, with usage rising. A comparison of the toxicity of different brands of GBHs in tissue culture cell assays showed that several commercial formulations were up to one thousand times more toxic than glyphosate, the regulated active ingredient.[6] Our results also revealed that one component of the adjuvant mixture in some GBHs, a surfactant called polyoxyethylene tallow amine (POEA), classified as an inert ingredient, was ten thousand times more cytotoxic than glyphosate itself when applied to human tissue culture cells.[6] This and other work led the European Commission to recommend a ban on the use of POEA in GBH products. More recently, we showed that the chronic administration of a GBH induced liver toxic effects in rats at an environmental concentration and daily intake of active ingredient declared safe.[7] However, further research is required to elucidate whether the glyphosate, the adjuvants, or the combination of the two is at the basis of the observed liver and kidney toxicity seen in these animals. In addition, the finding that POEA is widely found in fields in the U.S. where GBH are applied raises concerns that this and other classes of pesticide adjuvants may be entering the food and feed chain undetected, with as yet unknown health consequences.[8]

In conclusion, evidence suggests that the so-called inert ingredients constitute the "dark matter" of pesticide toxicology. As the dark matter in the universe is responsible for most of its structure and bearing, the "other ingredients" are an all-pervasive toxic fraction of a pesticide. While invisible, under certain circumstances they can account for most of the toxic potency of a commercial formulation. The study of the effects of chemical mixtures on health indicators is frequently aired as a priority for the toxicology of twenty-first century. However, within this framework, ignoring the toxicity of the combination of each active ingredient with its adjuvants could lead to misrepresentations of the safety profile that may be revealed by investigating combinations of active ingredients alone.

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