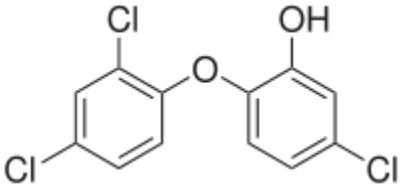
TRICLOSAN

Overview

Triclosan is a synthetic chlorinated aromatic compound with antibacterial properties that has been used widely in many consumer products such as antibacterial soaps, deodorants, toothpastes, cosmetics, fabrics, plastics, and other products for at least the past 20 years. It was first registered as a pesticide in 1969. Triclosan safety is currently under review by the Food and Drug Administration (FDA) and Environmental Protection Agency.

Chemical Description

Triclosan is a white powdered solid with a slight aromatic/phenolic odor and it is highly soluble in water. Triclosan is a chlorinated aromatic compound, which has functional groups representative of both ethers and phenols. Phenols often show anti-bacterial properties. Its International Union of Pure and Applied Chemistry (IUPAC) name is 5-Chloro-2-(2,4-dichlorophenoxy)phenol.



Depending on the company that sells the chemical, it also appears in products as Microban® Additive B, Irgasan® (DP 300 or PG 60), Biofresh®, Lexol-300, Ster-Zac or Cloxifenolum. Some antibacterial soaps use triclocarban in place of triclosan (#Food&Water Watch).

Uses

Triclosan is used as an antibacterial agent in a number of personal hygiene products and as an anti-plaque agent in dentifrices. It is an ingredient in many detergents, soaps, skin cleansers, deodorants, lotions, creams, toothpastes, and dishwashing liquids. Triclosan is also used as a preservative, fungicide and biocide in several household cleaning products and other household items. Triclosan preparations have been used to control the spread of methicillin-resistant *Staphylococcus aureus* (MRSA) in clinical settings, pre-operatively to decolonize skin, and in sutures to prevent bacterial colonization of surgical wounds.

Routes of Exposure and Metabolism

Triclosan exposure may occur through ingestion of toothpaste, mouthwash, or dentifrices containing triclosan and through dermal contact with consumer products containing triclosan, or through consumption of contaminated food and drinking water.

Triclosan is a fat-soluble chemical and can easily cross cell membranes. Once inside the cell, triclosan poisons a specific enzyme that many bacteria and funguses need for survival. Triclosan blocks the active site of an enzyme called enoyl-acyl carrier-protein reductase (ENR for short), preventing the bacteria from manufacturing the fatty acids it needs for building cell membranes and other vital functions. Humans don't have this enzyme. One molecule of triclosan permanently disables an ENR molecule, which explains why triclosan has powerful antibiotic action even at very low concentrations (#General Chemistry online).

Health Effects

Acute Health Effects

Triclosan-containing products regulated by the EPA, such as adhesives, fabrics, vinyl, plastics, and textiles, are rated by the EPA as "highly toxic." (#PANNA).

Chronic Health Effects

It is listed as a "possible carcinogen" by the IARC (International Agency for Research on Cancer) (#IARC).

Currently, EPA is updating its 2008 assessment of triclosan exposure using the newly released 2005-2006 NHANES (National Health and Nutrition Examination Survey) urinary monitoring results. Once completed, EPA will post its revised assessment in the public docket, and revisit its regulatory decision, if the science supports a change.

Since the 2008 assessment, additional data on effects of triclosan on thyroid hormones and estrogen-related effects have also been made available from EPA's Office of Research and Development (ORD). ORD studies on the thyroid and estrogen effects led EPA to determine that more research on the potential health consequences of endocrine effects of triclosan is warranted. This research is underway and will help characterize the human relevance and potential risk of these effects observed in initial laboratory animal studies (#EPA, Triclosan Facts).

The Agency has previously indicated that because of the amount of research being planned and currently in progress, it will undertake another comprehensive review of triclosan beginning in 2013 (#EPA, Triclosan Facts).

A 2006 study has shown that low doses of triclosan act as an endocrine disruptor in the North American bullfrog (#Veldhoen et al., 2006). Another study in 2008 demonstrated that triclosan exposure significantly impacts thyroid hormone concentrations in male juvenile rats (#Zorrilla et al., 2009).

