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DIOXINS AND DIOXIN-LIKE COMPOUNDS IN THE FOOD SUPPLY: STRATEGIES TO DECREASE EXPOSURE

Dioxin and dioxin-like compounds, or DLCs, are found throughout the environment, in soil, water, and air. People are exposed to these unintentional environmental contaminants primarily through the food supply, although at low levels, particularly by eating animal fat in meat, dairy products, and fish. While the amount of DLCs in the environment has declined since the late 1970s, the public continues to be concerned about the safety of the food supply and the potential adverse health effects of DLC exposure, especially in groups such as developing fetuses and infants, who are more sensitive to the toxic effects of these compounds. Other groups that are exposed to high levels of DLCs in food include breastfeeding infants, subsistence fishers, and groups for whom DLC-containing fish and wild game are important cultural food sources.

DIOXINS AND HEALTH

Dioxins are unintentional contaminants that are released into the environment from the combustion of plant and other materials, such as in forest, brush, industrial, landfill, utility pole, and backyard barrel fires.

Scientific debate continues about what level of DLC exposure will cause adverse health effects in the population at large and in specific subpopulations. DLCs have relatively long half-lives in the human body and the rate the body rids itself of these compounds is inversely related to age and increased body fat. Thus, the overall amount of DLCs in the body tends to increase over time, even if exposure levels remain the same.

Numerous health effects have been linked to exposure to DLCs, including skin damage, cancer, non-insulin-dependent diabetes in adults, neurological and immune system impairments in infants, and endocrine system disruption. Many of these effects were identified in individuals who had high levels of exposure. However, information is limited on how low-level DLC exposure through foods, defined as occurring in everyday life, influences the development of cancer and other diseases.

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Although DLCs have been extensively studied as contaminants, a great deal of uncertainty still surrounds their potential for toxicity and the implications for human health. DLC exposure through foods occurs primarily by consuming animal fats. However, many foods that are sources of DLCs are also sources of important nutrients. These include milk and cheese, sources of vitamin D and calcium, and meats, sources of protein, iron, and niacin; eggs, sources of protein, vitamin A, and iron; and fish, which contains omega-3 fatty acids. While DLC exposure occurs through fruits, vegetables, and grains, it is believed to come primarily from soil that sticks to the plant material rather than from eating the plant.

DIET AND DLCS

Overall, about 34 percent of the calories in American adults' daily diet comes from fat, and one-quarter to one-third of that is from saturated fat, which is largely animal fat. Men eat more fat than women do. Adults eat more meat and fish than children do, but children generally consume almost twice as much milk and dairy products as do adults. Fish consumption is of particular note for several reasons. The DLC content of fish varies, with fish from contaminated waterways or those that received feed with high DLC levels having higher amounts.

DLCS AND THE FOOD SUPPLY

…the committee looked to future generations by targeting dietary choices to reduce DLCs in young girls and women prior to their child-bearing years.

To devise strategies for reducing human exposure to DLCs from the food supply, the National Science and Technology Council's Interagency Working Group on Dioxin with support from the U.S. Department of Agriculture, the U.S. Department of Health and Human Services, and other agencies and sponsors, requested the help of the Institute of Medicine of the National Academies. The resulting study, *Dioxins and Dioxin-like Compounds in the Food Supply: Strategies to Decrease Exposure,* recommends policy options to reduce exposure to these contaminants while considering how implementing these options could both reduce health risks and affect nutrition, particularly in sensitive and highly exposed groups, if dietary changes are suggested. In addition to the general population and DLC-sensitive and highly exposed groups, the study looked at preadolescent girls and teenage and young women because, over time, DLCs can accumulate in their bodies. During their child-bearing years, they can potentially expose their developing fetuses and infants to DLCs.

DLCs enter the food supply in three ways, through animal production systems, human foods, and food consumption patterns. In the animal production system pathway, airborne contaminants land on plants, soil, and water and are taken up by animals or fish that are, in turn, later eaten by humans. DLCs collect in human foods by way of the animal production pathway. DLC levels are generally uniform in most foods, except milk, because they are processed in bulk and distributed throughout the country. However, the DLC level of food from the wild varies depending on where fish or wildlife are caught. As a result, populations who subsist largely on wild fish and game may receive higher DLC exposure levels.

Due mostly to the high cost of analyzing DLCs, relatively little information is available on the DLC content of the U.S. food supply. This lack of data makes it impossible to determine the precise risk humans face from low levels of DLCs in their diet or how much the risk could be cut by reducing DLC exposure. Therefore, the study proposes risk management options to reduce contaminant exposure and recommends governmental actions to gather the data needed to prepare a long-term risk management plan. It also offers some interim options that would reduce exposure and promote good nutrition. The options fall into three categories: (1) reducing DLCs in animal feed and forage, (2) reducing DLCs in the human food supply, and (3) changing food consumption patterns to reduce DLC exposure.

Most actions taken now to reduce the amount of DLCs in the food supply will have a long-term effect on human health because DLCs are persistent and widespread in the food supply.

The recommended options, or interventions, that the committee determined would be both feasible and effective in reducing DLC exposure through the food supply, while not compromising good nutrition and health. Thus, for each option, the committee qualitatively evaluated

- alternative or interim actions,
- current barriers to implementation,
- anticipated reduced DLC levels reached through implementation, and
- risk relationships that included increases or decreases in other risks.

