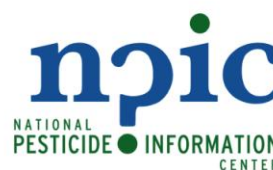


This fact sheet was created in 2002; some of the information may be out-of-date. NPIC is not planning to update this fact sheet. More pesticide fact sheets are available [here](#). Please call NPIC with any questions you have about pesticides at 800-858-7378, Monday through Friday, 7:30 am to 3:30 am PST.



NPIC Technical Fact Sheets are designed to provide information that is technical in nature for individuals with a scientific background or familiarity with the regulation of pesticides by the U.S. Environmental Protection Agency (U.S. EPA). This document is intended to be helpful to professionals and to the general public for making decisions about pesticides.

Bendiocarb

(Technical Fact Sheet)

For less technical information, please refer to the General Fact Sheet.

The Pesticide Label: Labels provide directions for the proper use of a pesticide product. *Be sure to read the entire label before using any product.* Signal words, listed below, are found on the front of each product label and indicate the product's potential hazard.

CAUTION - low toxicity

WARNING - moderate toxicity

DANGER - high toxicity

What is bendiocarb?

- Bendiocarb belongs to a class of insecticides (chemicals that kill or control insects) known as carbamates (1).
- Technical grade bendiocarb is an odorless, non-corrosive white crystalline solid (2).
- Bendiocarb was first registered in the United States in 1980. Its registration was voluntarily canceled in September 1999, and all products containing bendiocarb lost registration in December 2001. Products with canceled registrations cannot be purchased after that date, but existing stocks can still be used according to labeled directions (1).

How is bendiocarb used?

- Bendiocarb products are used in gardens, turf, soil, and ornamental plants as granular, dust, or liquid spray formulations.
- In and around the home, products with bendiocarb are formulated as dusts and sprays for spiders, wasps, ants, flies, and stored product pests.
- Bendiocarb products can also be registered for use in hotels, restaurants, warehouses, hospitals, railroad boxcars and aircraft.

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure. When pesticide products are used according to the label directions, toxic effects are not likely to occur because the amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

What are some products that contain bendiocarb?

- Ficam™
- Turcam™
- Tattoo™
- Multamat™

What is the mechanism of action for bendiocarb?

- Bendiocarb disrupts the normal functioning of an insect's nervous system and may cause toxicity by either contact or ingestion (3).
- The chemical neurotransmitter acetylcholine is released to relay nervous system signals across the nerve synapse. Acetylcholinesterase is the enzyme responsible for breaking down this neurotransmitter once it is released into the synapse and is necessary for proper nerve function. When the enzyme is inhibited, acetylcholine accumulates, resulting in nervous system overstimulation (4).
- Bendiocarb disrupts the nervous system by adding a carbamyl moiety to the active site of the acetylcholinesterase enzyme. This prevents acetylcholine from reaching the active site and renders the enzyme inactive. However, the carbamyl group is released by spontaneous hydrolysis, thus reversing the disruption and restoring activity (5, 6).

LD50/LC50: A common measure of acute toxicity is the lethal dose (LD50) or lethal concentration (LC50) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD50 is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC50 is often expressed as mg of chemical per volume (e.g., liter (l)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD50/LC50 is small and practically non-toxic when the value is large. However, the LD50/LC50 does not reflect any effects from long-term exposure (i.e., cancer, birth defects, or reproductive toxicity) that may occur at levels below those that cause death.

What is the acute toxicity of bendiocarb?

Oral

- Bendiocarb is moderately to highly toxic to both male and female rats when ingested. The oral LD50 in male and female rats ranges from 34 mg/kg to 156 mg/kg (7). See boxes on **Laboratory Testing, LD50, and Toxicity Category**.
- Ingested bendiocarb is highly toxic to guinea pigs. The acute oral LD50 in guinea pigs is 35 mg/kg (7).
- Bendiocarb is also highly toxic to rabbits by ingestion. The acute oral LD50 in rabbits ranges from 35-40 mg/kg (7).
- In one test, female beagles were given high doses orally and recovered in 24-25 hours with no side-effects (7).

