RODENTICIDES

Rodenticides, pesticides specially designed to kill rodents, pose particular risks for accidental poisoning for several reasons. Since they have been designed to kill mammals, they are also toxic to humans. Because rodents usually share human environments, use of rodenticides poses an inherent risk of exposure to people, particularly children and their pets, as well as other non-target species. In addition, as rodents have developed resistance to these chemicals, there continues to be a need to develop new and potentially more toxic rodenticides.[1]

What are Rodenticides?

Rodenticides can be broken down into three categories, baits, tracking powders and fumigants. Both baits and tracking powders are rodent poisons in the traditional sense, they must be eaten to kill the pest. Baits are designed to attract the rodent to a feeding station. Baits can be used both in the field and in and around buildings. Tracking powders are placed along rodent runways in and around buildings, picked up by the fur as the animal passes by, and then ingested during grooming. Fumigants are poisonous gasses, designed to kill rodents in their burrows.

Rodenticide baits and tracking powders are the type of rodenticides that are most often encountered by homeowners with a rodent problem. There are two types of rodent poisons generally available – acute poisons (also known as single feed baits) and chronic poisons (multiple feed baits).[2] Acute poisons are extremely dangerous to pets and children, as one encounter can make them very sick or kill them.[3]

Multiple feed baits are the most commonly used type of rodent poisons. Typically these poisons act as anti-coagulants, literally causing the victim to bleed to death internally. The fact that these poisons must be made available to the pest animal over time makes them very hazardous as children, pets and other non-target animals have an extended opportunity to get into them. Current labels for rat and mouse baits used outdoors require that baits be applied in protective, tamper proof bait stations or placed in areas inaccessible to non-target wildlife.[4]

Classes of Baits

ANTI-COAGULANTS

There are two classes of anti-coagulant type rodent poisons, the courmarins and the indandiones. Courmarins include some very common rodent poisons such as warfarin, bromadiolone, and courmafuryl. Indandiones include the rodent poisons diphacionone and chlorophacinone.[5]

Both of these classes of toxic materials work by blocking vitamin K-dependent synthesis of the blood clotting substance prothrombin. Animals suffering from exposure to anti-coagulant rodenticides suffer from the following list of immediate toxic effects: nosebleeds, bleeding gums, blood in urine and feces; bruises due to ruptured blood vessels; and skin damage.[6]

Exposure to these poisons also has long-term health effects. The courmarin, warfarin, for example, has been shown to cause paralysis due to cerebral hemorrhage[7] and is teratogenic[8] (causes birth defects). Long-term exposure to the indandione, diphacinone causes nerve[9], heart, liver, and kidney damage as well as damage to skeletal muscles.[10]

CHOLECALCIFEROL

Also known as vitamin D_3, cholecalciferol has a unique mode of action. It is metabolized by the body into its active form, which increases the absorption of calcium and phosphorus from the gut, resulting in very high serum levels of calcium.[11] The prolonged hypercalcemia is delayed in onset and insidious in progression, leading ultimately to the death of the victim.[12]

BROMETHALIN

Bromethalin is a neurotoxin, unlike the other rodent poisons. The poison affects the body's ability to control muscle contraction through uncoupling oxidative phosphorylation. It can cause swelling of the brain, spinal column and nerves, leading to a loss of the myelin nerve sheath and ultimately to a reduction of nerve impulses and death.[13] Immediate effects of exposure to bromethalin include skin and eye irritation, weakness in legs, loss of tactile sensation, and death by respiratory arrest.[14]

ZINC PHOSPHIDE

When zinc phosphide is ingested, it reacts with water and stomach juices to release phosphine gas, which can enter the blood stream and affect the lungs, liver, kidneys, heart and central nervous system. It is easily absorbed through skin or inhaled from fumes. With repeated exposure, it accumulates in the body to dangerous levels.[15]

Signs and symptoms of mild zinc phosphide poisoning include diarrhea and stomach pains. In more severe cases, nausea, vomiting, chest tightness, excitement, coldness, unconsciousness, coma and death can occur from pulmonary edema and liver damage.

Table 1. Demographic Profile of Exposure Cases to Rodenticides in 1998

SUBSTANCE	NO. OF EXPOSURES	AGE			REASON		TREATED BY DOC.	OUTCOME		
		<6	6-19	>19	Unintent	Other		Mod	Maj	Death
Anti-coagulants	17,724	15,854	561	1,146	17,029	654	5,882	72	28	1
Strychnine	186	35	20	113	97	78	99	15	5	3
Other/unknown	2,390	1,719	158	434	2,156	219	917	35	6	1
Totals	20,300	17,608	739	1,693	19,282	951	6,898	122	39	5

From: Litovit, T.L., et al. 1999. 1998 Annual Report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *American Journal of Emergency Medicine* 17(5). <http://www.aapcc.org/1998.htm>

STRYCHNINE

Strychnine causes violent convulsions because of its direct action on the central nervous system, chiefly the spinal cord. The onset of symptoms begins usually within 15 to 20 minutes of ingestion. A lethal dose of this natural toxin is as little as 15 mg in children.[16]

Immediate effects of exposure are irritation to the upper respiratory tract and skin, vomiting, convulsions, hyperthermia, and death due to respiratory or cardiovascular failure.[17] Victims of strychnine poisoning should be placed in a warm, dark room in order to reduce the stimuli that can trigger convulsions. Medical help should be brought to the victim rather than transporting the victim to the medical center because movement will trigger convulsions.[18]

Table 2. Ounces of Rodenticide Bait LD50s for Pets.

