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## Preventing Secondary Toxicity due to Rodent Control

# History and function of anticoagulants for rodent control

From time immemorial, humans have sought to control rodent infestations – particularly in areas where people live. The reasons for this are primarily health-related. In fact, commensal species (i.e., Brown rats, Black rats, mice) can pass a wide variety of diseases to humans (Firth et al., 2007). Rural rodent species (e.g., voles, field mice), however, are controlled more for their economic impact on crops.

Since the first generation of anticoagulant baits were introduced in the 1950s, anticoagulants have been and are still by far the most popular method of chemical control due to their efficacy in all target rodents, and because of their delayed action which circumvents rodents' potential distrust of bait. From 3 to 4 days after ingestion, anticoagulants disrupt coagulation, causing internal hemorrhage, a period of coma, then death. Anticoagulants are stored in the liver, allowing them to act for long enough before being broken down by liver enzymes.

Newer, second generation anticoagulants are not as easily broken down in the liver as first-generation anticoagulants. With their increased potency, newer second generation anticoagulants are more potent against rats and mice.

First generation anticoagulants	Second generation anticoagulants
Warfarin	Bromadiolone
Coumatetralyl	Difenacoum
Chlorophacinone	Flocoumafen
Diphacinone	Difethialone
	Brodifacoum

Nonetheless, all anticoagulants used as rodenticides can cause both primary toxicity (i.e., when non-target species consume the bait) and secondary toxicity (when non-target species eat rodents that have ingested the anticoagulant bait) (Beryn et al., 2010). Toxicity to non-target species is possible because anticoagulants are effective in all animals (e.g., mammals, birds) whose coagulation is Vitamin K1-dependent (Rattner et al., 2014).

- Primary toxicity affects pets and other non-target animals that eat rodenticide bait that was accessible.
- Secondary toxicity affects pets (e.g. dogs who may eat a large number of dead rats or mice) and wildlife that primarily feed on rodents (e.g., birds of prey, foxes, wild boar).

In recent decades, more stringent regulations have been introduced on the use of anticoagulants, especially in Europe and the U.S. These are aimed at reducing environmental exposure. Recently in the European Union, the hazard reclassification of anticoagulants has substantially restricted their use by non-professionals (i.e., non-professional users can only access anticoagulant baits containing less than 30 parts per million of active substance, as bait is classified as 'toxic for reproduction' when above this threshold).



above:  
*Brown rats, Black rats, and mice, respectively, can transmit a wide variety of diseases to humans.*

## Prevention of unwanted poisoning

In recent years, the number of unwanted poisonings from anticoagulants has decreased due to the widespread adoption of good practices such as ready-to-use bait (e.g., not needing dilution), the consistent use of bait stations and bait boxes where appropriate (mainly to avoid primary toxicity), and the collection and disposal of dead rodents (to prevent secondary toxicity).

Most instances of secondary toxicity happen on farms where anticoagulant baits are used to protect crops in areas with very dense populations of rodents (mainly voles) – attracting high populations of predators (e.g., birds of prey, foxes, wild boar). The use of anticoagulants for urban public health rodent control generates little secondary toxicity as dead rodents in urban settings are often visible and can be collected, urban environments have fewer predators, and urban rodents tend to live inside buildings or underground.



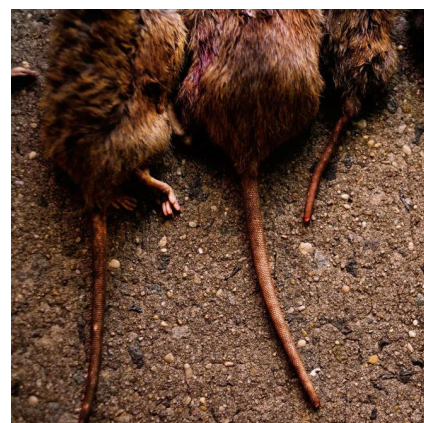
**above:**

*Bait boxes for specific purposes have prevented the dispersion of bait into the environment.*

## Tips to prevent secondary toxicity

To reduce the incidence of secondary toxicity, it is important to:

- Train applicators on the proper use of anticoagulant rodenticides.
- To always use product in a bait station, or covered and protected bait point, providing a similar level of protection.
- Collect all dead rodents to protect species that are not targeted.
- Consider using rodenticides that are not expected to accumulate in the food chain, provided it is effective on target rodents.



**above:**

*Collect any dead rodents found to protect the species that are not targeted.*

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