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#636 - Dioxins -- The View From Europe
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The term "dioxin" encompasses a family of 219 different toxic chemicals, all with similar characteristics but different potencies.[1] In recent years, the International Agency for Research on Cancer (IARC), a division of the World Health Organization, has labeled the most potent dioxin, called TCDD, a known human carcinogen.[2] IARC has labeled many of the less potent dioxins "probable" human carcinogens.

Low-level exposures to dioxins are also known to interfere with the immune system, the reproductive system, the endocrine system, and the early growth and development of humans and animals.[3] In sum, dioxins are a family of powerful all-purpose poisons.

In the early 1990s, many governments, including the U.S. government, reported that everyone in the industrialized world is exposed to substantial quantities of dioxins day in and day out, thus acknowledging a humiliating failure of the world's public health apparatus.

In 1991, the U.S. EPA [Environmental Protection Agency] with considerable fanfare announced it was undertaking a full-blown scientific re-assessment of dioxin. Nine years later, that re-assessment has now disappeared from view and may have died, a victim of politics. (See REHW #390, #391.) The big corporate dioxin dischargers are also major contributors to federal election campaigns, and the Clinton/Gore administration at this point in history seems incapable of even gumming the hand that feeds it. Furthermore, since 1994, the Republican-dominated Congress has dropped all pretense of acting independently of its corporate sponsors.

Meanwhile, a meeting of 40 scientists convened in Switzerland last May by the World Health Organization concluded that dioxin is 2 to 10 times as toxic as it had seemed in 1990,[3] and a group of German scientists concluded last April that dioxin may be responsible for 12% of human cancers in industrialized countries.[4] If this estimate were correct, it would mean dioxin is responsible for 120,000 cancers each year in the U.S. This new German estimate is at least 10 times as high as previous estimates by U.S. government scientists (see REHW #390, #391).

The good news is that the levels of dioxin in the environment have dropped as much as 50% in the last decade as governments in Europe and local activists in this country have forced industry to adopt cleaner technologies.[3] Still, many of the effects of dioxins are delayed by a decade or more, so health effects from past exposures will continue to manifest themselves for several decades.

Except as laboratory curiosities, dioxins are never intentionally produced because they have no commercial value. However, they are created as unwanted byproducts by most combustion processes; during the manufacture of many kinds of chemicals, pesticides and wood preserva- tives; during incineration of medical, municipal and hazard- ous wastes; in metal smelting; and in the manufacture of paper. An important pathway for spreading dioxins into the environment is using sewage sludge as a soil amendment or a fertilizer.

Dioxins are also present in cigarette smoke at about the same concentration found in the stack of a municipal incinerator, the difference being that no one draws the smoke from an incinerator into their lungs undiluted, or exhales incinerator flue gas into an enclosed room for others to breathe.[5]

Some dioxins are more toxic than others, and the scientific community has established a way of comparing the toxicities and the quantities of various mixtures of dioxins. The technique is called TEQ, or toxic equivalents. The TEQ system takes into account the variations in toxicity and expresses toxicity in terms of the most toxic dioxin, which is TCDD.

For example, U.S. EPA estimates that total dioxin emissions in the U.S. averaged about 3000 grams (3 kilograms, or 6.6 pounds) per year TEQ in 1995. This means that all of the dioxins released into the environment in 1995 in the U.S. had a total toxicity equal to the toxicity of 3000 grams of TCDD.[6] (EPA acknowledges considerable uncertainty in this estimate; the true average lies somewhere between 1200 grams and 7900 grams TEQ, EPA says.[6,pg.2-7])

According to EPA, the major sources of dioxins in 1995 were municipal garbage incinerators (1100 grams, 36% of the national total); medical waste incinerators (477 grams, 16%); cement kilns burning hazardous waste (153 grams, 5%); industrial coal combustion (73 grams, 2.4%); residential wood combustion (63 grams, 2%); industrial wood combustion (29 grams, 1%); diesel engines (33 grams, 1%); copper smelting (504 grams, 17%); aluminum smelting (17 grams, 0.5%); forest fires (208 grams, 7%); incineration of sewage sludge (6 grams, 0.2%); plus 375 grams (12% of the national total) spread directly into the nation's soils in sewage sludge.[6,pg.2-13] (The total is not exactly 100% because of rounding.)