Most actions taken now to reduce the amount of DLCs in the food supply will have a long-term effect on human health because DLCs are persistent and widespread in the food supply. These actions will also immediately affect the food supply, which, in turn, could affect individual health and nutrition. Changing the diet to reduce DLC exposure by cutting back on animal fats, which are largely saturated fats, would be beneficial nutritionally. Eating less animal fat could be accomplished by selecting lean cuts of meat, poultry, and fish; trimming visible fat and removing skin, as appropriate; and by selecting reduced-fat dairy products. DLCs in fruits and vegetables appear to be concentrated mainly in the outer skins and can be reduced through washing and, in some cases, peeling.

Changing the diet to reduce DLC exposure by cutting back on animal fats, which are largely saturated fats, would be beneficial nutritionally.

RISK MANAGEMENT RECOMMENDATIONS

The study's recommendations to reduce human exposure to DLCs through the food supply are categorized in three ways, as follows:

General recommendations:

- Develop an integrated risk management strategy and action plan.
- Foster collaboration between government and the private sector to reduce DLCs.
- Invest in the data required for effective risk management.

High-priority risk management interventions:

- Interrupt the cycle of DLCs through forage, animal feed, and food-producing animals. The government's risk management strategy for DLCs should give high-priority attention to reducing the contamination of animal forage and feed and interrupting the recycling of DLCs that result from the use of animal fat in animal feed.
- Reduce DLC exposure in girls and young women years before they become pregnant. One action would be to make it easier for them to drink low fat or skim milk instead of whole milk and eat foods lower in animal fat, in government-sponsored food programs.

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Other risk management interventions that deserve consideration in the development of the risk management plan are:

- Reduce DLC discharge sources in animal production areas.
- Remove DLC residues from food during processing, particularly trimming fat from meat.
- Advise and educate highly exposed populations.
- Educate the public about ways to reduce DLC exposure.

RESEARCH AND TECHNOLOGY DEVELOPMENT

The study recommends that the government make the following research and technology development efforts a priority:

- Develop low-cost analytical methods and re-evaluate using toxic equivalents to assess DLC exposure.
- Increase research to remove DLCs from animal feed.
- Expand the National Health and Nutrition Examination Survey's data collection on DLC body burdens.
- Increase research on the effects of dietary DLCs on fetuses and breastfeeding infants.
- Develop modeling studies that predict and assess movement of DLCs into the food supply.

CONCLUDING REMARKS

Given the paucity of scientific evidence available to the committee about current levels of DLCs in food and feeds and the impact of low-level exposure on human health, this report provides qualitative recommendations for options to reduce exposure through the food supply. Further, this report emphasizes the need for cost-effective analytical methods and research to determine the direction of future actions to further reduce DLC exposure through pathways leading to human foods.

For More Information…

Copies of *Dioxins and Dioxin-like Compounds in the Food Supply: Strategies to Decrease Exposure* will be available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, http://www.nap.edu. The full text of this report will be available at **http://www.nap.edu**

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COMMITTEE ON THE IMPLICATIONS OF DIOXIN IN THE FOOD SUPPLY

ROBERT S. LAWRENCE *(chair)*, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland; **DENNIS M. BIER**, Children's Nutrition Research Center, Baylor College of Medicine, Houston, Texas; **ROBERT E. BROYLES**, Chesterfield, Missouri; **DOROTHY R. CALDWELL**, North Carolina Initiative for Healthy Weight in Children and Youth, Division of Public Health, Raleigh, North Carolina; **DAVID O. CARPENTER**, Environmental Health and Toxicology, School of Public Health, University at Albany, Rensselaer, New York; **JULIE A. CASWELL**, Department of Resource Economics, University of Massachusetts, Amherst; **KEITH R. COOPER**, Department of Biochemistry and Microbiology, Rutgers University, Cook College, New Brunswick, New Jersey; **JAMES K. HAMMITT**, Department of Health Policy and Management, Harvard School of Public Health, Boston, Massachusetts; **GAIL G. HARRISON**, Department of Community Health Sciences, UCLA School of Public Health, Los Angeles, California; **JAMES T. HEIMBACH**, JHeimbach LLC, Washington, DC; **BARBARA A. KNUTH**, Department of Natural Resources, Cornell University, Ithaca, NY; **JAMES D. MCKEAN**, Department of Veterinary Diagnostic and Production Animal, Iowa State University, Ames; **PIETER J.J. SAUER**, Department of Pediatrics, University of Groningen, University Hospital, Groningen, Netherlands; **ROBERT E. SMITH**, R.E. Smith Consulting, Inc., Newport, Vermont; **MICHAEL R. TAYLOR**, Resources for the Future, Washington, DC; **KATHERINE L. TUCKER**, Jean Mayer U.S. Department of Agriculture Human Nutrition Research Center on Aging, Tufts University, Boston, Massachusetts

Consultant
A. JOHN BAILER, Department of Mathematics and Statistics, Miami University, Oxford, Ohio

Study Staff
ANN YAKTINE, Study Director
TAZIMA A. DAVIS, Research Assistant
SANAIT TESFAGIORGIS, Senior Project Assistant (through September 2002)
SYBIL BOGGIS, Senior Project Assistant (from September 2002)