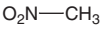
Nitromethane
CAS No. 75-52-5

Reasonably anticipated to be a human carcinogen
First Listed in the *Eleventh Report on Carcinogens* (2004)



Carcinogenicity

Nitromethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals. When administered by inhalation, nitromethane significantly increased the combined incidences of benign and malignant tumors at three tissue sites in mice and at a different tissue site in rats. In mice, nitromethane caused harderian gland and lung tumors in both sexes and liver tumors in females. In rats, nitromethane caused mammary-gland tumors in female F344/N rats but did not cause any increased tumors in Long-Evans rats (exposed to lower levels) (NTP 1997). The International Agency for Research on Cancer (2000) also has concluded that there was sufficient evidence for the carcinogenicity of nitromethane in experimental animals.

No studies evaluating the carcinogenicity of nitromethane in humans were found in the published literature.

Additional Information Relevant to Carcinogenicity

The mechanism by which nitromethane causes cancer is not known. Nitromethane did not cause mutations in bacteria and does not appear to cause genetic damage in mammalian test systems. In cultured mammalian cells, nitromethane did not cause chromosomal aberrations (changes in chromosome structure or number), sister chromatid exchange, or micronucleus formation (a sign of chromosome damage or loss). Inhalation exposure of mice to nitromethane did not cause micronucleus formation in the erythrocytes (red blood cells), in either bone marrow or peripheral (circulating) blood (IARC 2000). In cultured Syrian hamster embryo cells, nitromethane induced cell transformation (a step in tumor formation) (Kerckaert *et al.* 1996, NTP 2002).

Nitromethane appears to be absorbed by inhalation; the available data suggest that dermal absorption is negligible. Metabolism of nitromethane by experimental animals *in vivo* has not been characterized. Metabolism of nitromethane by liver microsomes from Fischer 344 rats resulted in formation of only trace amounts of formaldehyde (IARC 2000).

Properties

Nitromethane is a nitroparaffin with a molecular weight of 61.0. It is a colorless, oily liquid with a moderately strong, disagreeable odor. Nitromethane melts at -28.5°C and boils at 101.1°C. It is highly flammable (with a flash point of 35°C) and reacts with alkalis, strong acids, oxidizers, and metallic oxides. It can form an explosive sodium salt that ignites on contact with water. Nitromethane has a vapor pressure of 27.8 mm Hg at 20°C and a vapor density of 2.1. It is slightly soluble in water (95 mL/L at 20°C), acetone, carbon tetrachloride, ethanol, and diethyl ether, and reported log octanol-water partition coefficients are -0.35 and 0.17. Nitromethane slowly corrodes steel and copper when they are wet. The hazardous decomposition products of nitromethane are toxic fumes of nitrogen oxides (IARC 2000, HSDB 2003).

Use

Most of the nitromethane produced in the United States (85% to 90%) is used in the synthesis of nitromethane derivatives used as pharmaceuticals, agricultural soil fumigants, and industrial antimicrobials (Markofsky 1991, Angus 2001). Nitromethane also is used as a fuel or fuel additive with methanol in racing cars, boats, and model engines. It formerly was used in the explosives industry as a component in a binary explosive formulation with ammonium nitrate and in shaped charges, and it was used as a chemical stabilizer to prevent decomposition of various halogenated hydrocarbons (NTP 1997, IARC 2000, Angus 2001).

Production

Nitromethane is produced commercially by high-temperature vapor-phase nitration of propane, a reaction that also yields nitroethane, 1-nitropropane, and 2-nitropropane. Domestic production is about 16 million pounds (7,300 metric tons) per year from one producer (Angus 2001). In 2003, 19 U.S. suppliers of nitromethane were reported (ChemSources 2003).