Dioxins do not dissolve readily in water, but they do in fat. Therefore, fat-containing foods tend to be contaminated with dioxins. Adults in the U.S. take in between one and 10 picograms of dioxin TEQ per kilogram of body weight per person per day (pg/kg/day).[1,3] (A kilogram is 1000 grams, or 2.2 pounds; a picogram is a trillionth of a gram and there are 28 grams in an ounce.) Eighty to 90 percent of our daily dioxin intake comes from eating milk, meat and fish.

Breast-fed infants take in 70 picograms of dioxin TEQ per kilogram of body weight per day -- seven to 70 times as much as the average adult. [3] Despite this, breast-fed infants are healthier than infants fed bottled formula.

The cancer hazard from routine exposure to dioxin has recently been estimated by a group of German scientists.[4] They report that, for adults, the lifetime cancer hazard lies somewhere between one per hundred and one per thousand for each picogram of dioxin TEQ ingested per kilogram of body weight per day (pg/- kg/day) Since the daily ingestion in the U.S. ranges from one to 10 pg/kg/day, we can calculate that the cancer hazard from environmental exposure to dioxin ranges between one per thousand and 100 per thousand. The middle of this range would be 50 per thousand. Because the average person's lifetime chance of getting cancer is now about 400 per thousand (or four in 10), we can see that routine exposure to environmental dioxins may be making a substantial (12%) contribution to the danger of cancer in this country, if the German estimate holds true. If it holds true, it qualifies as a public health disaster.

The mechanisms by which dioxin causes cancer remain poorly understood. In most studies, dioxin seems to be a powerful promoter of cancer, rather than an initiator. In other words, once a cell has been made cancer-prone by something else, dioxin may push it over the edge and turn it into a full-blown cancer. This would explain why dioxin seems to cause a general increase in many cancers among exposed populations. [2]

However, a study published during 1998 made it clear that dioxin can cause breast cancer in rats without either initiating it or promoting it in the traditional sense. As we reported earlier (REHW #630), researchers in the U.K. exposed pregnant rats to small amounts of dioxin on the 15th day of pregnancy.[7]

The female offspring of the dioxin-exposed pregnant rats were born normal, but by the time they were 7 weeks old, their mammary glands had developed an unusually high number of "terminal end buds" -- the places in a breast where breast cancers develop. Four studies have shown that there is a direct correlation between the number of terminal end buds in a breast and its susceptibility to breast cancer.

The British researchers went on to expose these young rats (and a control group) to a well-known carcinogenic chemical, dimethylbenz[a] anthracene. The dioxin-exposed young rats developed many more breast cancers than did the control group.

Thus a chemical (like dioxin) that, under some circumstances, appears to protect against breast cancer may, in fact, under other circumstances, cause it.

Based on non-cancer health effects, the World Health Organization's meeting on dioxin in May, 1998, recommended that the "tolerable daily intake" of dioxin should be between 1 and 4 picograms per kilogram of body weight per day (pg/kg/day). To reach this number, they took the lowest observed level that caused problems in laboratory animals and reduced it by a safety factor of 10. Normal practice in such circumstances would be to apply a safety factor of 100, but, according to a knowledgable source who asked not to be quoted, if the WHO group had applied a safety factor of 100 they would have been declaring much of the food supply in industrial countries dangerously contaminated, which they were reluctant to do for political reasons.

The middle of the range that they adopted -- one to 4 pg/kg/day -- would be 2.5 pg/kg/day, 4 times as low as the World Health Organization's 1990 recommendation, which was 10 pg/kg/day as the tolerable daily intake. Thus the tolerable daily intake recommended at the May meeting for an adult weighing 70 kg (154 pounds) would be 2.5 x 70 = 175 picograms per day, or 175 x 365 = 63,875 picograms per year.

