

and bentonite (as a 7% suspension) are alternative oral adsorbents and are given in similar doses to those of charcoal. When none of these adsorbents is available, a suspension of clay or of uncontaminated soil should be considered if medical attention is likely to be delayed. An osmotic laxative may be used with the first dose of the adsorbent in order to hasten bowel evacuation and prevent obstruction due to the adsorbent. Patients may require intensive supportive therapy, but oxygen should not be given initially as it appears to enhance the pulmonary toxicity of paraquat; however, it may be needed in later stages as part of palliative care.

Methods aimed at hastening elimination such as forced diuresis, peritoneal dialysis, haemodialysis, and haemoperfusion have been tried but the first three appear to be ineffective and results with the last method have varied; no method is of proven value.

◇ For some general references concerning the treatment of paraquat toxicity, see under Adverse Effects, above.

Once paraquat has been absorbed, moderate to severe poisoning may result in acute renal failure, hepatitis, and pulmonary fibrosis; death may occur after 2 to 3 weeks. Pulse therapy with cyclophosphamide and methylprednisolone might be of benefit in such patients but not in those with fulminant poisoning.<sup>1,2</sup>

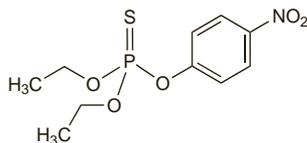
- Lin J-L, et al. Pulse therapy with cyclophosphamide and methylprednisolone in patients with moderate to severe paraquat poisoning: a preliminary report. *Thorax* 1996; **51**: 661-3.
- Lin J-L, et al. A prospective clinical trial of pulse therapy with glucocorticoid and cyclophosphamide in moderate to severe paraquat poisoned patients. *Am J Respir Crit Care Med* 1999; **159**: 357-60. Correction to the dose of cyclophosphamide. *ibid.* 2001; **163**: 292.

### Uses

Paraquat is a contact herbicide widely used as the dichloride in agriculture and horticulture. Liquid concentrates are supplied in the UK only to approved users.

### Parathion

Parathion. *O,O*-Diethyl *O*-4-nitrophenyl phosphorothioate.  $C_{10}H_{14}NO_5PS = 291.3$ . CAS — 56-38-2.



### Profile

Parathion is an organophosphorus insecticide (p.2047) that has been used in agriculture and horticulture. Its metabolite diethyl nitrophenyl phosphate (paraoxon, p.1883) contributes to its toxicity.

#### ◇ References.

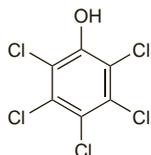
- WHO. Parathion health and safety guide. *IPCS Health and Safety Guide 74*. Geneva: WHO, 1992. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg74.htm> (accessed 26/04/04)

#### ◇ Reports of poisoning with parathion.

- Anastasiades CJ, Ioannides M. Organophosphate poisoning and arterial fibrillation. *BMJ* 1984; **289**: 290.
- Golsousidis H, Kokkas V. Use of 19 590 mg of atropine during 24 days of treatment, after a case of unusually severe parathion poisoning. *Hum Toxicol* 1985; **4**: 339-40.
- Clifford NJ, Nies AS. Organophosphate poisoning from wearing a laundered uniform previously contaminated with parathion. *JAMA* 1989; **262**: 3035-6.
- Wang M-H, et al. Q-T interval prolongation and pleomorphic ventricular tachyarrhythmia ("Torsade de pointes") in organophosphate poisoning: report of a case. *Hum Exp Toxicol* 1998; **17**: 587-90.
- Eyer F, et al. Human parathion poisoning: a toxicokinetic analysis. *Toxicol Rev* 2003; **22**: 143-63.
- Lund CM, Iversen G. Bladanforgiftning forekommer endnu. *Ugeskr Laeger* 2005; **167**: 3195-6.
- Hoffmann U, Papendorf T. Organophosphate poisonings with parathion and dimethoate. *Intensive Care Med* 2006; **32**: 464-8.

### Pentachlorophenol

PCP; Penta; Pentaclorofenol.  $C_6HCl_5O = 266.3$ . CAS — 87-86-5.



NOTE. The name PCP has also been used as a synonym for phenacycline hydrochloride.