Dermal

- Bendiocarb applied to the skin of rats is moderately toxic. The dermal LD50 ranges from 566 to 800 mg/kg for male and female rats (7).

Signs of Toxicity - Animals

- Signs of bendiocarb poisoning may include behavioral changes, excessive tearing and salivation, muscle tremors, twitching, vomiting, and diarrhea. Severe intoxications can result in paralysis and death (6).
- Cats are typically more sensitive to the effects of bendiocarb than dogs (6).

Signs of Toxicity - Humans

- Early symptoms associated with bendiocarb exposure may include headache, malaise, muscle weakness, nausea, gastrointestinal cramps, sweating, and restlessness (4, 5).

Toxicity Category

	High Toxicity (Danger)	Moderate Toxicity (Warning)	Low Toxicity (Caution)	Very Low Toxicity (Caution)
Oral LD50	Less than 50 mg/kg	50 - 500 mg/kg	500 - 5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200 - 2000 mg/kg	2000 - 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50 - 4hr	Less than 0.05 mg/l	0.05 - 0.5 mg/l	0.5 - 2 mg/l	Greater than 2 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible within 7 days	Minimal effects, gone within 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Labeling
<http://www.epa.gov/oppfod01/labeling/lrm/chap-07.pdf> (17).

- Bendiocarb intoxication may lead to pin-point pupils, tearing, excessive salivation, nasal discharge, vomiting, diarrhea, muscle twitching, and ataxia. Severe poisonings can result in convulsions, CNS depression, coma, and death (4, 5).
- The red blood cell cholinesterase test may be able to document an acute bendiocarb poisoning if administered immediately after exposure, but it may be misleading due to the rapid regeneration of the affected enzyme. Also, urine can be analyzed for unique breakdown products of bendiocarb to assess exposure (5).

Is bendiocarb a carcinogen?

Animals

- Mice fed diets containing either 50, 250, or 1250 ppm bendiocarb did not show any significant increases in tumors over the control animals (7). See **Cancer** box.
- Rats fed diets containing 2, 20, or 200 ppm bendiocarb for 104 weeks showed a dose-dependent increase in lymphoreticular tumors. Only the highest dose produced a statistically significant effect (7).

Cancer: The U.S. EPA has strict guidelines that require testing of pesticides for their potential to cause cancer. These studies involve feeding laboratory animals large *daily* doses of the pesticide over most of the lifetime of the animal. Based on these tests, and any other available information, EPA gives the pesticide a rating for its potential to cause cancer in humans. For example, if a pesticide does not cause cancer in animal tests, then the EPA considers it unlikely the pesticide will cause cancer in humans. Testing for cancer is not done on human subjects.

Humans

- Researchers have found bendiocarb does not increase the risk of cancer in humans. The EPA has categorized bendiocarb as a Group E carcinogen, indicating evidence of non-carcinogenicity for humans (1).

Does bendiocarb cause reproductive or teratogenic effects?

Animals

- Rabbits exposed to 2.5 and 5 mg/kg bendiocarb *in utero* throughout days 6-28 of gestation showed a dose dependent increase in eye abnormalities and undeveloped pubic bones (7).
- In another experiment with rats, researchers administered 0.25, 1, and 4 mg/kg bendiocarb during days 6-15 of gestation and found no significant differences existed between offspring of control rats and treated rats (7).
- Reduced survival rates or lowered birth weights were observed in 2 of 21 female rats intubated with 4 mg/kg bendiocarb from days 6-15 of gestation (7).

Exposure: Effects of bendiocarb on human health and the environment depend on how much bendiocarb is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

Humans

- No human data was found on the reproductive or teratogenic effects of bendiocarb.

What is the fate of bendiocarb in the body?

