

Furfural

Furfural is used as a chemical intermediate, a solvent in petroleum refining and other industries, a constituent of rubber cement, a weed killer, a fungicide, and a flavoring agent. Furfural occurs naturally in some fruits and vegetables. It can be formed in other foods during cooking, and is present in wood smoke. Because of the many industrial and consumer uses, as well as the presence of this chemical in some foods and in wood smoke, the general public and workers in a variety of occupations are exposed to furfural.

Furfural passed the animal data screen, underwent a preliminary toxicological evaluation, and is being brought to the Carcinogen Identification Committee for consultation. This is a compilation of the relevant studies identified during the preliminary toxicological evaluation.

Epidemiological data

No cancer epidemiology studies were identified.

Animal carcinogenicity data

- 103-week gavage studies
 - Male and female B6C3F₁ mice: NTP (1990)
 - *Increases in hepatocellular adenomas and carcinomas (combined) (by pairwise comparison and trend) and occurrence of rare renal cortical adenomas or carcinomas in males*
 - *Increases in hepatocellular adenomas and forestomach squamous cell papillomas (by pairwise comparison and trend) in females*
 - Male and female F344/N rats: NTP (1990)
 - *Occurrence of rare cholangiocarcinomas in males*
 - *No treatment-related tumor findings in females*
- Initiation study in female CD-1 mice
 - Dermal application of furfural as initiator twice per week for 5 weeks, followed by dermal application of promoter (12-O-tetradecanoylphorbol 13-acetate) twice per week for 47 weeks: Miyakawa *et al.* (1991)
 - *Increases in skin squamous cell papilloma and carcinoma*

Co-carcinogenicity studies in hamsters

- Long-term inhalation of furfural and repeated intratracheal installation of benzo[a]pyrene or N-nitrosodiethylamine: Feron and Krusysse (1978), as described in IARC (1995, p. 417)
 - *No co-carcinogenic effects observed*
- Repeated simultaneous intratracheal installations of furfural and benzo[a]pyrene: Feron (1972), as described in IARC (1995, p. 417)
 - *Slight co-carcinogenic effects on respiratory tract*

Other relevant data

- Genotoxicity
 - DNA-protein cross-link formation in Burkitt lymphoma cells: (*positive*): Kuykendall *et al.* (2007)
 - Review: IARC (1995, pp. 420-423)
 - Destabilization of calf thymus DNA secondary structure and DNA strand break formation *in vitro* (*positive*)
 - *Salmonella* TA100 reverse mutation assay (*positive and negative*)
 - *Salmonella* reverse mutation assays, multiple strains (*negative*)
 - *Drosophila melanogaster* sex-linked recessive lethal mutation assays (*positive and negative*)
 - *Drosophila melanogaster* heritable translocation assay (*negative*)
 - Mouse lymphoma cell mutation assay (*positive*)
 - Sister chromatid exchange (SCE) in Chinese hamster ovary (CHO) cells and human lymphocytes *in vitro* (*positive*)
 - Chromosomal aberrations in CHO cells and Chinese hamster V79 cells *in vitro* (*positive*)
 - SCE and chromosomal aberrations in mouse bone marrow cells *in vivo* (*negative*)

Review

- IARC (1995)

References¹

International Agency for Research on Cancer (IARC, 1995). *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Dry*

¹ Excerpts or the complete publication have been provided to members of the Carcinogen Identification Committee, in the order in which they are discussed in this document.

Cleaning, Some Chlorinated Solvents and Other Industrial Chemicals, Vol. 63. IARC, World Health Organization, Lyon, France. Pp. 409-429.

Kuykendall JR, Jarvi EJ, Finley BL, Paustenbach J. (2007) DNA-protein cross-link formation in Burkitt lymphoma cells cultured with benzaldehyde and the sedative paraldehyde. *Drug Chem Toxicol* **30**:1-16.

Miyakawa Y, Nishi Y, Kato K, Sato H, Takahashi M, Hayashi Y (1991). Initiating activity of eight pyrolysates of carbohydrates in a two-stage mouse skin tumorigenesis model. *Carcinogenesis* **12**:1169-73.

National Toxicology Program (NTP, 1990). *NTP Technical Report on the Toxicology and Carcinogenesis studies of Furfural (CAS No. 98-01-1) in F344/N rats and B6C3F₁ mice (Gavage Study)*. ISS NTP-TR-382. NIH Publication No. 90-2837 U.S. DHHS, NIH, Bethesda MD.