### Adverse Effects, Treatment, and Precautions

Pentachlorophenol may be absorbed in toxic amounts through the skin or by inhalation, as well as by ingestion. Pentachlorophenol and its aqueous solutions are irritant to the eyes, mucous membranes, and to the skin, and may produce caustic burns. The systemic effects are due to uncoupling of oxidative phosphorylation with consequent stimulation of cellular metabolism. Acute poisoning with pentachlorophenol increases metabolic rate, leading to raised temperature with copious sweating and thirst, restlessness, fatigue, increased rate and depth of respiration, and tachycardia. There may be abdominal pain and nausea, and death has occurred from respiratory failure. Symptoms of subacute or chronic poisoning include hyperpyrexia and CNS, haematological, renal, reproductive, respiratory, and skin disorders.

Treatment is symptomatic. Raised body temperature should be treated by physical means; the use of antipyretics is not recommended since they can increase toxicity.

#### ◇ Reviews of the toxicity of pentachlorophenol.

- Health and Safety Executive. Pentachlorophenol. *Toxicity Review 5*. London: HMSO, 1982.
- WHO. Pentachlorophenol. *Environmental Health Criteria 71*. Geneva: WHO, 1987. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc71.htm> (accessed 26/04/04)
- Pentachlorophenol health and safety guide. *Health and Safety Guide 19*. Geneva: WHO, 1989. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg019.htm> (accessed 26/04/04)
- Jorens PG, Schepens PJ. Human pentachlorophenol poisoning. *Hum Exp Toxicol* 1993; **12**: 479-95.
- Proudfoot AT. Pentachlorophenol poisoning. *Toxicol Rev* 2003; **22**: 3-11.

◇ There have been reports of malignant neoplasms,<sup>1,2</sup> aplastic anaemia,<sup>3</sup> pancreatitis,<sup>4</sup> intravascular haemolysis,<sup>5</sup> and urticaria<sup>6</sup> associated with exposure to pentachlorophenol.

- Greene MH, et al. Familial and sporadic Hodgkin's disease associated with occupational wood exposure. *Lancet* 1978; **ii**: 626-7.
- Hardell L. Malignant lymphoma of histiocytic type and exposure to phenoxycetic acids or chlorophenols. *Lancet* 1979; **i**: 55-6.
- Roberts HJ. Aplastic anaemia due to pentachlorophenol. *N Engl J Med* 1981; **305**: 1650-1.
- Cooper RG, Macaulay MB. Pentachlorophenol pancreatitis. *Lancet* 1982; **i**: 517.
- Hassan AB, et al. Intravascular haemolysis induced by pentachlorophenol. *BMJ* 1985; **291**: 21-2.
- Kentor PM. Urticaria from contact with pentachlorophenol. *JAMA* 1986; **256**: 3350.

### Pharmacokinetics

Pentachlorophenol may be absorbed after ingestion or inhalation or through the skin. After ingestion, the majority of a dose is eliminated in the urine as unchanged pentachlorophenol and its glucuronide, with small amounts appearing in the faeces.

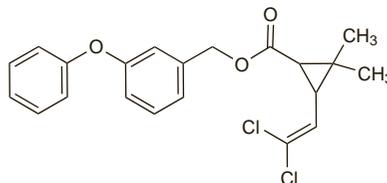
### Uses

Pentachlorophenol has been used mainly as the sodium salt ( $C_6Cl_5NaO = 288.3$ ), as a preservative for a wide range of industrial and agricultural products, including wood and other building materials, textiles, glues, and starch. It has also been used for the control of slime and algae, and as a molluscicide, fungicide, and herbicide.

### Permethrin (BAN, USAN, rINN)

Permethrine; Permethrinum; Permetriini; Permetrin; Permetrina; Permetryna. 3-Phenoxybenzyl (1*RS*,3*RS*)-(1*RS*,3*SR*)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate.

Перметрин  
 $C_{21}H_{20}Cl_2O_3 = 391.3$ .  
CAS — 52645-53-1.  
ATC — P03AC04.  
ATC Vet — QP53AC04.



### Profile

Permethrin is a pyrethroid insecticide (see Pyrethrum Flower, p.2049). It is used in the treatment of head pediculosis (p.2034) as a 1% application; there have been signs of resistance. It is also used as a 5% cream for pubic pediculosis and as an acaricide in the treatment of scabies (p.2035).

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

Permethrin is active against mosquitoes and is widely used for the impregnation of bednets and curtains in the control of malaria

(p.594). It is also active against blackflies in the adult and larval stages and is used for the larvicidal treatment of rivers in the control of onchocerciasis (p.137). It is also active against tsetse flies.

