

Synergism

(by Ingrid Pollyak, 2/10)

Though synergism is widely unknown by most people (except in the field of toxicology), and appears not to be much of a focus in chemistry (references are lacking in most chemistry books), it has proven to have major effects on chemical potency. The concept of synergism is simply: when you have two or more substances, if synergism occurs, the reaction of the substances together cause a substance stronger than only the addition of the two effects of the substances alone. Another way you could say the same thing would be that, the substance was potentiated. Although synergism can occur between natural substances to create a helpful (to humans or the environment) potentiated end product, usually it is thought of in the context of harmful products created by this process, like the examples of pharmaceutical drugs and toxic pesticides. Everyone who takes any kind of pharmaceutical could tell you it's a bad, and possibly dangerous, idea to take pharmaceuticals with alcohol, no matter what type, strength, or dosage of pills are taken, but what most don't understand is that this is just another case of synergism; the alcohol potentiates the effects of the drugs into something much stronger, and even more dangerous in many cases than just drinking alcohol by itself or taking pharmaceuticals by themselves.

Though synergism mostly occurs between chemicals it is not restricted to only potentiating the reaction of chemicals with chemicals. Research has shown synergism can also cause pharmaceuticals like antibiotics and even over-the-counter drugs such as Children's Advil and Children's Motrin to react with pre-existing infections in the body leading to the disabling and sometimes deadly diseases, Stevens-Johnson Syndrome, and Toxic Epidermal Necrolysis (1)

In synthetic pesticides (e.g. RoundUp, Raid, and all other lab-created chemicals) synergism is especially important to take into account, as they always are a formulation of more than one chemical making up the final product. Even though some chemicals in the pesticide formulation when tested alone are considered to be non-toxic or non-carcinogenic (cancer-causing), often they are combined (even if they mix with another so called non-toxic chemical, or elements harmless to humans) into a potentiated pesticide product. One such illustration is the pesticide Carbaryl, better known under its brand names, Arylat, Arylam, Atoxan, Bercema, Carbaryl, Carpolin, Carbotox, Denapon, Dicarbam, Hexavin, Monsur, Murrin, Panam, Pamex, Prosevor, Rayvon, Sevimol, Sevin, Viaxon. As one of the more popular pesticides, in the category of insecticide, it is in more than 1,500 home, garden, pet, and agricultural products sold all over the U.S.A..(2) Carbaryl works in the body of insects, humans, and other vertebrate bodies alike, by way of the nervous system. Designed to inhibit the enzyme Cholinesterase, which is needed to stop the stimulating electric signals carried by the neurotransmitter Acetylcholine across the intersection of nerve to muscle, when Carbaryl (or other Cholinesterase-inhibiting chemicals) comes into play, the Acetylcholinesterase (a specific Cholinesterase enzyme designed to break down the Acetylcholine) is unable to stop the signal messenger Acetylcholine. The nervous system gets jammed up, thus causing mild to severe twitching, paralyzed breathing, convulsions, and possible death.(3) This is only what it was created to do; unfortunately it doesn't end at that. While Carbaryl is not found to be carcinogenic alone, there is one chemical compound formed when Carbaryl residues react to Nitrates present in fish, many cured meats, frankfurters, bacon, ham and bologna. Nitrates also reside in human saliva.(2) The compound formed by Carbaryl and Nitrates, Nitroso Carbaryl IS, unlike the two former chemicals (this compound is subject to Synergism if you hadn't already guessed), one of the most highly potent carcinogens known, according to Dr. William Lijinsky, director of the Chemical Carcinogenesis Program for the National Cancer Institute in Maryland.(2) It is also important to remember that Nitroso Carbaryl can

be created by any exposure to residues of Carbaryl and Nitrates, be that from drift inhalation, residual contamination, or other contact. And yet none of these Sevin products has a warning for even the damage it can cause to your health when doing what it is expected to do. The formation of carcinogens when in contact with Nitrates is something you'll never see on a warning label.

To get a very basic idea of how much is considered too much, studies have been conducted using the World Health Organization's figures for what THEY say is the "Acceptable Daily Intake" (ADI) to calculate that if a pound of Carbaryl (the common poundage for an acre of potatoes) was applied per acre (meaning 10.4 milligrams per square foot), the ADI would be, for a child of thirty-three pounds, not to exceed the .01 milligram per kilogram, which equals one ten billionth of the child's weight. This would mean she or he could only touch two square inches per day on the day of the spray and one week later could still only touch four square inches per day.(2) This doesn't take into account the residues of the product drifting in the air and being inhaled. What about dogs which happen to brush up against pesticided plants in the garden? What happens when bees and other beneficial insects go and try to pollinate these contaminated plants?

This model of looking at toxicity is called a Risk Assessment model. It decrees a certain number of people, animals or plants to be "the acceptable risk" meaning that no pesticide has to be completely safe by their standards, it just has to supposedly kill or harm no more than a certain percentage of the population. This results in some of the most vulnerable populations, such as people with immune system deficiency problems or babies with developing immune systems being put at most risk.

