rence in industrial wastes as well as its use as a fungicide; its use is banned in some countries.

Hexachlorobenzene is reported to be distributed into breast milk.

◊ References.

1. WHO. Hexachlorobenzene. *Environmental Health Criteria 195*. Geneva: WHO, 1997. Available at: http://www.inchem.org/documents/ehc/ehc/ehc195.htm (accessed 26/04/04)
2. WHO. Hexachlorobenzene health and safety guide. *IPCS Health and Safety Guide 107*. Geneva: WHO, 1998. Available at: http://www.inchem.org/documents/hsg/hsg/hsg107.htm (accessed 26/04/04)

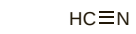
Toxicity. Porphyria cutanea tarda[1] and parkinsonism[2] have both been reported in subjects who had ingested seed crops treated with hexachlorobenzene. In a further report the symptoms of porphyria in some patients have been said to persist for many years.[3]

1. Cam C, Nigogosyan G. Acquired toxic porphyria cutanea tarda due to hexachlorobenzene. *JAMA* 1963; **183:** 88–91.
2. Chapman LJ, *et al.* Parkinsonism and industrial chemicals. *Lancet* 1987; **i:** 332–3.
3. Cripps DJ, *et al.* Porphyria turcica due to hexachlorobenzene: a 20 to 30 year follow-up study on 204 patients. *Br J Dermatol* 1984; **111:** 413–22.

Hydrocyanic Acid

Cianhídrico, ácido; Prussic Acid.

CAS — 74-90-8.



Description. Hydrocyanic acid is an aqueous solution containing hydrogen cyanide, HCN = 27.03. A colourless liquid with a characteristic almond odour.

Adverse Effects and Precautions

Hydrocyanic acid and its vapour are intensely poisonous. Cyanides interfere with the oxygen uptake of cells by inhibition of cytochrome oxidase, an enzyme necessary for cellular oxygen transport.

Poisoning by cyanides may occur from inhalation of the vapour, ingestion, or absorption through the skin. Poisoning may arise from cyanide pesticides, industrial accidental exposure, or the inhalation of fumes from some burning plastics. Poisoning may also occur from cyanide-containing plants or fruits.

When large doses of hydrocyanic acid are taken, unconsciousness occurs within a few seconds and death within a few minutes. With smaller toxic doses the symptoms, which occur within a few minutes, may include constriction of the throat, nausea, vomiting, giddiness, headache, palpitation, hyperpnoea then dyspnoea, bradycardia (although initially there may be tachycardia), unconsciousness, and violent convulsions, followed by death. The characteristic smell of bitter almonds may not be obvious and not all individuals can detect it. Cyanosis is not prominent. Similar but usually slower effects occur with cyanide salts.

The fatal dose of hydrocyanic acid for man is considered to be about 50 mg and of the cyanides about 250 mg.

Treatment of Adverse Effects

Treatment must be given rapidly but should not involve the use of antidotes unless it is certain that cyanide has been absorbed and poisoning is severe.

Cyanide is absorbed very rapidly on inhalation and the poisoned patient should be removed from the area and given oxygen. Steps should be taken to ensure that the airway is adequate. Contaminated clothing should be removed and skin washed. If the patient is conscious, amyl nitrite may be inhaled for up to 30 seconds in every minute but the value of this practice is questionable. Should the patient be unconscious or nearly so, then in the UK and some other countries it is the practice to give dicobalt edetate (p.1443) by injection since it forms a stable complex with the cyanide ion. However, cyanide poisoning should be confirmed, as absence of cyanide puts the patient at risk from the adverse effects of dicobalt edetate. The recommended dose of dicobalt edetate is 300 mg given intravenously over about 1 to 5 minutes, depending on the severity of the poisoning, and repeated once or twice depending on the response. It is customary to give 50 mL of glucose 50% intravenously after each injection. In the USA cyanide antidote kits containing amyl nitrite, sodium nitrite, and sodium thiosulfate are available. After the use of inhaled amyl nitrite, 10 mL of sodium nitrite injection (3%) is given intravenously over 5 to 20 minutes, then, using the same needle and vein, an injection of 12.5 g of sodium thiosulfate (50 mL of a 25% solution or 25 mL of a 50% solution) is given over a period of about 10 minutes. The nitrite components from amyl nitrite and sodium nitrite convert haemoglobin to methaemoglobin which competes with cytochrome oxidase for cyanide, with the formation of cyanmethaemoglobin; sodium thiosulfate acts as a sulfur donor and aids the conversion or inactivation of cyanide from cyanmethaemoglobin to thiocyanate. If toxic symptoms recur, the injections of nitrite and thiosulfate may be repeated at half the initial doses. Appropriate measures should be instituted to correct hypotension and acidosis. The methaemoglobinaemia induced by the nitrites in the antidote kits can be dangerous and fatalities have been reported.

