

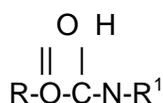


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Carbamate Insecticides

Introduction

Investigations of chemicals that exert an anticholinesterase action on the nervous system similar to organophosphates led in the 1950s to the development of the carbamate insecticides. Carbamate insecticides are derivatives of carbamic acid, HOC(O)NH_2 . They have the general formula shown below where R is an alcohol, oxime or phenol and R^1 is hydrogen or a methyl group.



Carbamates vary in their spectrum of activity, mammalian toxicity and persistence. They are relatively unstable compounds that break down in the environment within weeks or months. Carbamates are commonly used as surface sprays or baits in the control of household pests.

Usage

Carbaryl, the first successful carbamate, was introduced in 1956. Two distinct qualities have made it a widely used insecticide. First, it has very low mammalian, oral and dermal toxicity. Secondly, it has a rather broad spectrum of insect control. This has led to its wide use as a lawn and garden insecticide.

Propoxur is highly effective against cockroaches that have developed resistance to organophosphates. It is commonly used by pest control operators for the control of cockroaches and other household insects in restaurants, kitchens and homes.

Bendiocarb has found its greatest use as a household, turf and ornamental insecticide.

Methomyl is often applied as an adult fly bait.

Several carbamates have systemic use in plants because they have a high water solubility which allows them to be taken up by the roots and into the leaves of plants.

Mode of Action

The mode of action of carbamate insecticides is very similar to that of the organophosphate insecticides as they inhibit cholinesterase enzymes. However, they differ in action from the organophosphate compounds in that the inhibitory effect on cholinesterase is brief.

The reversal of the effect of carbamates is so rapid that measurements of blood cholinesterase levels in human beings or other animals exposed to carbamates are likely to be inaccurate and always in the direction of appearing to be normal.

To assess exposure to carbamates, it is necessary that the blood sample is collected on the same day as the exposure occurred and that the analysis is performed as soon as possible to minimise any reversal in the collected specimen.

In insects, the effects of carbamates are primarily those of poisoning of the central nervous system where cholinergic reactions are thought to take place. However, the insect neuromuscular junction is not cholinergic, as it is in mammals.

Effects of Poisoning

Carbamates are used as either dusts or sprays. They may be absorbed through the skin as well as by ingestion and inhalation. The immediate toxic effect of carbamates is very similar to that of organophosphates, but the recovery is comparatively rapid. Spontaneous recovery without medical treatment occurs generally within 4 hours of an exposure which has produced symptoms and signs of headache, light-headedness or dizziness, weakness, excessive salivation, nausea, or vomiting. More severe symptoms and signs generally prompt medical treatment. Individuals have recovered from poisoning that produced such symptoms and signs as visual disturbances, profuse sweating, abdominal pain, incoordination, muscle fasciculations, breathing difficulties or changes in the pulse rate.

There is no evidence of carbamates causing delayed neurotoxicity as is seen with some of the organophosphate compounds.

Like organophosphates, there is no clear evidence that carbamates have adverse health effects from long-term exposure at levels that do not affect acetylcholinesterase levels. Carbamates are not regarded as mutagenic, carcinogenic or teratogenic substances.

Treatment of Poisoning

If a carbamate insecticide is ingested, vomiting should be induced. If absorbed through the skin, contaminated clothing should be removed and the skin washed thoroughly with soap and water. In carbamate poisoning, the use of atropine is indicated, but oximes are contra-indicated.

It is very important to note that the absorption of a small amount of relatively non-toxic carbamate by a person who was recently exposed to organophosphates, but who does not show evidence of clinical poisoning, may precipitate an acute toxic state. This may occur because about a 70% depression of cholinesterase activity may be tolerated without clinical signs. Any further depression can result in an acute poisoning.

Generally, a depression of cholinesterase activity lasting longer than 48 hours is unlikely to be caused by carbamates. A detailed history of pesticides used recently should be taken whenever possible to ascertain the total exposure of the patient to cholinesterase inhibiting and other pesticides.

Source of Exposure

The most important human exposure route is dermal. Those most likely to be affected are occupationally exposed workers, such as insecticide formulators and applicators, and farm workers.

Low level exposure to residues in foods may occur wherever carbamates are used on crops or food producing animals. These residues should be within the maximum residue limits prescribed by the Food Standards Code. A low level of exposure may result from use of carbamates in the control of household

pests through the use of surface sprays or baits. Such low level exposures would not be expected to be of any clinical significance.

Monitoring of Exposure

The level of cholinesterase activity can be measured in blood samples. However, any reduction in cholinesterase activity due to carbamates is present for only a short period (up to 48 hours). Therefore, it is essential that whole blood specimens be obtained as soon as possible after exposure. As carbamates are rapidly metabolised and excreted, the metabolites in the urine may be used for biological monitoring.

Legislative Control

Most carbamates are classified as Schedule 5 and 6 poisons depending on the relative concentrations. They are readily available to the general public.

A few carbamates, such as methomyl and some concentrations of bendiocarb, are classified as Schedule 7 poisons. However, certain formulations with limited concentrations of these active ingredients are available in products rated as Schedule 5 or Schedule 6 poisons.

Part 10 - Pest Control Operators of the *Health Regulation 1996* includes requirements on storage, vehicle suitability, packaging and container disposal.

Acute Toxicity Data for some Carbamate Insecticides

Accepted Common Name	Some Common Trade Names	Oral Ld_{50} (mg/kg)
Bendiocarb	Ficam	34 – 64
Carbaryl	Carbene	400
Methomyl	Lannate	27
Propoxur	Baygon, Blattanex	40 - 128

Selected Bibliography

1. Division of Occupational Health and Radiation Control, Health Commission of New South Wales, 1979: "Poisoning by Pesticides".
2. Hadlington P and Gerozisis J. "Urban Pest Control in Australia" 2nd Ed. 1988. New South Wales University Press.
3. Hayes Jr. W J and Laws Jr. E R. "Handbook of Pesticide Toxicology" Vol 3. Classes of Pesticides, 1991.
4. International Programme on Chemical Safety, Environmental Health Criteria 64: "Carbamate Pesticides: A General Introduction". World Health Organization, Geneva, 1986.
5. Ninth Report of the WHO Expert Committee on Vector Biology and Control. Technical Report Series 720. "Safe Use of Pesticides". World Health Organization, Geneva, 1985.
6. Marer PF. "The Safe and Effective Use of Pesticides". Pesticide Application Compendium 1.

University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources, Publications 3324, 1988.

7. Ware GW, University of Arizona. "The Pesticide Book" 3rd Ed. 1989 Thomson Publications California.

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