Update on Health and Environment Risk Management Activities in Canada for PCDDs, PCDFs and PCBs

Andrew P. Gilman
Bioregional Health Effects Programs Division, Health Canada, Room 1108, Main Building, Tunney's Pasture, Ottawa, Ontario, Canada, K1A 0K9, # 0301 A1
Mark Feeley
Bureau of Chemical Safety, Health Canada, Sir Fredrick Banting Building, Tunney's Pasture, Ottawa, Ontario, Canada, K1A 0L2, #2204 D1
Sheila Jones
Chemical Evaluation Division, Commercial Chemicals Branch, Environment Canada, 351 St. Joseph Boulevard, Hull, Québec, Canada, K1A 0H3

Introduction

PCDDs, PCDFs and PCBs have been of concern to Canadian regulatory agencies, scientists and public advocacy groups for over 20 years.[1)2)3)4)5)6)] Since 1975, there has been accumulating evidence that a number of congeners within the three related families can exert a wide range of toxic effects at very low doses in a variety of laboratory species and possibly in human populations. The key questions have focused on dose-response and dose effect, i.e., how much is too much for human beings and what are the critical health end points?

From both a human health perspective and an environmental perspective the Canadian assessments of PCDDs and PCDFs have been clear - these substances pose a threat to the health and well being of the ecosystem and have to be reduced to the lowest possible levels. Based on the best available science reviewed in 1989 [6)], Canada concluded that..."human intakes (from all sources) should be below 10 picograms per kilogram of body weight per day of (2,3,7,8- TCDD) toxic equivalents, averaged over a lifetime". This tolerable daily intake (TDI), used as a bench mark for action to address potential public health threats, e.g., the need for fishery closures, health advisories, etc., has largely been referred to as the Canadian 'guideline'. While some may have misinterpreted its use, i.e., a permit to pollute, its purpose, for assessment of risks to public health is clear. The elimination of dioxin generation and release continues to be the Canadian objective.

Scientific studies of the effects of dioxins and dioxin like contaminants have increased dramatically over the last five years. Much of the new research has been recently reviewed by

the US EPA in their draft Dioxin Reassessment Document. [7] It is normal and important for guidelines relating to contaminants to be re-examined as new scientific findings are reported. Health Canada is currently reviewing the available scientific evidence concerning dioxins and dioxin - like compounds to determine whether the federal TDI established in 1990 requires reevaluation.

Canadian efforts to control sources

In 1983, Canada developed a dioxin action plan [3] which identified the sources of these contaminants and ways and means of reducing their generation and release. The major sources of dioxins and furans identified in Canada included municipal and hazardous waste incinerators, effluents from pulp and paper mills, some smelting operations, some chemical processes and products (e.g. contaminants in some pesticides and PCBs) and long-range atmospheric transport from other countries.

Trichlorophenol and 2,4,5-T were deregistered as pest control agents in 1985. At the same time, dioxin and furan content in herbicides such as 2,4-D and in wood treatment chemicals such as penta- and tetrachlorophenol was restricted, domestic production of all these chemicals ceased, and pentachlorophenol's use as a wood protection agent was deregistered. Successive PCB regulations were put in place (in 1977, 1985, 1990 and 1992) to curb manufacturing, new and existing uses, export, destruction and storage. New incinerator technology was developed in the mid- 1980's and the Canadian Council of Ministers of the Environment (CCME) issued operating and emission guidelines for dioxins and furans in municipal solid waste and hazardous waste incinerators in 1989. Dioxins and furans were declared "toxic" under the Canadian Environmental Protection Act in 1990 and two years later regulations were passed requiring the virtual elimination of discharges of PCDDs and PCDFs from pulp mills.

