

Type	Animal repellent, insect repellent and insecticide
Controls	Repels animals and insects but also kills some insects.
Mode of Action	Non-toxic mode of action - as an animal repellent it causes inflammation to lung tissue and irritates skin. In insects, capsaicin appears to disrupt metabolism, damages membranes, and can cause nervous system disfunction (Reference 2).

Thurston County Review Summary:

Capsaicin is an extract of peppers in the genus Capsicum and is used to repel animals and as an insecticide / insect repellent. Capsaicin is rated low in hazard and pesticide products containing it as a sole active ingredient pass Thurston County's pesticide review criteria.

Capsaicin is found in foods that have been eaten for centuries without any known systemic toxicity. Because of this, capsaicin is considered low in hazard for pesticidal uses and most of the EPA required toxicity data has been waived. Toxicity data that could be found was not performed for EPA pesticide registration, so, the adverse effects that were observed were not compared to the expected concentrations from pesticidal use. However, Thurston County believes that enough information is available to rate capsaicin pesticide products as low hazard because human exposures are assumed to be short in duration and relatively small compared to dietary exposures. Risk to non-target organisms is also expected to be low.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	10	2	Low
Soil Sorption (Kd=mL/g)	Value not found		
Organic Sorption (Koc=mL/g)	1,100	2	Moderate

Mobility Summary:

Capsaicin is not very soluble in water and adheres moderately to soil. The hazard to move off the site of application with water is moderate.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	"Very low"	2	High
Biotic or Aerobic Half-life (days)	2 to >14	2 and 5	Low to moderate
Abiotic Half-life (days)	No photolysis or hydrolysis	2	High
Terrestrial Field Test Half-life (days)	Value not found		
Hydrolysis Half-life (days)	Value not found		
Anaerobic Half-life (days)	Value not found		
Aquatic Field Test Half-life (days)	Value not found		

Persistence Summary:

Capsaicin is an oily resin that is not water soluble and is not expected to dissipate into the air after application. Testing with sandy loam soil estimated that capsaicin is likely to degrade to half of the applied concentration within one week, however, the study indicated that the capsaicin may have leached into the soil after application instead of breaking down (Reference 2). Another study indicated that the amount of water placed on the treated soil increased the rate of degradation and when there was no water the degradation half-life was greater than 14 days. The hazard for persistence is rated moderate (likely to take between one week and 60 days to degrade to half of the applied concentration).

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	Value not found		
Octanol/Water Partition Coefficient	log Kow = 3	2	Moderate

Bioaccumulation Summary:

The octanol / water partition coefficient of capsaicin (log Kow = 3) indicates that it binds to oil and fat and may accumulate in fish or animal tissue. Metabolism testing with rats indicates that capsaicin is quickly distributed to the blood, spinal cord tissue, kidneys and liver, however, it was not detectable in any tissue 17 hours after administration (Reference 2). The hazard for bioaccumulation is rated low.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	97.4 mg/kg	1	Moderate
Avian (LD50)	Data waived by EPA		
Honey bee or insect (LD50)	>100 ug/bee	3	Low
Annelida -worms (LC50)	Data waived by EPA		
Fish (LC50)	Data waived by EPA		
Crustacean (LC50)	Data waived by EPA		
Mollusk (LC50)	Data waived by EPA		
Amphibian (LD50 or LC50)	Data waived by EPA		

Acute Toxicity Testing and Ecotoxicity Summary:

The EPA believes that because capsaicin is such an effective repellent based on its strong irritant properties to the skin or when eaten, that exposures to non-target species would be small enough to waive exposure risk assessments (Reference1). Bird feeding studies indicate that birds do not have the ability to detect "hot" spice in their diet and were not repelled from eating a diet containing capsaicin. Capsaicinoid chemicals may be a natural defense evolved within plants to allow seed dispersal by birds (promoting dispersal and germination) while protecting them from animals and insects. The hazard and risk to fish and other aquatic organisms is unknown so, the EPA required products to contain a warning that they may be toxic to fish and to not apply them or allow them to runoff into waterbodies (Reference 1). Oral toxicity testing with honeybees indicates that it is low in toxicity (Reference 3), however it has insecticidal activity indicating that it may be toxic to other non-target beneficial insects. The hazard to non-target wildlife is rated low.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Short-term exposure risk was not evaluated						
Short-term exposure risk was not evaluated						
Short-term exposure risk was not evaluated						
Short-term exposure risk was not evaluated						

