

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

ToxGuide™ for Pyrethrins and Pyrethroids

September 2003

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Human Services
Public Health Service
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General Populations

- The general population may be exposed to pyrethrins and pyrethroids primarily from the ingestion of foods, particularly vegetables and fruits.
- Pyrethrins and pyrethroids are insecticides for both home and commercial use.
- People can also be exposed due to inhalation of ambient air after these compounds have been used.
- Inhalation and dermal exposure can also occur when using household products that contain these chemicals.

Occupational Populations

- Occupational exposure by the inhalation and dermal routes may occur when agricultural workers apply pyrethrins and pyrethroids onto crops.
- Similar exposure may occur to workers involved in the manufacturing and production of insecticides that contain these substances.
- Veterinarians or pet groomers who frequently apply pyrethrin- and pyrethroid-containing shampoos or flea applications to animals may be exposed to these compounds through dermal routes.

Toxicokinetics

- Studies of pesticide applicators indicate that pyrethrins and pyrethroids can be absorbed through the lungs and skin. However, rates of absorption through the lungs are not known and dermal absorption appears to be minimal. Studies in volunteers suggest that more than 40-60% of an oral dose may be absorbed.
- There are no data on distribution of pyrethrins and pyrethroids in humans, but based on their lipophilic nature, will probably distribute to fatty tissues.
- Based on the analysis of metabolites in urine from exposed workers and volunteers it appears that the major metabolic pathways are hydrolysis, oxidation, and conjugation reactions.
- Water-soluble metabolic products are excreted mainly in the urine. Elimination half-time in humans range from 6.4 to 16.5 hours.

Normal Human Levels

- There are no reference values for pyrethrins and pyrethroids in the general U.S. population.

Biomarkers

- Urinary metabolites of pyrethroids are the most useful biomarkers of pyrethroid exposure.

Environmental Levels

Air

- There are no data regarding background concentration of pyrethroids in air. Air concentrations are usually in the $\mu\text{g}/\text{m}^3$ range after spraying.

Sediment and Soil

- The average concentration of the pyrethroid permethrin in soils collected from 48 agrochemical facilities throughout the state of Illinois in the early 1990s was 190 $\mu\text{g}/\text{kg}$.

Water

- Permethrin was detected in 24 of 12,253 ambient surface water samples in the U.S. at a mean concentration of 0.0137 $\mu\text{g}/\text{L}$.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological Profile for Pyrethrins and Pyrethroids. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Chemical and Physical Information

- Pyrethrins are naturally-occurring compounds that are found in pyrethrum extract from certain chrysanthemum flowers.
- Pyrethrins are often used in household insecticides and products to control insects on pets or livestock.
- Pyrethroids are synthetic esters derived from the naturally-occurring pyrethrins.
- Pyrethroids are broad-spectrum insecticides and are more toxic to insects than pyrethrins.
- More than 1,000 pyrethroids have been developed, but less than a dozen of them were in use as of 2003.
- Permethrin is the most frequently used pyrethroid in the United States.
- Technical grade pyrethrins and pyrethroids are usually mixed with carriers or solvents to produce a commercial-grade formulated product.

Routes of Exposure

- Inhalation (breathing) – Minor route of exposure for the general population. Significant route of exposure for workers who apply these pesticides onto crops.
- Oral (mouth) – The predominant route of exposure to pyrethrins and pyrethroids is via ingestion of food.
- Dermal – Minor route of exposure for the general population due to use of household products containing these substances. Predominant route of exposure for agricultural workers.

Fate in the Environment

- Pyrethrins and many pyrethroids are readily degraded (days) in air by sunlight. Certain pyrethroids, such as permethrin and cyhalothrin, are more stable to sunlight.
- Pyrethrins and pyrethroids bind strongly to soil and usually do not leach into groundwater.
- Pyrethrins and pyrethroids are biodegraded in soil and water and can undergo hydrolysis under alkaline conditions.
- These compounds are not taken up substantially by the roots of vascular plants.
- Pyrethrins and pyrethroids bioconcentrate in aquatic organisms.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No inhalation MRLs were derived for pyrethrins or pyrethroids.

Oral

- An MRL of 0.3 mg/kg/day was derived for acute-duration oral exposure to permethrin (≤ 14 days).
- An MRL of 0.02 mg/kg/day was derived for acute-duration oral exposure to cypermethrin (≤ 14 days).
- An MRL of 0.01 mg/kg/day was derived for acute-duration oral exposure to cyhalothrin (≤ 14 days).
- An MRL of 0.2 mg/kg/day was derived for intermediate-duration oral exposure to permethrin (15–364 days).
- An MRL of 0.01 mg/kg/day was derived for intermediate-duration oral exposure to cyhalothrin (15–364 days).
- No chronic-duration oral MRLs were derived for pyrethrins or pyrethroids (≥ 1 year).

Health Effects

- The main target for pyrethrins and pyrethroids is the nervous system.
- Acute inhalation or oral exposure to high levels of pyrethrins or pyrethroids may cause dizziness, headache, nausea, muscle twitching, fatigue, changes in awareness, convulsions, and loss of consciousness.
- Changes in mental state may last several days after exposure to high concentration of pyrethroids has ended.
- Chronic exposure to low-levels of pyrethrins and pyrethroids usually do not cause neurological effects in mammals, largely due to rapid metabolism and elimination.
- Dermal exposure to pyrethrins or pyrethroids may cause temporary paresthesia (sensation of tingling or numbness) limited to the area of contact.

Children's Health

- It is not known whether children differ from adults in their susceptibility to pyrethrins or pyrethroids.