Ecosystem levels

As a result of Canadian regulatory and guideline initiatives, dioxin and furan emissions from municipal solid waste and hazardous waste incinerators have decreased by 80 percent. Currently, less than 50 grams of dioxin and furan toxic equivalents are released from municipal solid waste incinerators in Canada per year. PCDD / PCDF emissions from bleached kraft pulp mill effluents have decreased by 97 percent, i.e., from more than 350 grams of TCDD-TEQs in 1989 to less than 9 grams in 1994.

The sum total of the actions taken has led to significant declines in the levels of dioxins and furans in the Canadian environment and in human tissues. PCB and dioxin residues in Lake Ontario Herring Gulls and Salmon also declined from the early 1970's to the mid 1980's, however levels are now relatively constant. [8] Several shellfish closures and health advisories for recreational and commercial fishing put in place in 1988-1989 because of concern over pulp mill wastes have now been rescinded because of significant declines in fish and shellfish contamination levels in these areas. Cross-Canada surveys indicate that from 1981 to 1992 TCDD-TEQ concentrations of PCDDs / PCDFs and PCBs in breast milk lipid fell 49% (for PCDDs / PCDFs from 28.6 ppt to 14.5 ppt TCDD-TEQ and for PCB from 337 ppb to 173 ppb). [9]

At present, the rates of decline in PCDD/PCDF and PCB levels in human tissue appears to be negligible. Comparisons between fish consumers and non-fish consumers do indicate small elevations in dioxins/furans and PCBs in the tissues of the fish consumers, however the magnitude of the difference is small (Table 1).

Table 1 **COMPARISON OF RECENT PCDD/PCDF AND PCB LEVELS IN CANADIANS RELATIVE TO FISH CONSUMPTION**

TISSUE	n	DIOXIN (TEQ)	PCB
Blood (1993)[a]			
Ontario (Cornwall): Non Fish Eaters	32	25 - 37[c]	472
Fish Eaters	109	21 - 33[d]	590
Ontario (Mississauga): Non Fish Eaters	48	29 - 34[c]	442
Fish Eaters	43	32 - 41[c]	494
Breast Milk 1992[b]			
All Canada: Low Fish Eaters (< 100g 1 week)	363	-	6
Fish Eaters (> 100g 1 week)	134	-	6.7

a Reference10. PCDD/PCDF expressed as TCDD-TEQs, ng/kg lipid; PCB expressed as geometric means, Ar 1260 standard, µg/kg lipid, sum of 40 congeners.
b Reference11.. Median values, ng/g whole milk. Significantly different ($P < 0.01$)
c range of 3 pools **d** range of 5 pools

Future Canadian Initiatives

Despite the positive news about declines in ecosystem levels of these chemicals, exposures of the developing fetus and newborns, especially in more highly exposed communities that rely on country foods for subsistence, remain a concern. Recent reports of adverse effects ascribed to some congeners of the dioxin, furan and PCB families on hormonal activity, neurobehavioural development, reproductive system development and maturation, and concerns about their carcinogenic potential need to be carefully reviewed. This review is underway in Health Canada to determine whether or not theTDI published in 1990 and the health advice derived from it need to be revised.

Under the recently adopted federal Toxic Substances Management Policy [12], dioxins, furans, PCBs and a number of other "toxic, persistent and bioaccumulative" substances have been targeted for virtual elimination. Environment Canada has established a federal/provincial task force to identify and characterize additional sources of release of dioxins and furans in Canada. This group is preparing an analysis of sectors or areas requiring further actions to eliminate measurable releases of these substances and will recommend target dates for their virtual elimination from the environment.

Canada has also taken a lead role in establishing the basis for the development of an international protocol for the control of persistent organic pollutants (POPs) including dioxins, furans and PCBs. International controls will be essential if we are to curb long range transport of these substances into Canada. Long range atmospheric transport is the largest source of dioxins, furans and PCBs to much of the Canadian ecosystem [8) 13)] especially the Arctic and Great Lakes regions, and is likely the key factor preventing further declines in environmental levels and human exposure in Canada.

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