Now that we know that a picogram of dioxin has some public health significance, we are in a better position to appreciate that 3000 grams of dioxin emitted each year by industrial sources in the U.S. is a very substantial quantity. If we multiply 3000 grams by a trillion to turn it into picograms, then divide by the U.S. population (260 million), we can see that 3000 grams of dioxin TEQ represents 11 million picograms of dioxin TEQ for each man, woman and child in the U.S. each year.

Scientists at the May, 1998, World Health Organization meeting concluded that, based on animal experiments, the following effects might be expected in humans: decreased sperm counts might be expected in humans who have a daily dioxin intake of 14 pg/kg/day; learning disabilities and endometriosis might be expected in humans with a dioxin intake of 21 pg/kg/day; suppression of the immune system might be expected in offspring of humans with an intake of 37 pg/kg/day. [3,pg.25] The May, 1998 WHO meeting "recognized that subtle effects may already occur in the general population in developed countries at current background levels, 2 to 6 pg/kg body weight. They therefore recommended that every effort should be made to reduce [dioxin] exposure to the lowest possible level," according to a statement released by the World Health Organization.[3]

All together, not very reassuring news from Europe about dioxin, we conclude.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)

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[1] Jean A. Grassman and others, "Animal Models of Human Response to Dioxins," ENVIRONMENTAL HEALTH PERSPECTIVES Vol. 106, Supplement 2 (April 1998), pgs. 761-775. There are 75 polychlorinated dibenzodioxins (PCDDs), the most potent of which is TCDD; plus 135 polychlorinated dibenzofurans (PCDFs), plus 9 PCBs (polychlorinated biphenyls) that are structurally similar to PCDDs and PCDFs.

[2] Douglas B. McGregor and others, "An IARC Evaluation of Polychlorinated Dibenzo-P-dioxins and Polychlorinated Dibenzofurans as Risk Factors in Human Carcinogenesis," ENVIRONMENTAL HEALTH PERSPECTIVES Vol. 106, Supplement 2 (April 1998), pgs. 755-760.

[3] "Executive Summary; Assessment of the health risk of dioxins: re- evaluation of the Tolerable Daily Intake (TDI); WHO Consultation, May 25-29 1998, Geneva, Switzerland." World Health Organization, WHO European Centre for Environment and Health, International Programme on Chemical Safety, Final December, 1998. This paper is marked as follows: "This report does not constitute a formal WHO publication. It should not be quoted or cited and is for personal use only!" However, see http://www.who.org/inf- pr-1998/en/pr98-45.html, a WHO press release announcing the results of the May meeting. We can send the WHO paper free as an Adobe acrobat file to anyone who requests is by E-mail. If you want the paper by U.S. mail, please send $3.00 to cover postage and handling to Rachel's, P.O. Box 5036, Annapolis, MD 21403 with a note saying what you want.

[4] Heiko Becher, Karen Steindorf, and Dieter Flesch-Janys, "Quantitative Cancer Risk Assessment for Dioxins Using an Occupational Cohort," ENVIRONMENTAL HEALTH PERSPECTIVES Vol. 106, Supplement 2 (April 1998), pgs. 663-670.

[5] H. Muto and Y. Takizawa, "Dioxins in Cigarette Smoke," ARCHIVES OF ENVIRONMENTAL HEALTH Vol. 44, No. 3 (May/June 1989), pgs. 171-174.

[6] U.S. Environmental Protection Agency, THE INVENTORY OF SOURCES OF DIOXIN IN THE UNITED STATES [EPA/600/P-98/002Aa External Review Draft] (Washington, D.C.: U.S. Environmental Protection Agency, April, 1998).

[7] Nadine M. Brown and others, "Prenatal TCDD and predisposition to mammary cancer in rats," CARCINOGENESIS Vol. 19, No. 9 (1998), pgs. 1623-1629.

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