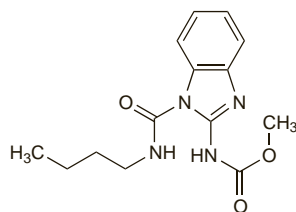


Benomyl

Benomilo. Methyl 1-(butylcarbamoyl)benzimidazol-2-ylcarbamate.

$C_{14}H_{18}N_4O_3 = 290.3$.
CAS — 17804-35-2.

**Profile**

Benomyl is a fungicide used for the treatment and control of fungal plant diseases.

◇ References.

1. WHO. Benomyl. *Environmental Health Criteria* 148. Geneva: WHO, 1993. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc148.htm> (accessed 23/04/04)
2. WHO. Benomyl health and safety guide. *IPCS Health and Safety Guide* 81. Geneva: WHO, 1993. Available at: http://www.inchem.org/documents/hsg/hsg/hsg81_e.htm (accessed 23/04/04)

Toxicity. Although experimental evidence in *animals* has suggested a possible link between benomyl and congenital eye defects (anophthalmia) the association could not be confirmed in humans.¹⁻⁴

1. Gilbert R. "Clusters" of anophthalmia in Britain. *BMJ* 1993; **307**: 340-1.
2. Bianchi F, *et al.* Clusters of anophthalmia. *BMJ* 1994; **308**: 205.
3. Kristensen P, Irgens LM. Clusters of anophthalmia. *BMJ* 1994; **308**: 205-6.
4. Castilla EE. Clusters of anophthalmia. *BMJ* 1994; **308**: 206.

BenzyI Benzoate

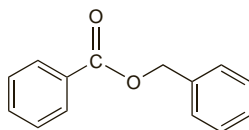
Bencilo, benzoato de; Bensylbensoat; Bentsylibentsoaatti; Benzil Benzoat; Benzil-benzoat; Benzilbenzoatas; Benzoato de bencilo; Benzoato de Benzilo; Benzoessäurebenzylester; Benzyl Benz; Benzyl-benzoat; Benzyle, benzoate de; Benzylis benzoas; Benzylu benzoetas.

$C_6H_5.CO.O.CH_2.C_6H_5 = 212.2$.

CAS — 120-51-4.

ATC — P03AX01.

ATC Vet — QP53AX11.



Pharmacopoeias. In *Eur.* (see p.vii), *Int.*, *Jpn.*, and *US*.

Ph. Eur. 6.2 (Benzyl Benzoate). Colourless or almost colourless crystals, or a colourless or almost colourless oily liquid. F.p. is not below 17°. Practically insoluble in water; miscible with alcohol, with dichloromethane, and with fatty and essential oils. Store in well-filled airtight containers. Protect from light.

USP 31 (Benzyl Benzoate). A clear, colourless, oily liquid with a slight aromatic odour. Practically insoluble in water and in glycerol; miscible with alcohol, with chloroform, and with ether. Store at a temperature not exceeding 40° in well-filled airtight containers. Protect from light.

Adverse Effects and Treatment

Benzyl benzoate is irritant to the eyes and mucous membranes and it may be irritant to the skin. Hypersensitivity reactions have been reported. If ingested, benzyl benzoate may cause stimulation of the CNS and convulsions. Systemic symptoms have been reported on excessive topical use. For poisoning associated with topical use the skin should be washed. Appropriate symptomatic measures should also be instituted.

Uses and Administration

Benzyl benzoate is an acaricide used in the treatment of scabies (p.2035) although other treatments are generally preferred. A 25% emulsion is applied to the whole body, usually from the neck down (although the *BNF* considers that application should be extended to the scalp, neck, face, and ears). If the application is thorough, one treatment may suffice, although the possibility of failure is lessened by a second application within 5 days. Alternatively, three applications at 12-hour intervals, without bathing, may be made, followed by bathing 12 hours after the last application. The *BNF* recommends one application to the whole body, repeated, without bathing, on the next day, and washed off

24 hours later; a third application may sometimes be necessary. Benzyl benzoate is not generally recommended for infants and children, but if used the application should be diluted to minimise the risk of irritation, although this also reduces efficacy.

Benzyl benzoate has also been used as a pediculicide.

Benzyl benzoate is also used as a solubilising agent.

Preparations

BP 2008: Benzyl Benzoate Application;

USP 31: Benzyl Benzoate Lotion.