Animals

- Mice, rats, rabbits, hamsters, and dogs eliminated 80-95% of an oral bendiocarb dose within 24-48 hours. The primary route of elimination was in the urine (7).
- In a study with rats, 90% of an oral bendiocarb dose was excreted in the urine, 1-3% in expired air, and 3-8% in the feces. Excretion was complete within 24 hours (8).

- Male and female rats were fed bendiocarb at two doses and monitored for residue accumulation. The chemicals did not partition into any one tissue to a greater extent than another and all tissue residues were very low (8). Other studies agree with this, finding no sign of accumulation in mammals (7).
- The primary metabolite in rat urine is the conjugated phenol, 2,2-dimethyl -1, 3-benzoxodiol-4-ol. This compound is also referred to as NC 7312 (7, 8, 9).

Humans

- A male volunteer ingested 9.8mg bendiocarb and excreted 99.2% in the urine within 22 hours (8).
- The primary metabolite excreted in the urine of humans exposed to bendiocarb is the conjugated phenol, NC 7312 (7,8).

What is the environmental fate of bendiocarb?

Plants

- The half-life of bendiocarb residues on plant foliage ranges from 3 to 18.3 days (9, 10). See **Half-life** box.

Soil

- The half-life of bendiocarb in the soil depends on soil composition and pH. The half-life can range from 3 to 21 days, with an average soil half-life of 5 days (11).
- Bendiocarb has a very low potential for movement through the soil to groundwater due to its soil sorption coefficient of 570 ml/g and low water solubility of 40 mg/l (12).

Half-life: The time required for half of the compound to degrade.

1 half-life=50% remaining
2 half-lives=25% remaining
3 half-lives=12% remaining
4 half-lives= 6% remaining
5 half-lives= 3% remaining

The amount of chemical remaining after a half-life will always depend on the amount of the chemical present initially.

Does bendiocarb degrade indoors?

- Researchers who applied a 1% solution of bendiocarb to a vinyl tile floor in a furnished office found that airborne concentrations peaked during the application at 2.7 $\mu\text{g}/\text{m}^3$. Concentrations were reduced to 26% of the peak value in 2 hours, 6% after 1 day, and 5% after 2 days (13).
- In another study, scientists applied a 0.5% wettable-powder bendiocarb solution to cracks and crevices in furnished dorm rooms. Airborne concentrations peaked during application at 7.7 $\mu\text{g}/\text{m}^3$. Airborne levels of bendiocarb decreased to 1.3 $\mu\text{g}/\text{m}^3$ after one day, and were not detectable on the second or third days (14).

Does bendiocarb affect wildlife?

Birds

- Ingested bendiocarb is moderately to highly toxic to various species of birds. The oral LD50 for mallard ducks is 3.1mg/kg, 19 mg/kg in bobwhite quail, and 137 mg/kg in domestic hens (15).

Fish and Aquatic Life

- The 96-hour LC50 for fish exposed to bendiocarb is 0.86 mg/l for sheepshead minnows, 1.65 mg/l for bluegill sunfish, and 1.55 mg/l for rainbow trout, indicating it is moderately to highly toxic (15).
- Bendiocarb is highly toxic to freshwater invertebrates. In *Daphnia*, it has a 24-hour LC50 of 0.33mg/l and a 48-hour LC50 of 0.16 mg/l (15).

Terrestrial Invertebrates

- Bendiocarb is highly toxic to honey bees with an oral LD50 of 0.1 $\mu\text{g}/\text{bee}$ (1, 15).
- Bendiocarb is extremely toxic to earthworms. In one study, it reduced the earthworm population by more than 90% when applied at labeled rates (16).