Hydroxocobalamin may be used for the management of cyanide toxicity. The usual dose is 70 mg/kg by intravenous infusion, repeated once or twice according to severity. Alternatively, hydroxocobalamin 5 g may be given by intravenous infusion over 15 minutes, followed if necessary by a second dose of 5 g intravenously, infused over 15 minutes to 2 hours.

If cyanide has been ingested, one of the above procedures should be used. Activated charcoal or gastric lavage may be considered if the patient presents within 1 hour.

◊ Some references concerning the management of cyanide poisoning.[1-4] The use of solutions A and B (15.8% ferrous sulfate in 0.3% citric acid, and 6% sodium carbonate respectively) as so called oral antidotes in persons exposed to cyanide has been condemned as ineffective and lacking scientific evidence.[2]

1. Langford RM, Armstrong RF. Algorithm for managing injury from smoke inhalation. *BMJ* 1989; **299:** 902–5.
2. Koizumi A. Fighting myths. *Lancet* 1994; **344:** 559–60.
3. Proudfoot A, ed. *Pesticide poisoning: notes for the guidance of medical practitioners*. 2nd ed. London: DoH, The Stationery Office, 1996.
4. Geller RJ, *et al.* Pediatric cyanide poisoning: causes, manifestations, management, and unmet needs. *Pediatrics* 2006; **118:** 2146–58.

Uses

Cyanides have various industrial applications. Hydrocyanic acid and cyanide salts produce hydrogen cyanide, which has been used as a gas for the eradication of rabbits, rodents, and some other pests. Cyanide salts that might be encountered include calcium cyanide, mercuric cyanide, potassium cyanide, potassium ferricyanide, potassium sodium cyanide, and sodium cyanide.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Spain:*** Oftalmol Ocular.

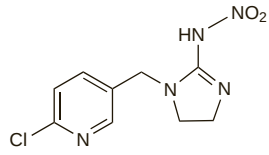
Imidacloprid

Bay-NTN-33893. 1-[(6-Chloro-3-pyridinyl)methyl]-4,5-dihydro-*N*-nitro-1*H*-imidazol-2-amine.

$C_9H_{10}ClN_5O_2$ = 255.7.

CAS — 105827-78-9; 138261-41-3.

ATC Vet — QP53AX17.



Profile

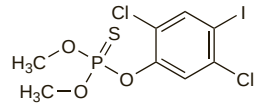
Imidacloprid is used as a topical ectoparasiticide in veterinary practice, and as an insecticide in agriculture. It has also been investigated for use in the treatment of head lice.

Iodofenphos *(BAN)*

Iodofenfós; Jodfenphos. *O*-2,5-Dichloro-4-iodophenyl *O,O*-dimethyl phosphorothioate.

$C_8H_8Cl_2IO_3PS$ = 413.0.

CAS — 18181-70-9.



Profile

Iodofenphos 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. It is an effective mosquito larvicide.

Iodopropynyl Butyl Carbamate

3-Iodo-2-propynyl-*N*-butyl carbamate.

$C_8H_{12}INO_2$ = 281.1.

CAS — 55406-53-6.

Profile

Iodopropynyl butyl carbamate is a carbamate pesticide (p.2037). It is used as a preservative in cosmetic preparations; contact sensitisation has been reported. It is also used as a wood preservative.

◊ References.

1. Bryld LE, *et al.* Iodopropynyl butylcarbamate: a new contact allergen. *Contact Dermatitis* 1997; **36:** 156–8.
2. Badreshia S, Marks JG. Iodopropynyl butylcarbamate. *Am J Contact Dermat* 2002; **13:** 77–9.

