The 'D' word – Dioxins

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PART 2 OF A SERIES OF ARTICLES:

• Sources of dioxins

SOURCES OF DIOXINS

Although dioxin levels in the environment have been declining since the early seventies, current exposure levels globally still remain a concern.[1]

PCDDs and PCDFs, or dioxins, are ubiquitously present environmental contaminants.[2] PCDDs and PCDFs are not commercially produced chemical products, but are trace level, unintentional byproducts of most forms of combustion, such as solid waste incineration, metal smelting and refining (especially high temperature steel production and scrap metal recovery furnaces) and coal/wood burning; and several industrial chemical processes, such as chlorine bleaching processes used in pulp, paper and textile production, municipal sewerage sludge treatments and chlorinated pesticide (herbicides) production.[1,3,4] PCBs were produced commercially in large quantities until production was stopped in 1977. Large quantities of PCBs, however, remain in electrical equipment, polyvinyl chloride (PVC) plastic products, buildings (e.g. plastic carpeting, sealing materials, etc.), and in the environment. Because PCBs are considered problem waste, their disposal is expensive, and may sometimes lead to attempts to dispose of them by mixing them with other waste products.[4]

Two well-established environmental accidents that have occurred are called Yusho (Japan) and Yu-Cheng (Taiwan). In both cases rice oil was contaminated and caused a number of health effects. Dioxin was also found at Love Canal in Niagara Falls, New York; and was the reason for evacuations at Times Beach, Mo and Seveso, in Italy.[3] In Europe, the Baltic Sea is an important sink of PCBs and dioxins. However, recent studies have revealed a major problem at localized spots, due to the production and use of chlorophenols for the impregnation of timber. In the most contaminated regions the concentration of PCDDs and PCDFs in soil and sediment appears to be incredibly high. A further unpredictable source of dioxins can be old transformers and capacitors, each of which may contain several kilograms of PCBs and hundreds of milligrams (mg) of PCDDs and PCDFs. Dioxins may also be formed during the combustion of automotive fuel and diesel.

According to the most recent U.S. EPA data the major sources of dioxin are coal fired utilities, metal smelting, diesel trucks, land applications of sewage sludge, burning treated wood and household trash burn barrels – these sources together account for nearly 80% of dioxin emissions (see Figure 1). Dioxins are also released in small concentrations by forest fires and volcanoes.[4]

Consumer products that may contain polychlorinated dioxins are the smoke from typical cigarettes. Dioxins are produced through the burning of the chlorine bleached cigarette paper, and cigarette tobacco that legally contains various chlorine pesticide residues. Dioxin in cigarette smoke was noted as "understudied" in the U.S. EPA in its 'Re-evaluating Dioxin' (1995). In the same report the U.S. EPA acknowledged that dioxin is "anthropogenic" ("man-made", "not likely in nature") and therefore does not come from the tobacco itself or any other natural plant for that matter.[4,6,7] Since then, dioxin was, however, classified as an IARC (International Agency for Research on Cancer) Group 1 "known human carcinogen" and the Stockholm Convention on Persistent Organic Pollutants (POPs) was signed, to globally phase out dioxin as well as 11 other of the worst industrial pollutants. Nevertheless, chlorine pesticides in tobacco and chlorine-bleached cigarette papers remain legal, with no warning required to consumers.[4]

Food is the major source for human exposure to PCBs and dioxins, especially fatty foods like dairy products (butter, cheese and fatty milk), meat, eggs and fish.[4,2,8,9] The current average body burden of dioxins is about 30–60 ng/kg (or 30–60 pg/g) per person, which is close to the lowest concentrations possibly causing health effects.[2] Because we are all being exposed through the same national food supply chains, we are all receiving a similar exposure, the main difference between individuals being individual food preferences.

Some subgroups within the general population e.g. individuals who, over an extended period of time consume primarily locally produced meat, fish or dairy products, might have significantly higher dioxin levels than those found in the commercial food supply. Individuals in this situation receive greater exposure and are at greater risk than the general population. These elevated dioxin food levels can be the result of nearby local sources or from past contamination of soil and sediment.[4]

Children are passed substantial body burdens prenatally by their mothers and breast feeding further increases the child's body burden. Children's body burdens are often many times above the amount implied by