Permethrin is suitable for aircraft disinsection.

#### ◇ References.

- WHO. Permethrin health and safety guide. *IPCS Health and Safety Guide 33*. Geneva: WHO, 1989. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg033.htm> (accessed 26/04/04)
- WHO. Permethrin. *Environmental Health Criteria 94*. Geneva: WHO, 1990. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc94.htm> (accessed 26/04/04)

### Preparations

#### Proprietary Preparations (details are given in Part 3)

**Arg.:** Assy Crema de Enjuague; Assy Espuma; B-Jen; Blum; Capitis; Dermopier; Duncankilij; Fripi; Haircintj; Helpp; Kinerdant; Kwell; Lumatj; Nopucid; Pelo Libre; Permapyj; Quitoso NF; Sapucarij; Witty; **Austral:** Lyclear; Pyrafoam; Quellada; **Belg:** Mouskito Textile; Nix; Zalvor; **Braz:** Clean Hair; Keltrina; Kwell; Lendrexj; Nedax; Nedax Plus; Permetelj; Permetrixj; Piodrex; Pioletal; Pliohol Plusj; Postopj; Plurintj; Toppycj; Wellcidi; **Canad:** Kwellada-P; Nix; **Chile:** Assy Espuma; Kintis; **Cz:** Infectoscab; **Denm:** Nix; **Fin:** Nix; **Fr:** Insect Ecran; Modul'Aidj; Mousticologne; Moustidose; Nix; Pharmavoyage; Moustiquaires; **Ger:** InfectoPedicul; Infectoscab; **Gr:** Nix; **Hong Kong:** Quellada; **India:** Perlice; Permite; **Indon:** Scabimite; **Irl:** Lyclear; **Israel:** Lyclear; Mite-X; New-Nok; Nokj; Zehu-Ze; **Ital:** Nix Pre Clean; **Mex:** Novo-Herklid 2000; Scabisan; Scabisan Plus; **Neth:** Loxazol; **Norw:** Nix; **NZ:** Lyderm; Pyrafoam; **Philipp:** Kwell Reformulated; Pyrafoam; **Port:** Desintan Ptj; Nix; Quitoso; **Rus:** Nix (Никс); **S.Afr:** Lyclear; **Spain:** Sarcop; **Swed:** Nix; **Switz:** Loxazol; **Turk:** Kwellada; Niksen; Zalvor; **UK:** Lyclear; Residex P55; **USA:** Acticin; Elimite; Nix; **Venez:** Piokil Plus.

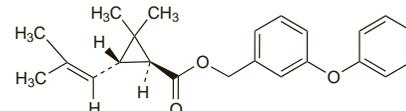
**Multi-ingredient Arg.:** Aero Helpp Forte; Arnecrem; Bencil Scab; Detebenci; Detebencil Nit; Hexa-Defital Plus; Hexabencil; Para Plus; Peditrem; Perbel; Permedic; Sapucarij; **Belg:** Para Plus; Shampoo; **Braz:** Plioholj; **Cz:** Charlieu Anti-Poux; **Fr:** Anti-Ac; Aspipur; Charlieu Anti-Poux; Para Plus; Pyreflor; Sanytolj; **Gr:** Para-plus; **Israel:** Para Plus; **Ital:** Antiscabbia CM; **NZ:** Para Plus; **Rus:** Para Plus (Пара Плюс); **S.Afr:** Nitagon.

### Phenothrin (BAN, rINN)

Fenotrin; Fenotrina; Phénothrine; Phenothrinum; S-2539. 3-Phenoxybenzyl (1*RS*,3*RS*)-(1*RS*,3*SR*)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate.

#### Фенотрин

$C_{23}H_{26}O_3 = 350.5$ .  
CAS — 26002-80-2.  
ATC — P03AC03.  
ATC Vet — QP53AC03.



### Profile

Phenothrin is a pyrethroid insecticide (see Pyrethrum Flower, p.2049). It is used for the treatment of head and pubic pediculosis (p.2034) as a 0.2% alcoholic or 0.5% aqueous lotion, or as a 0.5% alcoholic foam; as with permethrin there have been signs of resistance.

Phenothrin is also used in veterinary practice as a topical ectoparasiticide, as a household insecticide, and for the disinsection of public areas and aircraft.

