



World Health Organization

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Dioxins and their effects on human health

What are dioxins?

Dioxins are environmental "repeat offenders". They have the dubious distinction of belonging to "dirty dozen club" - a special group of dangerous chemicals known as persistent organic pollutants. Once dioxins have entered the environment or body, they are there to stay due to their uncanny ability to dissolve in fats and to their rock-solid chemical stability. Their half-life in the body is, on average, seven years. In the environment, dioxins tend to bio-accumulate in the food chain. The higher in the food chain one goes, the higher is the concentration of dioxins.

It takes a good chemist to remember dioxin's proper name: *2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD)*. The name dioxin is also used for the family of structurally and chemically related *polychlorinated dibenzo-para-dioxins (PCDDs)*, *polychlorinated dibenzofurans (PCDFs)*, and the certain *polychlorinated biphenyls (PCBs)*. Some 419 types of dioxin-related compounds have been identified but only about 30 of these are considered to have significant toxicity, with TCDD being the most toxic.

What are the sources of dioxin contamination?

Dioxins are mainly by-products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. These compounds are also unwanted by-products formed when thermal processes produce chlorine-containing organic substances. Dioxins are unwanted by-products of a wide range of manufacturing processes including smelting, bleaching of paper pulp and the manufacturing of some herbicides and pesticides. In terms of dioxin release into the environment, solid waste incinerators are the worst culprits due to incomplete combustion.

Dioxins are found throughout the world in practically all media, including air, soil, water, sediment, and food, especially dairy products, meat, fish and shellfish. The highest levels of these compounds are found in some soils, sediments and animals. Very low levels are found in water and air.

Extensive stores of waste industrial oils with high levels of dioxins exist throughout the world. Long term storage of this material may result in dioxin release into the environment and the contamination of human and animal food supplies. Dioxins are not easily disposed of without contamination of the environment and human populations.

How can dioxins be destroyed?

Incineration is the best available answer although other methods are being investigated. The process requires high temperatures, over 850° C. For destruction of large amounts of contaminated material, even higher temperatures -1000° C or more - are required.

Have there been dioxin contamination incidences?

High levels of dioxins were reported to have been found in poultry and eggs in Belgium. The cause of the contamination is thought to have been animal feed.

One particular dioxin, TCDD, was extensively studied for health effects linked to its presence as a contaminant in some batches of the herbicide Agent Orange used during the Vietnam War.

TCDD was also studied in a serious accident at a chemical factory in Seveso, Italy in 1976. A cloud of toxic chemicals, including dioxins was released into the air and eventually contaminated an area of 15 square kilometres with a population of 37,000 people.

A more recent case of dioxin contamination of food occurred in the southern part of the United States of America in 1997. Chickens, eggs, and catfish were contaminated with dioxin when a contaminated ingredient (bentonite clay or sometimes called "ball clay") was used in the manufacture of animal feed. American regulators eventually traced the contaminated clay to a bentonite mine. As there was no evidence that hazardous waste was buried at the mine, investigators speculate that the source of dioxins may be prehistoric.

Earlier incidents of food contamination reported in other parts of the world. Although all countries could be affected, most contamination cases have been reported in industrialized countries where adequate food contamination monitoring, greater awareness of the hazard and better regulatory controls are available for the detection of dioxin problems.

What are the effects of dioxins on human health?

Short-term exposure of human to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer. TCDD was evaluated by International Agency for Research on Cancer (IARC) in 1997. Based on human epidemiology data, dioxin was categorised by IARC as a "known human carcinogen". However, TCDD does not affect genetic material and there is a level of exposure below which cancer risk would be negligible.

Are certain population subgroups at greater risk from dioxins?

Foetuses are most sensitive to dioxin exposure. Newborns may also be more vulnerable to certain effects. Some individuals or groups of individuals may be exposed to higher levels of dioxins because of their diets (e.g. high consumers of fish in certain parts of the world) or their occupations (e.g. workers in the pulp and paper industry, in incineration plants and at hazardous waste sites, to name just a few).

How do you estimate the risks to consumers from consumption of food products contaminated with dioxins?