- *Resistance concerns*

  The highly specific way that triclosan kills has researchers concerned about its role in fostering antibiotic-resistant strains of bacteria. Researchers have recently demonstrated that mutations in the bacterial gene that produces ENR can produce triclosan-resistant bacteria. Because triclosan is now so widespread in the environment, it's likely that new antibiotics targeting ENR would be ineffective (#General Chemistry online).

- *Dioxin Link*

  Triclosan is listed as "could be" and "suspected to be" contaminated with dioxins in EPA's draft Dioxin Reassessment. Because of the chemical structure as a polychloro phenoxy phenol, it is possible that dioxin can be found in triclosan as synthesis impurities. In addition to being formed during the manufacturing process, dioxin may also be formed upon incineration of triclosan (#Beyond Pesticides, 2004).

- *Allergy Link*

  The "hygiene hypothesis," theorizes that there is a correlation between too much hygiene and increased allergies and asthma. This hypothesis is based on studies that have found an increase in the frequency of allergies, asthma, and eczema in persons who have been raised in more sterile and hygienic environments. Through over-cleaning ourselves, the theory states, the body's immune system is not challenged, and thus prevent it is prevented from developing and maturing (#Beyond Pesticides, 2004).

Environmental Health Effects

Over 95% of the uses of triclosan are in consumer products that are disposed of in residential drains. Since wastewater treatment plants fail to remove triclosan from the water and the compound is highly stable for long periods of time, a huge amount of triclosan is expected to be emitted into waterways. In a U.S. Geological Survey study of 95 different organic wastewater contaminants in U.S. streams, triclosan was one of the most frequently detected compounds, and in some of the highest concentrations. A study of triclosan in bodies of water in Switzerland also found high concentrations of the chemical in several lakes and rivers, as well as lower levels of methyl triclosan, its breakdown by-product. Methyl triclosan, which is formed by a process called biological methylation, is actually more lipophilic than its parent compound, and thus more bioaccumulative.

Triclosan can have detrimental effects on aquatic ecosystems. It has been found to be highly toxic to different types of algae. Triclosan effluents affect both the structure and the function of algal communities in stream ecosystems.

Because of its lipophilic nature and resistance to degradation, triclosan in waterways is readily available for absorption and bioaccumulation by aquatic organisms in the environment (#Beyond Pesticides, 2004).

Researchers who added triclosan to river water and shined ultraviolet light on the water found that between one and twelve percent of the triclosan was converted to dioxin in the water, leading to fears that sunlight could transform triclosan to dioxin naturally (#Beyond Pesticides, 2004, #Washington Toxic Coalition).

Ways to Reduce Exposure

- **Forgo antibacterial soap.**
  The American Medical Association says not to use it at home.
- **Watch for the antibacterial chemicals triclosan and triclocarban (triclosan's chemical cousin) in personal care products.**
- **Avoid "antibacterial" products.**
  Triclosan is used in everyday products like toothbrushes, toys, and cutting boards that may be labeled "antibacterial," "fights germs," "protection against mold," or that make claims such as "odor-fighting" or "keeps food fresher, longer."

  To protect your family's health from harmful microorganisms, follow these helpful tips from the Environmental Protection Agency:

  • Wash hands frequently and thoroughly with plain soap.

  • Wash surfaces that contact food (e.g., utensils, cutting boards, counter tops) with a regular (not "antibacterial") detergent and warm water.

  • Wash children's hands and toys regularly. Again, simple soap and good old-fashioned scrubbing will suffice (#Environmental Working Group).

Regulation

Triclosan is regulated by both the EPA and FDA. Basically, the EPA regulates the pesticide uses of triclosan while the FDA is concerned with its non-pesticide usage.

In November 2008 EPA released a RED (Reregistration Eligibility Decision) for triclosan. In general, the Agency has concluded that all EPA-registered uses of triclosan are eligible for reregistration, with the exception of the use in paints (registrants have recently requested

voluntary cancellation of this use), provided that the risk mitigation and data requirements outlined in the RED are fully implemented (#EPA Releases RED for Triclosan, 2008).

In December 2010 EPA has published in the Federal Register a petition, filed by 82 public health and environmental groups, to ban the hazardous antimicrobial/antibacterial pesticide triclosan for non-medical use. The Federal Register notice (Petition for a Ban on Triclosan, 75 FR 76461, December 8, 2010) has announced a public comment period until February 7, 2011 on the need to ban triclosan under numerous federal statutes from pesticides, clean water, safe drinking water, to endangered species.

Source : http://www.toxipedia.org/display/toxipedia/Triclosan