Acute Toxicity Risk Assessment Summary:

The EPA determined that the risks to humans from occupational or dietary exposures to capsaicin from pesticidal uses are negligible (Reference1). The risk is considered low because red pepper has been used as a food item without incident throughout history and is not known to cause toxicity.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Not evaluated by EPA or IARC	"Inconclusive" and "anticarcinogenic"	2 and 4	Not rated
Mutagenicity	Inhibition of xenobiotic metabolizing enzymes	"Antimutagenic"	4	Low
Neurotoxicity - (NOAEL)	NOAEL / LOAEL data not found	Stimulates pain fibers / release somatostatin	4	Not rated
Endocrine Disruption	NOAEL / LOAEL data not found	Potential hypoglycemia	4	Not rated
Developmental Toxicity (NOAEL)	NOAEL / LOAEL data not found	Delayed ossification of metatarsal bones	2	Low
Reproductive Toxicity (NOAEL)	NOAEL / LOAEL data not found	Fewer pregnancies & matings	4	Not rated
Chronic Toxicity (NOAEL)	NOAEL / LOAEL data not found			

Chronic Toxicity Hazard Summary:

Long-term toxicity testing with rodents produced weight loss or no effects at all and rabbits displayed spleen and liver toxicity although there was no determination of the Lowest Observeable Adverse Effect Level (LOAEL) or No Observeable Adverse Effect Level (NOAEL) for toxic effects (Reference 2). The evidence of carcinogenicity is inconclusive and the EPA and the International Agency on the Research of Cancer have not evaluated its carcinogenic potential (Reference 2). Review of toxicity studies compiled by the Library of Medicine states that capsaicin may have anticarcinogenic and antimutagenic properties (Reference 4). Carcinogenic potential is not rated for this review based on lack of a scientific evaluation. Reproductive and developmental toxicities were observed after maternal toxicity which is not considered either high in hazard or moderate in hazard. Endocrine system effects with test animals (not humans) suggest that it may induce hypoglycemia (Reference 4).

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Long-term exposure risks were not evaluated						
Long-term exposure risks were not evaluated						
Long-term exposure risks were not evaluated						
Long-term exposure risks were not evaluated						

Chronic Toxicity Risk Assessment Summary:

Risk assessments for the potential to cause toxicity in humans from long-term exposures to capsaicin from pesticidal uses were not required by the EPA and were not available from any other source. Long-term exposures to capsaicin is not expected from pesticidal uses and are rated low in hazard because food uses of capsaicin have not reported any toxicities and pesticidal uses are expected to be smaller than dietary exposures.

Metabolites and Degradation Products:

Capsaicin is produced by grinding red peppers to a powder and then extracting the resin by soaking it in hexane, filtering it and then evaporating the hexane leaving an oily resin. The resulting resin is not supposed to contain more than 25 parts per million hexane.

In soil, capsaicin is metabolized to vanillylamine, which is further broken down into vanillin, vanillyl alcohol and vanillic acid (Reference 2).

Comments:

Capsaicin can be a severe eye irritant and is a skin irritant (Reference 2).

References

- USEPA. Prevention, Pesticides and Toxic Substances. Reregistration Eligibility Decision (RED), Capsaicin - List D. Case 4018. June 1992.
- Gervais, J. A. ; Luukinen, B.; Buhl, K.; Stone, D. 2008. Capsaicin Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. October 2008.
- Flesar J, et al. Czech University of Life Sciences Prague. "In vitro growth-inhibitory effect of plant-derived extracts and compounds against Paenibacillus larvae and their acute oral toxicity to adult honey bees." Vet Microbiol. 2010 Sep 28;145(1-2):129-33. Epub 2010 Mar 27.
- U.S. Department of Health and Human Services, National Institutes of Health, National Library of Medicine: Bethesda, MD. Hazardous Substances Data Bank (HSDB), Capsaicin. 9/24/2003.
- Sterner, R.T., Ames, A.D., Kinball, B.A. International Biodeterioration & Biodegradation 49 (2002) 145-149. "Persistence of capsicum oleoresin in soil". 2002.