Risk must be calculated on a case by case basis taking into account the levels of exposure and population sub-groups affected. Accurate information about the level of dioxin in the food, the amount of contaminated food consumed, and the duration of exposure to dioxin is needed to assess the actual risk of exposure. With this information at hand, an assessment of the health impact can be performed and used as a basis for policy decisions. A Tolerable Daily Intake (TDI) has been recommended as a tool for long term safety assessment. The TDI is calculated on the basis of exposure over a lifetime and the accumulated amount of dioxins in the body.

What can countries do to protect public health from dioxins?

It is estimated that 90% of human exposure to dioxins is through the food supply. Consequently, protecting the food supply is critical. Contamination of the food can occur at any point from "farm to table". The safety assurance of food is a continuous process that begins with production and ends in consumption. Good controls and practices during primary production, processing, distribution and sale are all essential to the production of safe food.

Food contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded. When incidents of contamination are suspected, countries should have contingency plans to identify, detain and dispose of unsafe food. The exposed population should be examined in terms of exposure (e.g. measuring the contaminants in blood or mother's milk) and effects (e.g. clinical surveillance to detect signs of ill health).

What should consumers do to reduce their risk of exposure?

Though speculative, trimming fat from meat, consuming low-fat dairy products, and simply cooking food may eventually decrease the body burden of dioxin compounds. Also, a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source. However, the ability of consumers to mitigate their own exposure is limited. It is the role of national governments to monitor the safety of the food supply and to take action to protect public health.

What does it take to identify and measure dioxins in the environment and food?

The analysis of dioxins requires sophisticated methods that are available only in a limited number of laboratories around the world. About 100 laboratories are able to analyse dioxins in environmental samples (e.g. ashes, soil, or water) and in food but about 20 laboratories in the world are able to reliably measure dioxins in biological materials (e.g. human blood or mother's milk). These are mostly in industrialized countries. Costs vary according to the type of sample, but range from US \$1,200 for the analysis of a single biological sample to US \$10,000 or more for the comprehensive assessment of release from a waste incinerator.

What is WHO doing about the problem of dioxins in the food supply?

Reducing dioxin intake is good public health policy and an important aspect of sustainable development. In 1998 WHO convened a consultation in Geneva to evaluate the tolerable daily dose of dioxins to which a human can be exposed without harm, the Tolerable Daily Intake (TDI). In light of new epidemiological data concerning dioxins' effects at low levels of exposure and based on animal studies, the TDI was reduced from 10 picogrammes/kilogram body weight to a range of 1 to 4 picogrammes/kilogram body weight. The current levels of exposure in industrialized countries are in the range of 1 to 3 picogrammes/kilogram body weight. The TDI recommended by the WHO consultation is internationally recognized as a reference value for ensuring that safe levels of exposure are not exceeded.

WHO in collaboration with the Food and Agriculture Organization (FAO) through the joint FAO/WHO Codex Alimentarius Commission is considering the establishment of guideline levels for dioxins in foods. WHO is also working with the United Nations Environmental Programme (UNEP) by providing risk assessments of persistent organic pollutants (POPs), including dioxins. A number of actions are being considered internationally to reduce the production of dioxins during incineration and manufacturing processes.

WHO, through its European Center for Environment and Health in Bilthoven, The Netherlands, conducts periodic studies on levels of dioxins in mother's milk, mainly in European countries. These studies provide an assessment of human exposure to dioxins from all sources. Recent exposure data show that measures introduced to control dioxin release in a number of countries have resulted in a substantial reduction in exposure to of these compounds over the past few years.

Since 1976, WHO has been responsible for the Global Environment Monitoring System's Food Contamination Monitoring and Assessment Programme. Commonly known as GEMS/Food, the programme provides information on levels and trends of contaminants in food through its network of participating laboratories in over 70 countries around the world.

Are there other sources of information about dioxins within WHO?

The WHO Food Safety Programme has established a web page (www.who.int/fsf) with general information about dioxins as well as links to other web sites with possible information on dioxins.

The International Programme on Chemical Safety (UNEP/ILO/WHO) has made the Executive Summary of the **Assessment of the health risk of dioxins: re-evaluation of the Tolerable Daily Intake (TDI)** is available at www.who.int/pcs and www.who.int/peh

The WHO Regional Office for Europe (EURO) has produced a fact sheet on the dioxin incident in Belgium which is available at <http://www.who.dk/>

For further information, journalists can contact :

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