RODENTICIDE	DOG 10 LBS.	DOG 22 LBS.	DOG 30 LBS.	CAT 4.4 LBS.
Warfarin	13	28	38	8
Bromadiolone	35	77	105	35
Diphacinone	3	6	8	7
Chlorophacinone	160	353	481	-
Cholecalciferol	19	42	57	-
Bromethalin	8	16	22	1
Zinc phosphide	0.16	0.35	0.48	0.06

From: 1998. Rodenticide Risk to Dogs and Cats. *Techletter: For Pest Control Technicians* 4(23).

Classes of Fumigants

Fumigants are used to kill rodents in their burrows. As a result, homeowners are much less likely to encounter the use of these chemicals but they are worthy of mention. The two most commonly used gasses to kill rodents are phosphine gas and methyl bromide.

PHOSPHINE GAS

Available in a variety of forms including aluminum phosphide and magnesium phosphide, phosphine gas is extremely toxic. Accordingly, EPA has placed chemicals that produce phosphine gas in toxicity category I, the highest toxicity category.[19]

When aluminum phosphide is dropped into a rodent burrow it reacts with moisture to form phosphine gas. The signs and symptoms of exposure to phosphine gas are described above under zinc phosphide.

METHYL BROMIDE

Methyl bromide has also been placed in EPA's toxicity category I. EPA has expressed concern over methyl bromide's potential to destroy ozone.[20] As a result, methyl bromide is scheduled to be phased out by 2005,[21] although there is political pressure to extend or reopen the phase out. Long-term exposure studies have found that methyl bromide is a mutagen, and neurotoxin that causes liver and kidney damage.[22]

RODENTICIDE RISK TO HUMANS AND PETS

Rodenticides rank second in the number of human exposures each year compared with the three other major categories of pesticides for which data is collected by the American Association of Poison Control Centers (AAPCC) (see table 1). According to AAPCC's latest numbers, 20,300 people were exposed to rodenticides in 1998. As mentioned above, anti-coagulant poisonings make up the vast majority of cases with 17,724 (87% of total) reported cases. Young children are the most common victims of exposure to rodenticides, 17,608 cases of exposure (87%) were children under six years of age; that is over seven times higher than the other two age groups combined. Tragically, five people died as a result of their exposure to rodenticides in 1998.

Pets and non-target wildlife also fall victim to exposure to rodenticides. Exposure to these animals can occur as a result of either feeding on the bait or eating rodents that have been killed by rodenticides. Toxicologists calculate the dose of poisons that will kill 50% of the animals that are exposed; this measurement is called an LD_{50}. It takes as little as 0.16 ounces of zinc phosphide to kill a 10 lb. dog (see table 2). Rodent poisons should be used only as a last resort. If poisons are used, homeowners need to practice extreme caution when choosing to control rodents in this way.

People dealing with a rodent problem need to consider all of the alternative, nontoxic approaches to rodent control. *See pages 10-12 or contact Beyond Pesticides/NCAMP to find out more about nontoxic approaches to rodent control.*

RODENTICIDES ChemicalWATCH Fact Sheet References

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[9] Rachel Carson Council. 1992.

[10] Extension Toxicology Network (ETN). 1995. "Diphacinone." *Pesticide Information Profiles.* <http://ace.orst.edu/cgi-bin/mfs/01/pips/diphacin.htm>

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[12] Ibid.

[13] Rachel Carson Council. 1992.

[14] Ibid.

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[17] Rachel Carson Council. 1992.

[18] Schulze, L.D., et al. 1997.

[19] Extension Toxicology Network (ETN). "Aluminum Phosphide." *Pesticide Information Profiles.* <http://ace.orst.edu/cgi-bin/mfs/01/pips/alumphos.htm>

[20] Extension Toxicology Network (ETN). 1996. "Methyl bromide: Bromomethane." *Pesticide Information Profiles.* < http://ace.orst.edu/cgi-bin/mfs/01/pips/methylbr.htm>

[21] U.S. EPA Methyl Bromide Phase Out Web Site. < http://www.epa.gov/spdpublc/mbr/>

[22] Rachel Carson Council. 1992.