

# Brief Review of Formaldehyde

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This is a brief review of formaldehyde (FA). For further information, see Toxicological Profile for Formaldehyde, US Department of Health & Human Services, Agency for Toxic Substances and Disease Registry, Division of Toxicology/Toxicology Information Branch, Atlanta, GA. However, I caution that this document is not complete. The reviewers have missed key English and foreign literature regarding embryo toxicity and mitochondrial damage.

FA is a gas at room temperature. It is a single carbon aldehyde that plays a key role in single carbon metabolism. Recently, it has been recognized that FA is important in the methylglyoxal cycle, which is formed from glyceraldehydes-3-phosphate. FA is highly reactive. It chemically reacts with biological molecules: amino acids; nucleosides; nucleotides; DNA, proteins and forms DNA-protein cross links. Thus, it is recognized as a mutagen and a probable human carcinogen.

The following occupational exposure levels have been set: OSHA TWA = 0.75 ppm (action level of 0.5 ppm and a STEL of 2 ppm); ACGIH TLV = 0.3 ppm; NIOSH REL = 0.016 ppm (0.1 ppm ceiling). OSHA and ACGIH standards apply to the work place, adult male. These standards do not apply to the home environment. Neither are they applicable to the elderly, the young and those with pre-existing health problems.

FA is toxic to humans and animals. It is irritating to the eyes, nose and upper respiratory tract. It has been shown to cause both irritation and allergic contact dermatitis. It can aggravate existing lung disease (asthma, emphysema, etc.). Asthma caused by FA is rare, but does occur. Antibodies to FA have been demonstrated in the blood of individuals exposed by inhalation and FA-treated kidney dialysis membranes. Other toxic effects of FA in humans are:

**Immune System:** Individuals exposed to FA in mobile homes have been shown to have alterations in their lymphocyte subsets and an increase in multiple-organ autoantibodies (lupus-like condition). Medical students in anatomy class have altered peripheral lymphocyte subsets and an increase in chromosome aberrations of peripheral lymphocytes

**Nervous System:** FA causes headaches. Measurable decrements in CNS functions in histology technicians occur as follows: memory and concentration; disturbed sleep, impaired balance, variations in mood and irritability. Individuals living in mobile homes complain of similar symptoms plus chronic fatigue.

**Reproductive:** Occupational exposure to FA is associated with reproductive problems in women. These are a decrease in fecundity and spontaneous abortions.

**Embryo Toxicity:** Studies published in England and the U.S. have shown no embryo toxic effects of FA in research animals (rats, guinea pigs). In contrast, foreign research has shown that FA crosses the placenta, enters the fetus and remains in fetal tissues longer than maternal tissues in mice. Studies on rats have shown increased rate of embryonic death, birth defects and abnormalities in fetal mitochondria. Young pups do not mature as rapidly as normal control animals. The difference between these contrasting observations is in the method of exposure. The negative studies have exposed pregnant rodents to FA beginning approximately on the 6<sup>th</sup>

day of gestation. The foreign investigations were done with two exposure scenarios. In one, females were exposed prior to mating, mated and then exposed throughout gestation. In the other, pregnant females were exposed from the 1st to 20 to 21 days of pregnancy. Both of these types of investigations showed effects on embryonic development and fetal organs (liver, lungs kidneys). The mitochondrial damage was demonstrated in fetal tissues.

**Summary:** You can be exposed to FA in your home or workplace. The sources of FA in the home are new construction materials (particle board, medium density fiber board, plywood), surface finishes, and a wide variety of consumer products. The bottom line is, if you live in a newly constructed home (framed, modular, mobile home) and are experiencing symptoms of eye irritation, chronic cough, shortness of breath, headaches, fatigue, joint and muscle aches and pain, difficulties with recent memory, loss of balance, among other symptoms have you have tested for formaldehyde. Finally, if you have had water intrusion you should test for the presence of microbial growth (molds and bacteria – see information on the complexity of the indoor environment resulting from water intrusion)