Proprietary Preparations (details are given in Part 3)

Austral.: Ascabiol; Benzemul; **Braz.:** Acarsan; Bencocan; Benzelbel; Benzin; Benzoax; Benzobenil; Benzocan; Benzolator; Benzolina; Benzolom; Benzotisan; Mitococan; Parasimed; Prunido; Sanasar; Samaton; Samezan; Samilab; Samodex; Scabenzil; Scabioid; Zilaben; **Ger.:** Acarif; Acarosant; Antiscabiosum; **Gr.:** Benzogal; **Ir.:** Ascabiol; **Israel:** Scabiex; **Ital.:** Mom Lozione Preventiva; **Mex.:** Ansar; Hastlan; **Pol.:** Novoscabin; **Port.:** Acarilial; Neo-Acarina; **Pizol. S.Afr.:** Ascabiol; **UK:** Ascabiol; **Venez.:** Benzalcor; Benzo-Bencil; Benzodit; Nistolal.

Multi-ingredient: **Arg.:** Anusol Duo S; Anusol-A; Amecrem; Bencil Scab; Detebencil; Hexabencil; Perbel; Permeil; Sapuca; Scabiocrem; **Austral.:** Anusol; **Belg.:** Pulmex; Pulmex Baby; **Braz.:** Anusol-HC; **Fr.:** Allerbio-cid S; Ascabiol; Sanytol; **Hong Kong:** Anusol-HC; **Hung.:** Novoscabin; **Ir.:** Anugesic-HC; Anusol-HC; **Ital.:** Antiscabbia Candioli al DDT Terapeutico; Antiscabbia CM; Dekar 2; Prurex; Skab 2; **Malaysia:** Anucare; Anusol; **NZ:** Anusol; **Pol.:** Cetriscabin; **S.Afr.:** Anugesic; **Singapore:** Anusol; **Spain:** Tulgrasum Cicatrizante; Yacutin; **Swed.:** Tenutex; **Thai.:** Anusol; **UK:** Anugesic-HC; Anusol-HC, Plus HC; Sudocrem; **USA:** Anumed; Anumed HC; Hemril; **Venez.:** Kertyol.

Bioallethrin (BAN)

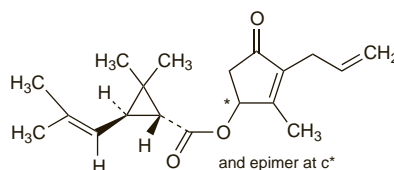
Allethrin I; Bioletrina; Depallethrin. (RS)-3-Allyl-2-methyl-4-oxo-cyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)-cyclopropanecarboxylate.

$C_{19}H_{26}O_3 = 302.4$.

CAS — 584-79-2.

ATC — P03AC02.

ATC Vet — QP53AC02.

**Profile**

Bioallethrin is a pyrethroid insecticide (see Pyrethrum Flower, p.2049). It is used topically, with the synergist piperonyl butoxide (p.2049), in the treatment of pediculosis (p.2034). It is also used in anti-mosquito devices and for the control of household insect pests.

◇ References.

1. WHO. Allethrin. *Environmental Health Criteria* 87. Geneva: WHO, 1989. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc87.htm> (accessed 23/04/04)
2. WHO. Allethrin health and safety guide. *IPCS Health and Safety Guide* 24. Geneva: WHO, 1989. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg024.htm> (accessed 23/04/04)

Preparations

Proprietary Preparations (details are given in Part 3)

UK: Actomite.

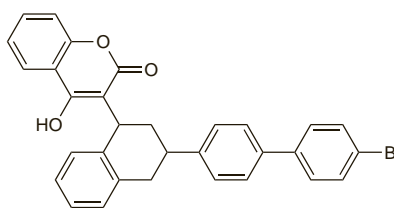
Multi-ingredient: **Arg.:** Limpacid; Para Plojicida; Scabiocrem; **Austral.:** Paralacet; **Belg.:** Para; **Braz.:** Samapen; **Canad.:** Para; **Fr.:** Para Special Poux; **Ger.:** Jacutin N; Spregal; **Israel:** Monocide; **Ital.:** Cruzy; **Neth.:** Para-Special.

Brodifacoum

Brodifacoum; WBA-8119. 3-[3-(4'-Bromobiphenyl-4-yl)-1,2,3,4-tetrahydro-1-naphthyl]-4-hydroxycoumarin.

$C_{31}H_{23}BrO_3 = 523.4$.

CAS — 56073-10-0.

**Profile**

Brodifacoum is an anticoagulant rodenticide. It is reported to be effective in warfarin-resistant strains of rodents.

◇ References.

