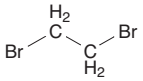
1,2-Dibromoethane

CAS No. 106-93-4

Reasonably anticipated to be a human carcinogen

First listed in the *Second Annual Report on Carcinogens* (1981)

Also known as ethylene dibromide



Carcinogenicity

1,2-Dibromoethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

1,2-Dibromoethane caused tumors in rats and mice at several different tissue sites and by several different routes of exposure. Inhalation exposure to 1,2-dibromoethane caused cancer of the nasal cavity (carcinoma and adenocarcinoma) and the blood vessels (hemangiosarcoma) in rats of both sexes and in female mice; benign or malignant lung tumors (alveolar/bronchiolar adenoma or carcinoma) in mice of both sexes and in female rats; and benign or malignant mammary-gland tumors (fibroadenoma or adenocarcinoma) in females of both species. It also caused testicular tumors (mesothelioma of the tunica vaginalis) in male rats and cancer of the subcutaneous tissue (fibrosarcoma) in female mice (NTP 1982). Dermal exposure to 1,2-dibromoethane caused lung and skin tumors in female mice (Van Duuren *et al.* 1979). Administration of technical-grade 1,2-dibromoethane by stomach tube caused cancer of the forestomach (squamous-cell carcinoma) in rats and mice of both sexes, blood-vessel cancer (hemangiosarcoma, primarily in the spleen) in male rats, benign lung tumors (alveolar-bronchiolar adenoma) in mice of both sexes, and liver cancer (hepatocellular carcinoma) in female rats (NCI 1978).

Since 1,2-dibromoethane was listed in the *Second Annual Report on Carcinogens,* additional studies in experimental animals have been identified. Inhalation exposure to 1,2-dibromoethane caused blood-vessel cancer (hemangiosarcoma in the spleen) and increased the combined incidence of benign and malignant adrenal-gland tumors (cortical adenoma, carcinoma, and pheochromocytoma) in rats of both sexes. It also caused mammary-gland tumors in females and skin tumors (mesenchymal tumors) in males (Wong *et al.* 1982). In mice, administration of 1,2-dibromoethane in the drinking water caused forestomach tumors (squamous-cell carcinoma) in both sexes and benign tumors of the esophagus (papilloma) in females (Van Duuren *et al.* 1985). In fish (rainbow trout), dietary administration of 1,2-dibromoethane caused benign glandular-stomach tumors (papilloma) in both sexes (Hendricks *et al.* 1995), and administration in the tank water caused benign and malignant tumors of the liver (hepatocellular adenoma and carcinoma), bile duct (cholangioma and cholangiocarcinoma), and gall bladder (papillary adenoma and adenocarcinoma) (Hawkins *et al.* 1998).

Cancer Studies in Humans

At the time 1,2-dibromoethane was listed in the *Second Annual Report on Carcinogens,* the data available from epidemiological studies were inadequate to evaluate the relationship between human cancer and exposure specifically to 1,2-dibromoethane. Since then, additional epidemiological studies have been identified. Results from three studies of occupational exposure to 1,2-dibromoethane were inconclusive, because the workers were exposed to mixtures of chemicals, and the statistical power of the studies to detect an effect was low (IARC 1999).

Properties

1,2-Dibromoethane is a volatile saturated brominated hydrocarbon that exists at room temperature as a colorless liquid with a sweet, chloroform-like odor (Akron 2009). It is only slightly soluble in water but is miscible with many organic solvents, such as diethyl ether, ethanol, acetone, and benzene. 1,2-Dibromoethane is stable in closed containers under normal conditions (Akron 2009). Physical and chemical properties of 1,2-dibromoethane are listed in the following table.

Property	Information
Molecular weight	187.9[a]
Density	2.17 g/mL[a]
Melting point	10°C[a]
Boiling point	131°C to 132°C[a]
Log K_{ow}	1.96[a]
Water solubility	3.91 g/L at 25°C[b]
Vapor pressure	11.2 mm Hg at 25°C[a]
Vapor density relative to air	6.5[a]

Sources: [a]HSDB 2009, [b]ChemIDplus 2009.

