# Rachel's Environment & Health News
## #173 - Dioxin - Part 2: Gauging The Toxicity Of Dioxin
**March 20, 1990**

Continuing our series on dioxin. Page numbers in parentheses refer to the ATSDR (the federal Agency for Toxic Substances and Disease Registry) Toxicological Profile for dioxin, cited in our last paragraph, below.

It has become fashionable to pooh-pooh dioxin. We believe there are two reasons why this is occurring. First, some scientists have been publishing studies indicating that humans exposed to dioxin do not have an increased risk of cancer. As we saw in RHWN #171, some of the most important of these studies have now been exposed as fraudulent. The second reason is that dioxin is so toxic that it is difficult to express its potency in normal terms; therefore the media frequently print scary claims without offering much evidence, leading some people to conclude (incorrectly) that there isn't much substance to any claims about the extreme toxicity of dioxin.

In this series, we hope to lay the groundwork for an understanding of dioxin, to help people put dioxin into perspective. Some of what follows may seem a bit more technical than you are accustomed to reading in this newsletter; but stick with it, and you'll see why we have taken this approach.

The scientific and medical evidence presented by ATSDR forces us to conclude that dioxin deserves our greatest respect. It seems to be one of the two or three most toxic chemicals ever discovered, and it is produced as a byproduct of several different industrial processes. For years, industry has been dumping dioxin into the environment in large quantities without paying attention to the consequences. This does not mean there have been no consequences; it just means no one has made any systematic effort to tally them up.

Dioxin is a family of chemicals (75 in all) that does not occur naturally, nor is it intentionally manufactured by any industry (pg. 1). The most toxic dioxin is called 2,3,7,8-TCDD. Dioxins are produced as byproducts of the manufacture of some herbicides (for example, 2,4,5- T), wood preservatives made from trichlorophenols, and some germicides (for example, hexachlorophene). Dioxins are also produced by the manufacture of pulp and paper, by the combustion of wood in the presence of chlorine, by fires involving chlorinated benzenes and biphenyls (e.g., PCBs), by the exhaust of automobiles burning leaded fuel, and by municipal solid waste incinerators.

ATSDR says, "2,3,7,8-TCDD is highly toxic to all laboratory animals tested...." (pg. 11). Even the most conservative of toxicologists says, "TCDD has been called the most toxic synthetic chemical known to man. If its acute toxicity to the guinea pig, and even the rat and mouse, is the criterion, the statement is probably correct.... TCDD is unquestionably a chemical of supreme toxicity to experimental animals. Moreover, severe chronic effects from low dosages have also been demonstrated in experimental animals. Therefore, the concern about its effects on human health and the environment is understandable."[1]

In cases of high exposure of humans through industrial accidents, 2,3,7,8-TCDD causes a severe acne (called chloracne) which is not just a skin ailment; chloracne is a systemic disease that is more disfiguring than teenage acne and its effects last for years (in some cases, decades) after exposure (pgs. 3, 39).

There is "suggestive evidence" that 2,3,7,8-TCDD causes liver damage in humans (pgs. 3, 52-53). It definitely causes severe liver damage in animals.

In animals, 2,3,7,8-TCDD is toxic to the immune system; such effects have not been proven in humans (pgs. 3, 40, 54-56). In animals, 2,3,7,8- TCDD causes reproductive disorders, including spontaneous abortions. Monkeys are particularly sensitive to reproductive effects from exposure to 2,3,7,8-TCDD. Such effects have not been proven in humans (pgs. 3, 17, 58-59). In animals, dioxin causes genetic damage (pgs. 60-61).

Both the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC) have concluded that dioxin is a "probable human carcinogen" (pgs. 7, 61-68, 94). As we saw in RHWN #171, scientists within EPA have asked that this question be reviewed again because some of the key studies of dioxin and cancer were fraudulent, and EPA has relied on these fraudulent studies to set current standards.

How can we judge the toxicity of dioxin (or of any chemical, for that matter)? One way is to look at the standards that have been set by regulatory agencies.

In the case of dioxin, EPA has calculated a "safe" dose, taking into consideration dioxin's ability to cause cancer. The "safe" dose is expressed in extremely small units: femtograms. There are 28 grams in an ounce, and one femtogram is 0.000,000,000,000,001 grams, or one quadrillionth of a gram, or 10**-15 (or, 10 raised to the power of negative 15) grams.