Exposure

Nitromethane has been detected in air, surface water, and drinking water (NTP 1997, IARC 2000). The general population may be exposed by inhalation of nitromethane in motor vehicle exhaust and cigarette smoke. In a simulated city driving study, estimated concentrations of nitromethane in motor vehicle exhaust ranged from less than 0.8 to 5.0 ppm, depending on the conditions (Angus 2001). Nitromethane also may be released into air and wastewater during manufacture of the explosives RDX (Royal Demolition Explosive) and HMX (High Melting Explosive) widely used in the military. Maximum ground-level concentrations of nitromethane in air at three locations on the boundary of an ammunition plant were 0.21, 2.0, and 2.0 mg/m^3 (HSDB 2003, IARC 2000). Nitromethane was identified, but not quantified, as a pollutant in drinking water in two of five cities (Philadelphia, PA, and Cincinnati, OH) tested in a 1975 United States Environmental Protection Agency survey (HSDB 2003). People also may be exposed to nitromethane through skin contact with, or accidental ingestion of, methanol-nitromethane fuel mixtures. However, products containing nitromethane are not widely used by consumers (IARC 2000).

Workers may be exposed to nitromethane by inhalation of vapors or by skin contact during its production, use, or disposal. From 1981 through 1983, approximately 135,000 male and 46,500 female workers in the United States potentially were exposed to nitromethane (NTP 1997, NIOSH1990). In addition, some workers may have been exposed to nitromethane in the past through exposure to other chemicals (such as 1,1,1-trichloroethane) containing nitromethane as an additive or contaminant (Henschler *et al.* 1980).

Regulations

DOT

Nitromethane is considered a hazardous material and special requirements have been set for marking, labeling, and transporting this material

EPA

Clean Air Act

NSPS: Manufacture of substance is subject to certain provisions for the control of Volatile Organic Compound (VOC) emissions

OSHA

Permissible Exposure Limit (PEL) = 100 ppm (250 mg/m^3)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 20 ppm

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 750 ppm

REFERENCES

Angus. 2001. M.A. Henning, Angus Chemical Company, Buffalo Grove, IL letter to Dr. C.W. Jameson, National Toxicology Program, Research Triangle Park, NC, September 20, 2001. http://ntp-server.niehs.nih.gov/newhomeroc/roc11nitromethane.html.

ChemSources. 2003. Nitromethane. Chemical Sources International, Inc. http://www.chemsources.com and search CAS number 75-52-5.

Henschler, D., D. Reichert and M. Metzler. 1980. Identification of potential carcinogens in technical grade 1,1,1-trichloroethane. Int Arch Occup Environ Health 47(3): 263-8.

HSDB. 2003. Hazardous Substances Database. Nitromethane. National Library of Medicine. Last updated: 2/14/03. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB and search CAS number. Last

accessed: 1/29/04.
IARC. 2000. Some Industrial Chemicals. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 77. Lyon, France: International Agency for Research on Cancer. 529 pp.
Kerckaert, G. A., R. Brauninger, R. A. Leboeuf and R. J. Isfort. 1996. Use of the Syrian hamster embryo cell transformation assay for carcinogenicity prediction of chemicals currently being tested by the National Toxicology Program in rodent bioassays. Environ Health Perspect 104 Suppl 5: 1075-1084.
Markofsky, S. B. 1991. Nitro Compounds, Aliphatic. In Ullmann's Encyclopedia of Chemical Technology, 5th rev. ed., vol. A17. B. Elvers, S. Hawkins and G. Schulz, eds. New York: VCH Publishers. pp. 401-409.
NIOSH.1990. National Occupational Exposure Survey (NOES) (1981-83). Unpublished provisional data as of 7/1/90, Cincinnati, OH. http://www.cdc.gov/noes/noes3/empl002.html.
NTP. 1997. Toxicology and Carcinogenesis Studies of Nitromethane in F344/N Rats and B6C3F1 Mice (Inhalation Studies). Technical Report Series No 461. Research Triangle Park, NC: National Toxicology Program.
NTP. 2002. Report on Carcinogens Background Document for Nitromethane. National Toxicology Program. http://ntp-server.niehs.nih.gov/newhomeroc/roc11/NitromethanePub.pdf