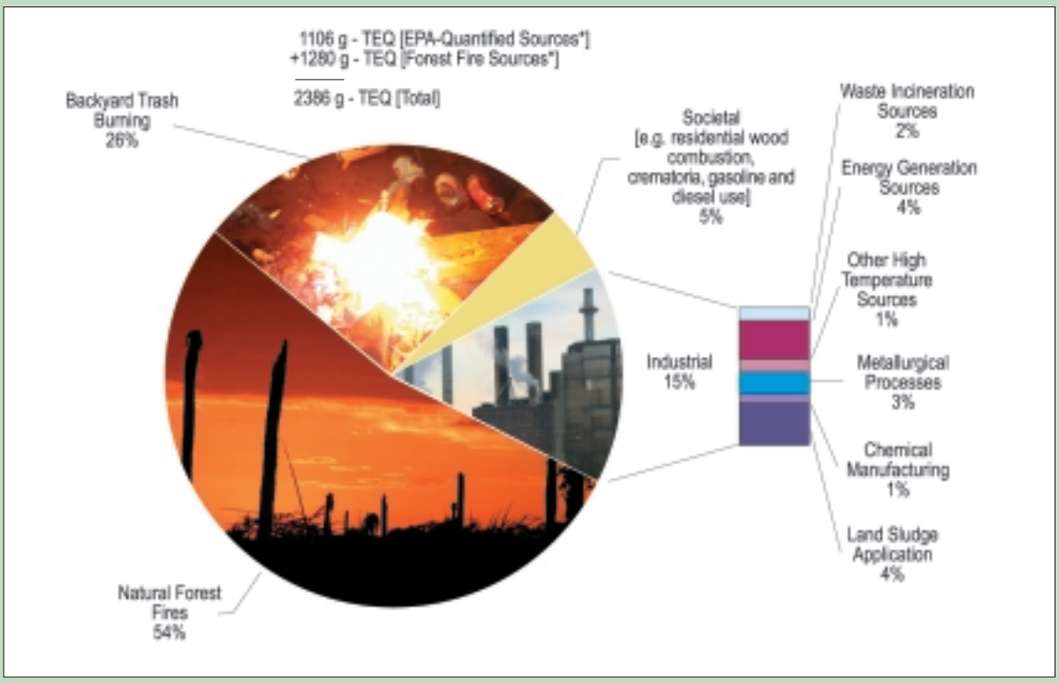

Figure 1. U.S. dioxin sources in 2004[5]

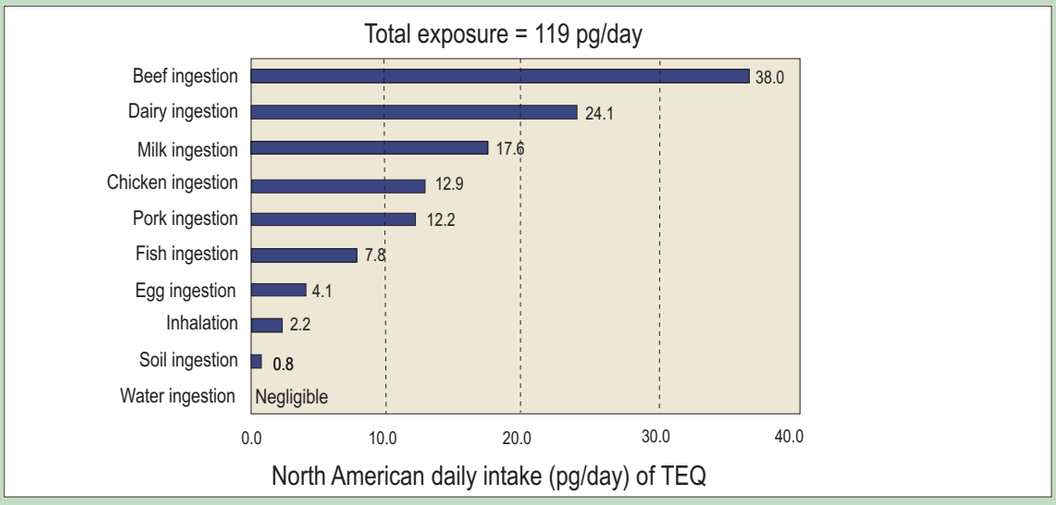

Figure 2. North American daily intake (pg/day) of TEQ[3,4]

tolerable intakes, which are based on body weight. Breast fed children usually have substantially higher dioxin body burdens than non-breast fed children until they are about 8–10 years old. The WHO, however, still recommends breast feeding because the other benefits far outweigh potential dioxin risks.[10,4]

Dioxins are also present in minuscule amounts in a wide range of other general consumer materials used by humans on a daily basis, including practically all substances manufactured using plastics, resins or bleaches e.g. food packaging products, food and water storage containers and even personal hygiene products. The use of these materials means that all modern humans receive (at least) a very small daily dose of dioxin.[4]

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