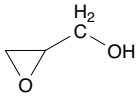
Glycidol

CAS No. 556-52-5

Reasonably anticipated to be a human carcinogen

First listed in the *Seventh Annual Report on Carcinogens* (1994)



Carcinogenicity

Glycidol is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

Oral exposure to glycidol caused tumors at many different tissue sites in mice and rats. Administration of glycidol by stomach tube increased the incidences of benign and/or malignant tumors of the mammary gland (adenoma, fibroadenoma, or adenocarcinoma) in rats of both sexes and female mice, the forestomach (papilloma or carcinoma) in rats of both sexes and male mice, the thyroid gland (follicular-cell adenoma or carcinoma) and the brain (glioma) in rats of both sexes, the Harderian gland (adenoma or adenocarcinoma) in mice of both sexes, and the skin (squamous-cell papilloma or carcinoma, basal-cell tumors, or sebaceous-gland adenoma or adenocarcinoma) in mice of both sexes and male rats. Also observed in rats were cancer of the Zymbal gland (carcinoma) and testis (mesothelioma of the tunica vaginalis) and intestinal tumors (adenomatous polyps or adenocarcinoma) in males and tumors of the mammary gland (fibroadenoma or adenocarcinoma), oral cavity (papilloma or carcinoma), and clitoral gland (adenoma, adenocarcinoma, or carcinoma) in females. In mice, oral exposure to glycidol also caused cancer of the uterus (carcinoma or adenocarcinoma) and subcutaneous tissue (sarcoma or fibrosarcoma) in females and tumors of the lung (alveolar/bronchiolar adenoma or carcinoma) and the liver (mainly carcinoma) in males (NTP 1990, IARC 2000). Also possibly releated to glycidol exposure were cancer of the glandular stomach (fibrosarcoma) in female rats and cancer of the urinary bladder (carcinoma) and testis (sarcoma of the epididymis) in male mice.

Cancer Studies in Humans

No epidemiological studies were identified that evaluated the relationship between human cancer and exposure specifically to glycidol.

Properties

Glycidol is an epoxide alcohol that is a colorless, slightly viscous liquid at room temperature (IARC 2000). It is miscible with water, alcohols, esters, ketones, ethers, and aromatics and almost insoluble in aliphatic hydrocarbons. Glycidol may decompose upon exposure to moisture (Akron 2009). Physical and chemical properties of glycidol are listed in the following table.

Property	Information
Molecular weight	74.1[a]
Specific gravity	1.115 at 20°C/4°C[a]
Boiling point	160°C at 760 mm Hg[a]
Log K_{ow}	–0.95[b]
Water solubility	1000 g/L at 20°C[b]
Vapor pressure	0.9 mm Hg at 25°C[a]
Vapor density relative to air	2.15[a]

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

Use

Glycidol is a member of a class of chiral molecules that are important intermediates in the industrial synthesis of pharmaceutical products and other biologically active substances and in production of flavoring and sweetening agents and insecticides. It has been used in the pharmaceutical industry since the 1970s; before then, it was used solely for research purposes (Sharpless 2001). Glycidol is used as a stabilizer in the manufacture of vinyl polymers and natural oils and as an intermediate in the synthesis of glycerol, glycidyl ethers, and amines. It is also used as an alkylating agent, demulsifier, and dye-leveling agent and for sterilizing milk of magnesia (IARC 2000, HSDB 2009). The glycidol structure is present in two commercially important groups of derivatives, glycidyl ethers and glycidyl esters, neither of which is prepared directly from glycidol (NTP 1990).

Production

In 2009, glycidol was produced by one manufacturer each in the United States and East Asia (SRI 2009) and was available from 19 suppliers, including 12 U.S. suppliers (ChemSources 2009). No data on U.S. imports or exports of glycidol were found. Reports filed from 1986 through 1998 under the U.S. Environmental Protection Agency's Toxic Substances Control Act Inventory Update Rule indicated that U.S. production plus imports of glycidol totaled 10,000 to 500,000 lb; no reports were filed in 2002. In 2006, the reported quantity was over 500,000 lb (EPA 2009).

Exposure

The primary routes of potential human exposure to glycidol are inhalation, eye and dermal contact, and ingestion. Heating causes the dehydration of glycol configurations in glycerol and sugars to form glycidol; however, the quantities formed during cooking are assumed to be low (Hindso Landin *et al.* 2000). Glycidol is a metabolite of 3-monochloropropane-1,2-diol (Jones 1975), a chloropropanol found in many foods and food ingredients, including soy sauce and hydrolyzed vegetable protein (Huang *et al.* 2005, Retho and Blanchard 2005). Glycidol was detected in the urine of rats exposed to 1-bromopropane by inhalation (Ishidao *et al.* 2002). Occupational exposure to glycidol could occur through inhalation. The National Occupational Exposure Survey (conducted from 1981 to 1983) estimated that 4,872 workers (in 88 facilities and 10 occupations in the Chemicals, Allied Products and Fabricated Metal Products industries), including 580 women, potentially were exposed to glycidol (NIOSH 1990).

Regulations

Occupational Safety and Health Administration (OSHA)

While this section accurately identifies OSHA's legally enforceable PELs for this substance in 2010, specific PELs may not reflect the more current studies and may not adequately protect workers.
Permissible exposure limit (PEL) = 50 ppm (150 mg/m^3).

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit value – time-weighted average (TLV-TWA) = 2 ppm.

National Institute for Occupational Safety and Health (NIOSH)

Recommended exposure limit (REL) = 25 ppm (75 mg/m^3).
Immediately dangerous to life and health (IDLH) limit = 150 ppm.

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