Use

Historically, the primary use of 1,2-dibromoethane has been as a lead scavenger in antiknock mixtures added to gasolines (IPCS 1996). Lead scavenging agents transform the combustion products of tetraalkyl lead additives to forms that are more likely to be vaporized from engine surfaces. In 1978, 90% of the 1,2-dibromoethane produced was used for this purpose (ATSDR 1992). Annual consumption of 1,2-dibromoethane in the United States has decreased since the U.S. Environmental Protection Agency banned the use of lead in gasoline.

Another major past use of 1,2-dibromoethane was as a pesticide and an ingredient of soil and grain fumigants and for post-harvest application to various vegetable, fruit, and grain crops (NTP 1982). It also was used to kill fruit flies on citrus fruits, mangoes, and papayas after harvest and in the soil to protect grasses in environments such as golf courses (ATSDR 1992). By 1984, EPA regulations had eliminated most of the uses of 1,2-dibromoethane as a pesticide in the United States. 1,2-Dibromoethane has been used as a chemical intermediate in the manufacture of resins, gums, waxes, dyes, and pharmaceuticals and as a high-density, nonflammable solvent in a number of applications. Small amounts of 1,2-dibromoethane have been used in the manufacture of vinyl bromide, which is used as a flame retardant (ATSDR 1992, HSDB 2009).

Production

Annual U.S. production of 1,2-dibromoethane peaked at 332 million pounds in 1974, but had declined to 170 million pounds by 1982 (ATSDR 1992, HSDB 2009). In 2009, 1,2-dibromoethane was produced by six manufacturers worldwide, including one in the United States, two in India, and one each in Europe, China, and the Middle East (SRI 2009), and was available from 36 suppliers worldwide, including 18 U.S. suppliers (ChemSources 2009). Imports in the category "ethylene dibromide and fluorinated, brominated, or iodinated derivatives of acyclic hydrocarbons" have varied considerably from 1989 to 2008, from zero in 2002, 2007, and 2008 to highs of over 2 million kilograms (4.4 million pounds) in 1997 and 2000 (USITC 2009). In 1978, U.S. exports of of 1,2-dibromoethane totaled 84.8 million pounds (ATSDR 1992), but from 1989 to 2008, exports declined from over 12 million kilograms (26 million pounds) to zero in 2007 and 2008 (USITC 2009). Reports filed under EPA's Toxic Substances Control Act Inventory Update Rule indicate that U.S. pro-

duction plus imports of 1,2-dibromoethane declined from between 100 million and 500 million pounds in 1986 to between 1 million and 10 million pounds in 1998 and 2002 (EPA 2004).

Exposure

Potential routes of human exposure to 1,2-dibromoethane are inhalation of ambient air and ingestion of contaminated drinking water and foods. As a result of its historical use as a gasoline additive and a soil fumigant and its persistence in soil and groundwater, 1,2-dibromoethane has been detected in ambient air, soil, groundwater, and food (ATSDR 1992). According to EPA's Toxics Release Inventory, environmental releases of 1,2-dibromoethane have declined dramatically since 1988. Total releases were 99,000 lb in 1988, declining to 19,000 lb in 1994 and 10,000 lb in 2001. However, almost 48,000 lb was released in 1999. In 2007, 4,236 lb of 1,2-dibromoethane was released, over half of which was released by one facility to air (TRI 2009).

In 1980, concentrations of 1,2-dibromoethane in U.S. ambient air ranged from 0.12 to 2.826 ng/m^3. Daily intake through inhalation of ambient air was estimated to range from 0 to 79 µg/kg (IPCS 1996). In addition, inhalation of 1,2-dibromoethane released to indoor air from contaminated groundwater, such as while showering, may play an important role in human exposure. Concentrations in groundwater not used for drinking water were measured at up to 90 µg/L in an irrigation well in Georgia in the early 1980s. Because 1,2-dibromoethane is readily volatilized from water, measured concentrations in surface water have not exceeded 0.2 µg/L in the United States (ATSDR 1992).

An EPA study detected 1,2-dibromoethane in slightly over 1% of public water systems tested, at mean concentration of 3.6 µg/L (EPA 2001). In California, the mean concentration in active and closed public wells was 0.006 ppb (0.006 µg/L), well below the California Department of Health Services maximum contaminant level (MCL) of 0.02 ppb (0.02 µg/L) (Kloos 1996). However, 1,2-dibromoethane was present at concentrations above the MCL in groundwater at about half of the underground storage tank sites tested (Falta *et al.* 2005). In a rural county in Kansas, the municipal water supply exceeded the U.S. EPA MCL for 1,2-dibromoethane (0.05 µg/L) on six occasions, the highest reported concentration being 0.18 µg/L (Neuberger *et al.* 2004). EPA estimated daily intake of 1,2-dibromoethane from drinking water to range from 0 to 16 µg/kg (ATSDR 1992).