Date Reviewed: 9-25-02

For more information contact: NPIC

Oregon State University, 310 Weniger Hall, Corvallis, Oregon 97331
Phone: 1-800-858-7378 Fax: 1-541-737-0761 Email: npic@ace.orst.edu
NPIC at www.npic.orst.edu EXTTOXNET at <http://exttoxnet.orst.edu/>

References

1. U.S. Environmental Protection Agency *EPA R.E.D. Facts: Bendiocarb*. From <http://www.epa.gov/oppsrrd1/REDs/factsheets/0409fact.pdf> (accessed Oct. 2001).
2. *Pesticide Profiles: Toxicity, Environmental Impact, and Fate*; Kamrin, M. A., Ed.; CRC/Lewis Publishing: Boca Raton, FL, 1997; pp 60-63.
3. *FAO/WHO Pesticide Data Sheet- Bendiocarb*. Data Sheets on Pesticides No. 52. Food and Agriculture Organization of the United Nations. From http://www.inchem.org/documents/pds/pds/pest52_e.htm (accessed Oct. 2001).
4. *Casarett and Doull's Toxicology: The Basic Science of Poisons*, 5th ed.; Klaasen C. D., Amdur, M. O., Doull, J., Eds.; McGraw-Hill: New York, 1996; pp 659-663.
5. Riegart, J. R.; Roberts, J. R. *Recognition and Management of Pesticide Poisonings*, 5th Edition; U.S. Environmental Protection Agency, Office of Pesticide Programs, U.S. Government Printing Office: Washington, DC, 1999; pp 48-54.
6. Osweiler, Gary D. *Toxicology*. National Veterinary Medical Series. Williams and Wilkins: Media, PA, 1996; pp 231-236.
7. *FAO/WHO Pesticide Residues in Food- 1982 Evaluations. Data and Recommendations of the JMPR*. Document 573. FAO Plant Production and Protection Paper No. 49. Food and Agriculture Organization of the United Nations, Rome 1983. From <http://www.inchem.org/documents/jmpr/jmpmono/v82pr05.htm> (accessed Oct. 2001).
8. Challis, I. R.; Adcock, J. W. The Metabolism of the Carbamate Insecticide Bendiocarb in the Rat and in Man. *Pestic. Sci.* **1981**, *12*, 638-44.
9. *Groundwater Loading Effects of Agricultural Management Systems (GLEAMS)*; W.G. Knisel, Ed. Version 2.10; USDA-ARS: Tifton, GA, 1993.
10. Nigg, H. N.; Brady, S. S.; Kelly, I. D. Dissipation of Foliar Dislodgeable Residues of Bendiocarb Following Application to Azaleas. *Bull. Environ. Contam. Toxicol.* **1992**, *48*, 416-20.
11. Hornsby, A. G; Wauchope, R. D; and A. E. Herner. *Pesticide Properties in the Environment*; Springer-Verlag: New York, 1996; pp 52.
12. Vogue, P.; Kerle, E.; Jenkins, J. *Oregon State University Extension Pesticide Properties Database*; Oregon State University Extension Service: Corvallis, OR, 1994.
13. Currie, K. L.; McDonald, E. C.; Chung, L.; Higgs, A. R. Concentrations of Diazinon, Chlorpyrifos, and Bendiocarb after Application in Offices. *Am. Ind. Hyg. Assoc. J.* **1990**, *51*(1), 23-7.
14. Wright, C. G.; Leidy, R. B.; Dupree, H. E. Jr. Insecticides in the ambient air of rooms following their application for control of pests. *Bull. Environ. Contam. Toxicol.*, **1981**, *26*, 548-53.
15. *A World Compendium: The Pesticide Manual*, 12th ed.; Tomlin, C. D. S., Ed.; British Crop Protection Council: Farnham, Surrey, UK, 2000; pp 67-68.
16. Kunkel, B. A.; Held, D. W.; Potter, D. A. Impact of Halofenozide, Imidacloprid, and Bendiocarb on Beneficial Invertebrates and Predatory Activity in Turfgrass. *J. Econ. Entom.* **1999**, *92*, 922-30.
17. U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Labeling <http://www.epa.gov/oppfod01/labeling/lrm/chap-07.pdf>

NPIC is sponsored cooperatively by Oregon State University and the U.S. Environmental Protection Agency. Data presented through NPIC documents are based on selected authoritative and peer-reviewed literature. The information in this profile does not in any way replace or supersede the restrictions, precautions, directions or other information on the pesticide label/ing or other regulatory requirements.