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# Methoxychlor

## Guideline

*The maximum acceptable concentration (MAC) for methoxychlor in drinking water is 0.9 mg/L (900 µg/L).*

## Identity, Use and Sources in the Environment

Methoxychlor ($c_{16}h_{15}cl_3o_2$) Is An Organochlorine Insecticide Used In The Control Of Livestock Parasites And A Variety Of Pests On Ornamentals, Fruits And Vegetables. Less Than 10 000 Kg Are Used Annually In Canada.[1]

Methoxychlor has a very low vapour pressure and low solubility in water (0.1 mg/L at 25°C).[2] Reported log octanol–water partition coefficients range from 3.05 to 4.30, indicating that methoxychlor has the potential to bioaccumulate; however, significant and persistent accumulation has not been demonstrated in laboratory studies.[3]

Methoxychlor released to the soil is likely to remain in the top layer as a result of its low solubility in water. Under anaerobic conditions, methoxychlor is biodegraded to dechlorinated methoxychlor and the mono- and dihydroxy derivatives of methoxychlor and dechlorinated methoxychlor; under aerobic conditions, biodegradation may be minimal. Biodegradation may also occur under anaerobic conditions in aquatic systems. Methoxychlor may adsorb to suspended solids and sediments in the water; oxidation and chemical hydrolysis are not expected to occur to a significant degree.[4] The half-life of methoxychlor in water is reported to be about 46 days.[5]

## Exposure

Methoxychlor was detected only once (in trace amounts, in Ontario) out of 984 samples of municipal and private water supplies from Prince Edward Island (1985–86), Toronto (1971–82), Ontario (1985–86), Manitoba (1986), Saskatchewan (1985) and Alberta (1978–85) (detection limits ranged from 0.005 to 10 µg/L).[6] It was not detected in 2431 surface water samples from the eastern provinces (1979–81), Ontario (1975–77), Manitoba (1983–84) and the Prairies (1971–77) (reported detection limits ranged from 0.01 to 0.05 µg/L).[6]

The theoretical maximum daily intake of methoxychlor from food is 5.7 mg/d, based on the pesticide tolerance limits set by the Food Directorate of the Department of National Health and Welfare.[7] Actual intake is estimated to be much lower—98 ng/d for an adult male.[8] Methoxychlor was detected only once (2.0 ppm) in 6391 samples of domestic foods analysed in the United States from 1981 to 1986 (detection limit not reported).[9]

## Analytical Methods and Treatment Technology

The concentration of methoxychlor in water may be determined by gas chromatography with electron capture detection (detection limits range from 0.002 to 5 µg/L).[10]

Coagulation/filtration reduced initial methoxychlor concentrations of 1, 5 or 10 mg/L in water by 74 to 97%, whereas softening resulted in a reduction of 48 to 97%. Granular activated carbon adsorption was 100% effective, whereas reverse osmosis removed 99 to 100%.[3]

## Health Effects

Orally administered doses of methoxychlor are rapidly absorbed and metabolized in the liver of experimental animals. In Swiss mice, 98% of an oral dose of 50 mg/kg bw of labelled methoxychlor was eliminated within 24 hours. The main metabolic pathway was O-demethylation to the monophenol—2-(p-methoxyphenol)-2-(p-hydroxyphenyl)-1,1,1-trichloroethane—and bisphenol—2,2-bis(p-hydroxyphenyl)-1,1,1-trichloroethane—and the dehydrochlorination product of the bisphenol—2,2-bis(p-hydroxyphenyl)-1,1-dichloroethylene; the metabolic products were excreted in the urine and faeces.[11] Methoxychlor was not stored in the fat of rats fed diets containing 25 ppm, but low levels were present in the fat of rats consuming 100 and 500 ppm after four

and nine weeks of treatment, respectively. Two weeks after cessation of treatment, no methoxychlor was detected in the fat.[12]

The estimated lethal oral dose for humans is approximately 6 mg/kg bw.[13] In human volunteers administered oral doses of methoxychlor of 0, 0.5, 1.0 and 2.0 mg/kg bw per day for eight weeks, there were no adverse effects on health, clinical chemistry or the morphology of the blood, bone marrow, liver, small intestine or testes.[14]

Rats (strain unspecified) fed dietary levels of methoxychlor of 1600 ppm for two years had reduced growth but no reduction of lifespan or histological changes. There were no adverse effects in animals exposed to 20 mg/kg bw per day for one year or 10 mg/kg bw per day for two years.[15] In rats (strain unspecified) exposed to dietary concentrations of 0, 10, 25, 100, 200, 500 or 2000 ppm of methoxychlor for two years, growth was retarded at 200 ppm and above. The no-observed-adverse-effect level (NOAEL) was considered to be 100 ppm, or 5 mg/kg bw per day.[16]

No significant increases in the incidence of tumours in bioassays in rats and mice have been reported.[3] The International Agency for Research on Cancer (IARC) has concluded that there is no evidence that methoxychlor is carcinogenic in animals.[13]

Methoxychlor was not mutagenic in *in vitro* microbial assays using *Salmonella typhimurium* (several strains), *Escherichia coli* WP 2 and *Saccharomyces cerevisiae* $D_3$. It was negative in the sex-linked recessive lethal assay in *Drosophila melanogaster*.[17]

Oestrogenic activity has been demonstrated for methoxychlor and its metabolites in a number of studies.[17] Methoxychlor has been found to be foetotoxic to rats at doses of 200 and 400 mg/kg bw. A dose-related increase in the incidence of wavy ribs was observed at 100, 200 and 400 mg/kg bw; this abnormality was considered to be the result of disturbed maturation rather than a teratogenic effect.[18]

## Rationale

The acceptable daily intake (ADI) of methoxychlor has been established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO)[19] as follows:

$$\text{ADI} = \frac{10 \text{ mg/kg bw per day}}{100} = 0.1 \text{ mg/kg bw per day}$$

where:
- 10 mg/kg bw per day is the NOAEL for growth retardation in rats[15]
- 100 is the uncertainty factor.

Based on the above ADI, the maximum acceptable concentration (MAC) for methoxychlor in drinking water is derived as follows:

$$\text{MAC} = \frac{0.1 \text{ mg/kg bw per day} \times 70 \text{ kg bw} \times 0.20}{1.5 \text{ L/d}} \approx 0.9 \text{ mg/L}$$

where:
- 0.1 mg/kg bw per day is the ADI established by the FAO/WHO
- 70 kg bw is the average body weight of an adult
- 0.20 is the proportion of daily intake of methoxychlor allocated to drinking water
- 1.5 L/d is the average daily consumption of drinking water by an adult.

## References


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