Preparations

Proprietary Preparations (details are given in Part 3)

Irl.: Saliker†.

Multi-ingredient: ***Arg.:*** Pityval†; Saliker†; ***Braz.:*** Effaclar; Pityval; Saliker; ***Fr.:*** Effaclar; Pityval; Saliker†; ***Irl.:*** Effaclar; Effaclar Al; Effaclar K.

Lindane *(BAN, USAN, rINN)*

666; Benhexachlor; Gamma Benzene Hexachloride; Gamma-BHC; Gamma-HCH; HCH; Hexicide; Lindaani; Lindán; Lindan; Lindanas; Lindano; Lindanum. 1α,2α,3β,4α,5α,6β-Hexachlorocyclohexane.

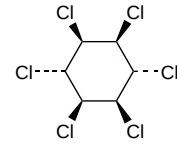
Линдан

$C_6H_6Cl_6$ = 290.8.

CAS — 58-89-9.

ATC — P03AB02.

ATC Vet — QP53AB02; QS02QA01.



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

Ph. Eur. 6.2 (Lindane). A white or almost white crystalline powder. Practically insoluble in water; soluble in dehydrated alcohol; freely soluble in acetone. Protect from light.

USP 31 (Lindane). A white, crystalline powder with a slight musty odour. Practically insoluble in water; soluble in dehydrated alcohol; freely soluble in chloroform; sparingly soluble in ether; slightly soluble in ethylene glycol.

Adverse Effects, Treatment, and Precautions

As for Chlorinated Insecticides, p.2037.

Serious adverse effects, including seizures and deaths, have been reported in patients who have used higher than recommended concentrations of lindane, or after a second application of lindane to the skin in the treatment of scabies and pediculosis: lindane should not be used as a first-line treatment in the management of the latter conditions. Babies, children, the elderly and people weighing less than 50 kg are considered to be particularly at risk. Lindane should not be used in patients who have a body-weight less than 50 kg, a history of epilepsy, have open or crusted sores on the skin around the head and neck or broken skin around the treatment areas, or skin conditions such as psoriasis or atopic dermatitis. Lindane is excreted into the breast milk but the amount excreted is not considered to be clinically significant; breastfeeding should, however, be avoided for at least 4 days after stopping treatment. There is limited human data on the use of lindane in pregnancy and *animal* data indicate a low risk for congenital defects, but because of its serious toxic potential safer alternative products are recommended.

◊ Seizures have been reported after the topical use of lindane.[1] In reply, one of the manufacturers stated that up to the end of 1983 they were aware of 21 cases of convulsive disorders apparently associated with the use of their product; it had been used by over 40 million people. Of the 21 cases, the seizures were definitely or probably caused by the product in 11, but in 9 the seizures were associated with ingestion or excessive use.[2] From 1998 to 2003, 870 cases of unintentional lindane ingestion were reported in the USA.[3] Signs and symptoms of illness after ingestion included abdominal cramps, confusion, cough, headache, nausea, oral irritation, seizures, and vomiting.

Isolated reports of adverse effects associated with lindane include disseminated intravascular coagulation and subsequent death after oral ingestion[4] and aplastic anaemia after prolonged topical exposure (twice daily application for 3 weeks).[5]

1. Etherington JD. Major epileptic seizures and topical gammabenzene hexachloride. *BMJ* 1984; **289:** 228.
2. Kelly VT. Major epileptic seizures and topical gammabenzene hexachloride. *BMJ* 1984; **289:** 837.
3. CDC. Unintentional topical lindane ingestions—United States, 1998–2003. *MMWR* 2005; **54:** 533–5. Also available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5421a2.htm (accessed 22/04/08)
4. Rao CVSR, *et al.* Disseminated intravascular coagulation in a case of fatal lindane poisoning. *Vet Hum Toxicol* 1988; **30:** 132–4.
5. Rauch AE, *et al.* Lindane (Kwell)-induced aplastic anemia. *Arch Intern Med* 1990; **150:** 2393–5.

Uses and Administration

Lindane is a chlorinated insecticide (p.2037). It has been used topically in a concentration of 1% for scabies (p.2035) in selected patients and has also been used in pediculosis (p.2034), but use for head lice is restricted by resistance.