Parathion

Chemical name: *O,O*-diethyl-*O*-(4-nitrophenyl)phosphorothioate
Synonyms: ethyl parathion, DNTP
CAS: 56-38-2
MF: $C_{10}H_{14}NO_5PS$
MW: 291.27
Log Kow=3.15±0.27
Solubility: poorly soluble in water (12.4±0.7 mg/l at 25°C); freely soluble in alcohols, esters, aromatic hydrocarbons and chloroform, generally, completely miscible with most organic solvents.

Major use
Parathion is a non-systemic organophosphate insecticide. It is widely used in agriculture to control sucking and chewing insects on fruit, vines, hops, cotton, and field crops [1, 2].

Human toxicity
Parathion is one of the most toxic organophosphates. Fatal human overdose occurred by ingestion, inhalation, eye, and dermal route. Oral doses in the range of 120 to 900 mg have been fatal; however, three individuals have survived much higher reported doses in the range of 20 to 40 g [1]. The lowest published lethal dose for a human was 0.171 mg/kg by the oral route [3].

The estimated minimum lethal oral dose ranges from less than 10 mg to 120 mg [1].

Plasma levels of parathion in fatal cases have been in the range of 0.5-34 mg/l [4].

Parathion depresses activity of either plasma pseudocholinesterase (ChE) or red blood cell acetylcholinesterase (AChE). Plasma ChE levels appears to be a sensitive index of exposure and may be better correlated with clinical effects then blood concentrations.

Among poisoning symptoms, the central nervous system (CNS) and peripheral nervous system (PNS) depression, cardiac and respiratory depression, dispnea, cramps, weakness, nausea, vomiting, miosis, headache, and coma were reported. Symptoms may be delayed up to 12 h [1, 2].

In the workplaces, an acceptable operator exposure level (AOEL) established from the short-term study in human volunteers is 0.006 mg/kg/day [2].

Carcinogenicity: category 3 (IARC, 2004). This category is used for agents for which the evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals.

Kinetic data
Human data on toxicokinetics are limited.
Absorption: parathion can be efficiently absorbed through any route of exposure.

Distribution: parathion is preferentially concentrated in neutral fat [5].

Elimination half-life was 2.1 days [1].

Metabolism and excretion
Parathion is desulfurised, and its oxygen analog (S is substituted for O) paraoxon-ethyl is formed [5]. This toxic metabolite is responsible for the cholinesterase inhibiting properties of parathion. Parathion can be also dealkylated; moreover, nitro-group can be reduced and aminoparathion is formed. All these reactions take place mainly in the liver, where microsomal enzymes play an important role for the formation of paraoxon-ethyl. Further, parathion and paraoxon-ethyl may be hydrolyzed to hydrophilic less toxic compounds with help of carboxyesterase [2, 6].

Another metabolites of parathion are monoethylphosphate (in blood and urine) and diethylphosphate (in blood) [4, 7]. Diethyl phosphate is a most sensitive indicator of dangerous exposure to parathion [8].

Excretion: Metabolites (see above) are excreted solely in the urine [4].

Toxicological mechanism
Parathion is an inhibitor of an acetylcholinesterase of nerve tissues. Consequently, acetylcholine is accumulated in the CNS, resulting in diverse effects ranging from emotional instability and neurosis to seizures, and coma. In most cases, the immediate cause of death is asphyxia (inability to breath and suffocation) following paralysis of respiratory centre in the brain [6].

Target organs: CNS, PNS.

References
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