Groundwater and river water from areas with known 1,2-dibromoethane contamination have been used to flood cranberry bogs for irrigation. 1,2-Dibromoethane was found at concentrations of 0.04 to 0.15 µg/kg in cranberry fruits exposed to 1,2-dibromoethane-contaminated water; however, the authors concluded that most of the contamination seemed to be associated with the water on the crop and not with the flesh of the fruit (Xia and Rice 2001). In the U.S. Food and Drug Administration's Total Diet Study, 1,2-dibromoethane was found in 1 of 40 samples of sweet pickles at a concentration of 0.013 mg/kg (13 µg/kg) (FDA 2006). In Greece, where 1,2-dibromoethane has been used as a fumigant for the wax moth that attacks honey combs, it was found in 2 of 25 samples of honey from treated hives, at concentrations of 12 and 75 µg/kg (Tananaki *et al.* 2005). EPA estimated the maximum daily intake of 1,2-dibromoethane from food to be 0.09 µg/kg (ATSDR 1992).

The National Occupational Exposure Survey (conducted from 1981 to 1983) estimated that about 8,500 workers, including about 800 women, potentially were exposed to 1,2-dibromoethane (NIOSH 1990). Eight facilities requested that the National Institute for Occupational Safety and Health make health hazard evaluation studies of their workplaces to investigate potential exposure to 1,2-dibromoethane. 1,2-Dibromoethane was detected in the air at five workplaces (White and Lybarger 1977, Markel 1980, Okawa 1980, Arenholz 1983, Thorburn and Gunter 1983). At four workplaces, personal protective equipment was recommended, even though the air concentration in two workplaces was below the OSHA limit. In the fifth workplace, no toxic effects on workers were found, and no changes to work practices were recommended.

Regulations

Coast Guard (Dept. of Homeland Security)

Minimum requirements have been established for safe transport of 1,2-dibromoethane on ships and barges.

Department of Transportation (DOT)

1,2-Dibromoethane is considered a hazardous material, and special requirements have been set for marking, labeling, and transporting this material.

Environmental Protection Agency (EPA)

Clean Air Act

National Emission Standards for Hazardous Air Pollutants: Listed as a hazardous air pollutant.
New Source Performance Standards: Manufacture of 1,2-dibromoethane is subject to certain provisions for the control of volatile organic compound emissions.
Urban Air Toxics Strategy: Identified as one of 33 hazardous air pollutants that present the greatest threat to public health in urban areas.

Clean Water Act

Designated a hazardous substance.

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable quantity (RQ) = 1 lb.

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements.

Federal Insecticide, Fungicide, and Rodenticide Act

All registrations with 1,2-dibromoethane as the active ingredient have been cancelled.

Resource Conservation and Recovery Act

Listed Hazardous Waste: Waste codes for which the listing is based wholly or partly on the presence of 1,2-dibromoethane = U067, K117, K118, K136.
Listed as a hazardous constituent of waste.

Safe Drinking Water Act

Maximum contaminant level (MCL) = 0.00005 mg/L.

Food and Drug Administration (FDA, an HHS agency)

Action levels for 1,2-dibromoethane in food and animal feed range from 30 to 150 ppb.
Maximum permissible level in bottled water = 0.00005 mg/L.

Occupational Safety and Health Administration (OSHA, Dept. of Labor)

While this section accurately identifies OSHA's legally enforceable PELs for this substance in 2018, specific PELs may not reflect the more current studies and may not adequately protect workers.
Permissible exposure limit (PEL) = 20 ppm.
Ceiling concentration = 30 ppm.
Acceptable peak exposure = 50 ppm (maximum duration = 5 min).

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Potential for dermal absorption.

National Institute for Occupational Safety and Health (NIOSH, CDC, HHS)

Recommended exposure limit (time-weighted-average workday) = 0.045 ppm.
Ceiling recommended exposure limit = 0.13 ppm (15-min exposure).
Immediately dangerous to life and health (IDLH) limit = 100 ppm.
Listed as a potential occupational carcinogen.

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