

Dichlorvos

Chemical name: *O,O*-dimethyl-*O*-2,2-dichlorovinyl phosphate

CAS: 62-73-7

MF: C₄H₇Cl₂O₄P

MW: 220.98

Log K_{ow}= 1.16.

Solubility: about 1% in water (10g/l), and 3% in kerosene and mineral oils [1].

Major uses

Dichlorvos is an organophosphate insecticide that is used in crop and food storage areas, green houses, barns, in workplaces and in the home. Veterinaries use dichlorvos to control parasites on pets [1].

Human toxicity

Dichlorvos has high to extreme acute toxicity from oral or dermal exposure, and extreme acute toxicity from inhalation.

The major effect of dichlorvos is on the central nervous system (CNS). Ingesting large doses may cause nausea and vomiting, restlessness, sweating, and muscle tremors. Very large doses may cause coma, inability to breathe, and death [2].

The lowest lethal inhalation dose of dichlorvos for humans is 1 mg/m³ [2].

The probable lethal oral dose is between 50 and 500 mg/kg [2].

Dichlorvos is generally undetectable in the blood and tissues because of its rapid degradation. However, plasma and red blood cells cholinesterase activity may be determined, because dichlorvos and nearly all organophosphates decrease the activity of either plasma pseudocholinesterase or erythrocytes acetylcholinesterase, or both (reviewed in [2]).

TLV-TWA is 0.1 mg/m³ [2].

Carcinogenicity: Probable human carcinogen, group B2 (EPA, 2000). No information is available on the carcinogenic effects in humans.

In 1995, EPA proposed cancellation of dichlorvos for all home uses, and for many commercial and industrial uses [2].

Kinetic data

Human data are insufficient.

Dichlorvos is generally undetectable in the blood and tissues because of its rapid degradation. Plasma so called “pseudocholinesterase” and erythrocyte acetylcholinesterase levels seems to be a more sensitive index of exposure, indicating kinetics of the recovery.

The peak plasma level of dichlorvos was 542.3 ± 193.6 ng/ml after acute oral administration of 7.5 mg/kg metrifonate, in three patients with Alzheimer disease. Metrifonate is metabolized in vivo to dichlorvos. The sensitive high-performance

liquid chromatographic (HPLC) method using UV-detection was used for determination of dichlorvos och metrifonate [3].

The half-life for disappearance of dichlorvos in the rat kidney was 13.5 min after exposure of 50 mg/kg [1].

Metabolism and excretion

Dichlorvos is rapidly metabolized by enzymes in the skin, lung, liver, intestine, kidney, heart, skeletal muscles, brain and blood. The metabolites were only about 1 to 10% as toxic as the parent compound in mice [1].

The main routes of metabolism involve hydrolysis and demethylation, although hydrolysis is a main route. The main metabolites of hydrolysis are *O,O*-dimethyl phosphate and dichloroacetaldehyde. Dimethyl phosphate is excreted unchanged, and dichloroacetaldehyde is rapidly degraded and is not detected in the tissues. The demethylation is glutathione-dependent, and the product is demethyl-dichlorvos (*O*-methyl-*O*-2,2-dichlorovinyl phosphate). The latter is further metabolized and excreted as methylcysteine derivatives and carbon dioxide [1,3].

Metabolites of dichlorvos are excreted in the urine and feces [1].

Toxicological mechanisms

Dichlorvos binds irreversibly to acetylcholinesterase, leading to its inhibition. It results in the accumulation of endogenous acetylcholine in nerve tissue and effector organs with consequent signs and symptoms that mimic the muscarinic, nicotinic, and CNS action of acetylcholine. Accumulation of acetylcholine is believed to be responsible for the toxic effects described above.

The immediate cause of death in fatal dichlorvos poisoning is a respiratory failure connecting with the muscarinic action (increased bronchial secretion), nicotinic action leading to paralysis of the respiratory muscles, and the CNS action of depression and paralysis of the respiratory center in the brain [4].

Target organ: CNS.

References

1. Handbook of Pesticide Toxicology (1991). Hayes WJ, Laws ER, eds. V. 2, pp. 990-1000. Academic Press, Inc. San Diego, CA.
2. Poisindex, Thomson Micromedex (2005).
3. Unni,L.K.,Hannant,M.E., Becker, R.E. (1992) High-performance liquid chromatographic method using ultraviolet detection for measuring metrifonate and dichlorvos levels in human plasma. J chromatogr 573, 99-103.
4. Casarett and Doull's Toxicology (1986). Claassen, C.D., Amdur, M.O, Doull, J. eds., 3rd ed., Macmillan Publishing Company, New York.

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