1. WHO. Anticoagulant rodenticides. *Environmental Health Criteria* 175. Geneva: WHO, 1995. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc175.htm> (accessed 23/04/04)
2. WHO. Brodifacoum health and safety guide. *IPCS Health and Safety Guide* 93. Geneva: WHO, 1995. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg093.htm> (accessed 23/04/04)

Toxicity. Brodifacoum, a second-generation anticoagulant rodenticide, inhibits prothrombin synthesis to cause bleeding that may be occult.¹ It is absorbed from the gastrointestinal tract; dermal absorption is possible. Poisons containing 100 mg in each kg of bait are not hazardous to man; more concentrated forms are particularly hazardous and their availability should be restricted. Baits, which should be prepared only by trained personnel, should contain a suitable marker-dye.

There have been reports of poisoning with brodifacoum.²⁻¹⁰

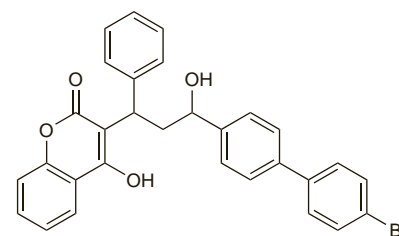
1. WHO. Safe use of pesticides: ninth report of the WHO expert committee on vector biology and control. *WHO Tech Rep Ser* 720 1985. Available at: http://libdoc.who.int/trs/WHO_TRS_720.pdf (accessed 21/07/08)
2. Watts RG, *et al.* Accidental poisoning with a superwarfarin compound (brodifacoum) in a child. *Pediatrics* 1990; **86**: 883-7.
3. Ross GS, *et al.* An acquired hemorrhagic disorder from long-acting rodenticide ingestion. *Arch Intern Med* 1992; **152**: 410-12.
4. Kruse JA, Carlson RW. Fatal rodenticide poisoning with brodifacoum. *Ann Emerg Med* 1992; **21**: 331-6.
5. Tecimer C, Yam LT. Surreptitious superwarfarin poisoning with brodifacoum. *South Med J* 1997; **90**: 1053-5.
6. Corke PJ. Superwarfarin (brodifacoum) poisoning. *Anaesth Intensive Care* 1997; **25**: 707-9.
7. La Rosa FG, *et al.* Brodifacoum intoxication with marijuana smoking. *Arch Pathol Lab Med* 1997; **121**: 67-9.
8. Miller MA, *et al.* Rapid identification of surreptitious brodifacoum poisoning by analysis of vitamin K-dependent factor activity. *Am J Emerg Med* 2006; **24**: 383.
9. Olmos V, López CM. Brodifacoum poisoning with toxicokinetic data. *Clin Toxicol* 2007; **45**: 487-9.
10. Kapadia P, Bona R. Acquired deficiency of vitamin K-dependent clotting factors due to brodifacoum ingestion. *Conn Med* 2008; **72**: 207-9.

Bromadiolone

Bromadiolone. 3-[3-(4'-Bromobiphenyl-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxycoumarin.

$C_{30}H_{23}BrO_4 = 527.4$.

CAS — 28772-56-7.

**Profile**

Bromadiolone is an anticoagulant rodenticide.

◇ References.

1. WHO. Anticoagulant rodenticides. *Environmental Health Criteria* 175. Geneva: WHO, 1995. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc175.htm> (accessed 23/04/04)
2. WHO. Bromadiolone health and safety guide. *IPCS Health and Safety Guide* 94. Geneva: WHO, 1995. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg094.htm> (accessed 23/04/04)

Toxicity. Bromadiolone, a second-generation anticoagulant rodenticide, inhibits prothrombin synthesis to cause bleeding that may be occult.¹ It is absorbed from the gastrointestinal tract; dermal absorption is possible. Poisons containing 100 mg in each kg of bait are not hazardous to man; more concentrated forms are particularly hazardous and their availability should be restricted. Baits, which should be prepared only by trained personnel, should contain a suitable marker-dye.

There have been reports of poisoning with bromadiolone.²⁻⁵

1. WHO. Safe use of pesticides: ninth report of the WHO expert committee on vector biology and control. *WHO Tech Rep Ser* 720 1985. Available at: http://libdoc.who.int/trs/WHO_TRS_720.pdf (accessed 21/07/08)
2. Greeff MC, *et al.* "Superwarfarin" (bromadiolone) poisoning in two children resulting in prolonged anticoagulation. *Lancet* 1987; **ii**: 1269.
3. Chow EY, *et al.* A case of bromadiolone (superwarfarin) ingestion. *CMAJ* 1992; **147**: 60-2.
4. Grobosch T, *et al.* Acute bromadiolone intoxication. *J Anal Toxicol* 2006; **30**: 281-6.
5. Lo VM, *et al.* Bromadiolone toxicokinetics: diagnosis and treatment implications. *Clin Toxicol* 2008; **1**-8.