On the other side of the continuum is what is called the Precautionary Principle which simply states: If the manufacturer can't prove the absolute safety of the product to be sold then it must not be allowed to be released. While it's not law, it's being used by European governments in decision-making and recently some pesticides, including RoundUp, and a product featuring Imidacloprid (commonly used in pet flea products in the U.S.), have been banned for use in Denmark and France.(6)

For a pesticide to go on the market, in the U.S.A., the company is mandated to test the active ingredient and produce a Material Safety Data Sheet. These MSDS's often will not even test for many aspects of toxicity simply saying, 'not known'.(6) In spite of scientific advances which allow companies to do complete testing, pesticide, pharmaceutical, and other chemical products are put on the market with minimal tests done in incomplete ways, making whole populations the "acceptable risk". (6)

The one major reason dangerous chemicals like RoundUp end up being called "safe" is in how the tests are conducted to register a chemical for use. Chemical companies are required only to test how the "active" ingredient, the chemical assigned to do what the pesticide is supposed to do, affects human, animal/insect or environmental health (i.e. inhibits the chemical used in the body to stop electrical signals when the allotted task is done, in the case of Carbaryl). None of the "inert" ingredients-- this group is vague, basically consisting of all remaining chemicals in the product-- is tested for possible synergistic effects they form with the active component, let alone with each other. With no warning from manufacturers or government about the chronic effects attributed to these products people have no way of understanding possible dangers related to exposure.

Another case of synergistic interactions is found in everyday products such as DEET. Alone it has been known to affect behavior and nervous systems, reduce sensory and motor skills, keep the blood-brain barrier from allowing molecules to enter the brain, create changes in Acetylcholine, the transmitter of nerve signals, and has been linked to seizures and nerve cell death in the brain.(7) These are the effects of DEET alone but, when in contact with the insecticides, Permethrin and Malathion, the product reacts synergistically into extremely potent chemical mixtures. In the case of synergism between DEET and Permethrin reactions showed lessened action of Acetylcholine, the type of Cholinesterase designed to break down the transport of nerve impulses by Acetylcholine; decreased ability of entrance to the blood-testes barrier; behavior problems; shown to create more DNA damage; and inhibits the liver from being

able to break down the chemical compound. Incidentally, another case of lack of proper warning, the government not only has allowed DEET to be sold, but has soldiers using clothes impregnated with Permethrin, while having them use DEET topically. Additionally, potentiated interactions between DEET and Malathion results in an increased the number of dying nerve cells in the midbrain. (7)

In the case of RoundUp, an herbicide, Glyphosate, the active ingredient, is supposed to stop enzyme activity needed for plants to create certain amino acids. When in contact with RoundUp, or other Glyphosate-containing products, the plant is essentially starved to death.(4) In humans RoundUp inhibits enzymes used for liver detoxification, keeping the poison in the body. (5) Exposure to RoundUp results in such symptoms as: acute skin and eye illnesses which also can persist for months, impaired lung function, throat irritation, coughing and breathlessness in workers using RoundUp on flax, gastrointestinal problems, and it causes destruction to tissue of the mucus membranes and upper respiratory tract.(5) For test animals the effects were worse, and deadly with the dosages to which they were exposed. Here are some of the results: (rare) tumor formation in the kidneys and adrenal cortex, changes in adrenalin levels, changes in Kidney, Liver, and Thymus, and cardiac arrest.(5) Also, several studies have shown it to be lethal or at least extremely toxic to fish and aquatic organisms.(5)

Herbicides including RoundUp, have been known to cause hormonal and endocrine disruption in humans.(6) Like many pesticides, at least until recently, the active ingredient was not considered carcinogenic; it's one of the "inert" chemicals which holds an undisclosed amount of the remaining 59% of the inerts; Polyethoxethyleneamine or as anyone who has to write or say this more than once, POEA.(5) A surfactant, POEA, is three times as acutely toxic as Glyphosate. In manufacturing of POEA it is contaminated by what the Office of Environmental Health Hazard Assessment labels a 'probable human carcinogen': 1,4 Dioxane.(5) As it is trade laws give Monsanto leeway to avoid disclosing more than the active ingredient and two inerts for RoundUp, though synergistic effects already are known among those chemicals.

To demonstrate synergism, a study found that, the dose of RoundUp needed to kill a rat was 2/3 less than the lethal doses of POEA or Glyphosate alone.(5) Chemical companies confuse people by talking about the active ingredient as though synergism doesn't exist. Sometimes people assume that, since the product is more potent and the amount used can be reduced, they think since less ounces or pounds are being used the product is safe or safer, and don't understand that toxicity is not based on poundage, but reactions, synergistic or not, taking place in the body or environment.

- 1: Drugs and infections: <http://www.stevensjohnsonsyndrome.org/>
- 2: Schultz, Jr., Warren The Trouble With Carbaryl. Organic Gardening, October, 1984.
- 3: Extoxnet's Cholinesterase Inhibition study
- 4: Caroline Cox's Glyphosate toxicological profile, NCAP
- 5: Californians for Alternatives to Toxics' staff scientist's RoundUp toxicological profile
- 6: East Bay Pesticide Alert (www.eastbaypesticidealert.org)
- 7: Caroline Cox's DEET toxicological profile (www.mindfully.org)