EPA believes that ingesting (eating) 6.4 femtograms (6.4 x 10**-15 grams) of 2,3,7,8-TCDD per kilogram of body weight per day would cause cancer in one in a million people so exposed (pg. 95). Since an average adult weighs 62 kilograms or 137 pounds (average men weigh 70 kilograms [154 pounds] and average women weigh 55 kg [120 pounds]), the EPA is saying that 397 femtograms of 2,3,7,8-TCDD consumed in food each day would kill one-in-a-million humans so exposed. Over a year's time, 397 femtograms per day add up to 145,000 femtograms; over a 70-year lifetime, this would add up to 10.1 million femtograms, so 10.1 million femtograms (or 0.01 micrograms) is the maximum amount you could safely get into your body during your entire lifetime, EPA believes.

How can we express this in terms that people can grasp?

Let's compare it to one single aspirin tablet. One aspirin tablet weighs 5 grains (or 325 milligrams, or 325 trillion femtograms), so to express one "safe" lifetime dose of 2,3,7,8-TCDD, you would take a single aspirin tablet and divide it into 32 million (actually 32,172,218) miniscule pieces. Then one of those tiny pieces would represent one "safe" lifetime dose of 2,3,7,8-TCDD.

Another comparison: A single grain of table salt weighs approximately 0.1 milligrams or 100 billion femtograms, so to get an amount of table salt that weighs the same amount as one "safe" lifetime dose of 2,3,7,8- TCDD, you would divide a single grain of table salt into 9,900 microscopic pieces. One of those tiny pieces would represent a "safe" lifetime dose of dioxin.

The U.S. Food and Drug Administration (FDA) has its own way of calculating the same one-in-a-million cancer risk and they believe the EPA has overestimated the hazard by a factor of 10. In other words, FDA believes you could represent a "safe" dose of 2,3,7,8-TCDD by dividing a single grain of table salt into 990 pieces, with one of those pieces representing a safe lifetime dose. The federal Centers for Disease Control (CDC) in Atlanta has done its own calculation, concluding that the cancer hazard from dioxin is about half-way between the EPA's estimate and the FDA's estimate. EPA says 6.4 femtograms per kilogram of body weight per day is the safe dose; CDC says the correct number is 27.6; FDA says it's 57.2 (pg. 95). No matter which agency does the calculation, there's no escaping the fact that dioxin is considered supremely toxic.

One other way to understand the toxicity of dioxin is to compare the dioxin "reference dose" established by EPA to the "reference dose" they have set for other common toxic materials. The "reference dose" is the highest amount they believe you could eat regularly without incurring any disease (not considering cancer).

The reference dose for dioxin is 0.000,000,001 milligrams per kilogram of body weight per day (mg/kg/day) (pg. 94); the

reference dose for the toxic metal cadmium[2] is 0.001 mg/kg/day and the "reference dose" for the toxic metal arsenic[3] is the same as for cadmium.[2] Thus we can see that EPA considers dioxin in food 1,000,000 times (one million times) more toxic than cadmium or arsenic[3], not counting the cancer hazard from dioxin. Yes, dioxin is toxic, no doubt about it.

--Peter Montague

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[1] Fred H. Tschirley, "Dioxin," SCIENTIFIC AMERICAN Vol. 254 (February, 1986), pg. 34."

[2] Agency for Toxic Substances and Disease Registry, TOXICOLOGICAL PROFILE FOR CADMIUM (Springfield, VA: National Technical Information Service [NTIS], 5285 Port Royal Rd., Springfield, VA 22161; phone (703) 487-4650), pg. 76.; NTIS number PB89-194476. $21.95.

[3] Agency for Toxic Substances and Disease Registry, TOXICOLOGICAL PROFILE FOR ARSENIC (Springfield, VA: National Technical Information Service [NTIS], 5285 Port Royal Rd., Springfield, VA 22161; phone (703) 487-4650), pg. 92.; NTIS number PB89-185706. $21.95.

Get: Agency for Toxic Substances and Disease Registry, TOXICOLOGICAL PROFILE FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (Springfield, VA: National Technical Information Service [NTIS], 5285 Port Royal Rd., Springfield, VA 22161; phone (703) 4874650); NTIS number PB89-214522. $21.95.

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