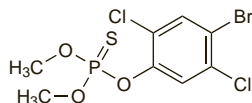
Bromophos

Bromofós; Bromofos; OMS-658. *O*-4-Bromo-2,5-dichlorophenyl *O,O*-dimethyl phosphorothioate.

$C_8H_8BrCl_2O_3PS = 366.0$.

CAS — 2104-96-3.

ATC Vet — QP53A11.



Profile

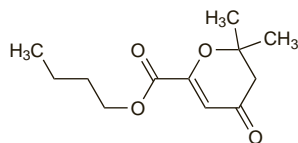
Bromophos is an organophosphorus insecticide (p.2047) used in veterinary practice for the control of ectoparasites in the environment. It has also been used as an agricultural insecticide.

Butopyronoxyl

Butopiroxinilo; Indalone. Butyl 3,4-dihydro-2,2-dimethyl-4-oxo-2H-pyran-6-carboxylate.

$C_{12}H_{18}O_4 = 226.3$.

CAS — 532-34-3.



Profile

Butopyronoxyl has been used as an insect repellent.

Carbamate Insecticides

Insecticidas del grupo de los carbamatos.

Description. The carbamate insecticides are *N*-substituted esters of carbamic acid.

References.

1. WHO. Carbamate pesticides: a general introduction. *Environmental Health Criteria* 64. Geneva: WHO, 1986. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc64.htm> (accessed 24/07/08)

Adverse Effects

As for Organophosphorus Insecticides, p.2047.

The carbamates are cholinesterase inhibitors, differing from the organophosphorus insecticides in that the inhibition they produce is generally less intense and more rapidly reversible. In addition, they do not appear to enter the CNS as readily and severe central effects are therefore uncommon.

Treatment of Adverse Effects

If substantial amounts of carbamate insecticides have been ingested the use of gastric lavage should be considered if the patient presents within 1 hour. Contaminated clothing should be removed and the skin washed with soap and water. Treatment is largely symptomatic and supportive and includes atropine, but this may not always be necessary due to the rapidly reversible nature of the cholinesterase inhibition produced. Pralidoxime is thought to be generally unnecessary; some *animal* studies have suggested that it may increase the toxicity of carbamates.

References.

1. WHO. Safe use of pesticides: fourteenth report of the WHO expert committee on vector biology and control. *WHO Tech Rep Ser* 813. 1991. Available at: http://libdoc.who.int/trs/WHO_TRS_813.pdf (accessed 21/07/08)
2. Proudfoot A, ed. *Pesticide poisoning: notes for the guidance of medical practitioners*. 2nd ed. London: DoH, The Stationery Office, 1996.

Carbaryl (BAN)

Carbaril (*pINN*); Carbarilo; Carbarilum; Karbaril; OMS-29. 1-Naphthyl methylcarbamate.

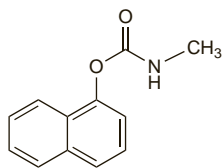
Карбарил

$C_{12}H_{11}NO_2 = 201.2$.

CAS — 63-25-2.

ATC Vet — QP53AE01.

The symbol † denotes a preparation no longer actively marketed



Pharmacopoeias. In Br.

BP 2008 (Carbaryl). A white to off-white or light grey powder which darkens on exposure to light. Very slightly soluble in water; soluble in alcohol and in acetone. Store at a temperature not exceeding 25°. Protect from light.

Adverse Effects and Treatment

As for Carbamate Insecticides, above. Carbaryl may be absorbed after ingestion, inhalation, or skin contamination.

Carbaryl has been reported to produce neoplasms in *mice* and *rats* and in late 1995 the UK DoH advised that it would be prudent to consider carbaryl as a potential human carcinogen; its medicinal use was limited to prescription only. However, the DoH emphasised that the risk was a theoretical one and that any risk from the intermittent use of head lice preparations was likely to be very small.

Uses and Administration

Carbaryl is a carbamate insecticide (above). It is used as a 0.5 or 1.0% lotion or shampoo in the treatment of head and pubic pediculosis (p.2034). Lotions are generally preferred to shampoos as the contact time is longer. Aqueous lotions are preferred to treat pubic lice because alcoholic lotions are irritant to excoriated skin and the genitalia; aqueous lotions may also be preferable in asthmatic subjects or children to avoid alcoholic fumes. Skin or hair treated with an alcohol-based preparation should be allowed to dry naturally.

Carbaryl is also used as a topical ectoparasiticide in veterinary practice and as an agricultural, horticultural, and household insecticide.

References.

1. WHO. Carbaryl health and safety guide. *IPCS Health and Safety Guide* 78. Geneva: WHO, 1993. Available at: http://www.inchem.org/documents/hsg/hsg/hsg78_e.htm (accessed 23/04/04)
2. WHO. Carbaryl. *Environmental Health Criteria* 153. Geneva: WHO, 1994. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc153.htm> (accessed 23/04/04)

Preparations

BP 2008: Carbaryl Lotion.

Proprietary Preparations (details are given in Part 3)

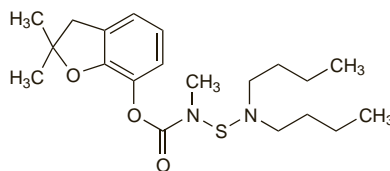
Israel: Haifi; **UK:** Carylterm.

Carbosulfan

Carbosulfán. 2,3-Dihydro-2,2-dimethylbenzofuran-7-yl (dibutylaminothio)methylcarbamate.

$C_{20}H_{32}N_2O_3S = 380.5$.

CAS — 55285-14-8.



Profile

Carbosulfan is a carbamate insecticide (p.2037) used in agriculture and for the larvicidal treatment of rivers in the control of onchocerciasis (p.137).

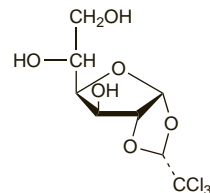
Chloralose (*hINN*)

Alphachloralose; Chloralosane; α -Chloralose; Chloralosum; Chloralosa; Glucochloral. (R)-1,2-O-(2,2,2-Trichloroethylidene)- α -D-glucofuranose.

Хлорало́за

$C_8H_{11}Cl_3O_6 = 309.5$.

CAS — 15879-93-3.



Profile

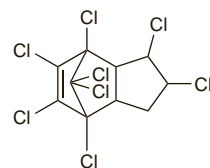
Chloralose has general properties similar to those of cloral hydrate (p.979), of which it is a derivative. It is used as a rodenticide. It was formerly used for its hypnotic properties.

Chlordane

Chloridan; Clordano. 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene.

$C_{10}H_6Cl_8 = 409.8$.

CAS — 57-74-9.



Profile

Chlordane is a chlorinated insecticide (p.2037). Its use is limited, or even prohibited, in some countries because of toxicity due to its persistent nature.

References.

1. Kutz FW, *et al.* A fatal chlordane poisoning. *J Toxicol Clin Toxicol* 1983; **20**: 167-74.
2. Olanoff LS, *et al.* Acute chlordane intoxication. *J Toxicol Clin Toxicol* 1983; **20**: 291-306.
3. WHO. Chlordane. *Environmental Health Criteria* 34. Geneva: WHO, 1984. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc34.htm> (accessed 23/04/04)
4. WHO. Chlordane health and safety guide. *IPCS Health and Safety Guide* 13. Geneva: WHO, 1988. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg013.htm> (accessed 23/04/04)

Chlorinated Insecticides

Insecticidas clorados.

Adverse Effects

Chlorinated or organochlorine insecticides form a very wide group and the toxicity of individual members varies considerably. In general these insecticides produce symptoms consistent with CNS stimulation. They may be absorbed through the respiratory and gastrointestinal tracts and through the skin.

Symptoms of acute poisoning include nausea and vomiting, paraesthesia, giddiness, tremors, convulsions, coma, and respiratory failure. Liver, kidney, and myocardial toxicity have been reported. Effects on the blood include agranulocytosis and aplastic anaemia. Symptoms may be complicated by the effects of the solvent.

Chlorinated insecticides have been reported to enhance microsomal hepatic enzyme activity. Skin reactions can occur after contact.

Polychlorinated biphenyl (PCB) and terphenyl compounds were formerly used as insecticides in many countries. They accumulate in body fat and are not readily excreted, although they are distributed into breast milk and possibly cross the placenta; because of this and because of accidental contamination they remain a cause for concern. The related polybrominated biphenyl compounds (PBB), which have no insecticidal uses, have also been absorbed by humans after accidental contamination of the food chain.

Some chlorinated insecticides have weak oestrogenic effects; it has been proposed that exposure may increase the risk of breast cancer.

Treatment of Adverse Effects

If chlorinated insecticides have been ingested gastric lavage or activated charcoal may be considered if the patient presents within 1 hour. Contaminated clothing should be removed and the skin washed with soap and water. Treatment is largely symptomatic