#### ◇ References.

- WHO. d-Phenothrin health and safety guide. *IPCS Health and Safety Guide 32*. Geneva: WHO, 1989. Available at: <http://www.inchem.org/documents/hsg/hsg/hsg032.htm> (accessed 26/04/04)
- WHO. d-Phenothrin. *Environmental Health Criteria 96*. Geneva: WHO, 1990. Available at: <http://www.inchem.org/documents/ehc/ehc/ehc96.htm> (accessed 26/04/04)

### Aircraft disinsection. References.

- Russell RC, Paton R. In-flight disinsection as an efficacious procedure for preventing international transport of insects of public health importance. *Bull WHO* 1989; **67**: 543-7.

### Preparations

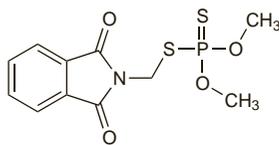
#### Proprietary Preparations (details are given in Part 3)

**Arg.:** Nopucid MC; Sumo; **Cz:** Parasidose; **Fr:** Itax Antipoux; Item Antipoux; Parasidose; **Gr:** Ivaliten; Pubex; Stiem; **Irl:** Headmaster; **Israel:** Sof-Soft; **Ital:** Cruzzly Shampoo Potenziato alla Sumitrina; Mediker; Mom Gel; Mom Shampoo Schiuma; Neo Mom; Ottocid; **Mex:** Herklid NF; **NZ:** Full Marks; Parasidose; **Rus:** Anti-Bit (Анти-Бит); Itax (Итак); **Turk:** Anti-Bit; **UK:** Full Marks; **USA:** Pronto.

**Multi-ingredient Fr:** Sanytol; **Gr:** Cif Candioli; **Ital:** Mom Shampoo Antiparassitario; Neo Mom; **Mex:** Herklid NF; **Neth:** Zinkan.

**Phosmet** (BAN)

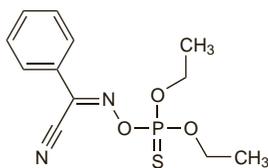
Fosmet. *O,O*-Dimethyl phthalimidomethyl phosphorodithioate.  
 $C_{11}H_{12}NO_4PS_2 = 317.3$ .  
 CAS — 732-11-6.  
 ATC Vet — QP53AF06; QP53BB03.

**Profile**

Phosmet is an organophosphorus insecticide (p.2047) used as a systemic ectoparasiticide in veterinary practice; it is applied topically to the host animal. It has also been used in agriculture and horticulture.

**Phoxim** (BAN, pINN)

Bayer-9053; Foksiimi; Foxim; Foxima; Phoxime; Phoximum. 2-(Diethoxyphosphinothioxyimino)-2-phenylacetonitrile.  
 Фоксим  
 $C_{12}H_{15}N_2O_3PS = 298.3$ .  
 CAS — 14816-18-3.  
 ATC Vet — QP53AF01.

**Profile**

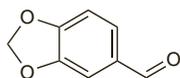
Phoxim is an organophosphorus insecticide (p.2047) used as a topical ectoparasiticide in veterinary practice. It is also used for the larvicidal treatment of rivers in the control of onchocerciasis (p.137).

**Preparations**

**Proprietary Preparations** (details are given in Part 3)  
**Ital.:** Baythion EC†.

**Piperonal**

Heliotropin; Piperonylaldehyde. 1,3-Benzodioxole-5-carboxaldehyde.  
 $C_9H_6O_3 = 150.1$ .  
 CAS — 120-57-0.

**Profile**

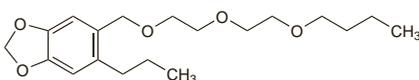
Piperonal is used as an insect repellent against head lice (see Pediculosis, p.2034).

**Preparations**

**Proprietary Preparations** (details are given in Part 3)  
**Fr.:** Para Repulsif; **UK:** Rappell.

**Piperonyl Butoxide** (BAN)

Piperonil Butoksit; Piperonilo, butóxido de. 5-[2-(2-Butoxyethoxy)ethoxymethyl]-6-propyl-1,3-benzodioxole.  
 $C_{19}H_{30}O_5 = 338.4$ .  
 CAS — 51-03-6.

**Pharmacopoeias.** In *BP* (Vet).

**BP(Vet) 2008** (Piperonyl Butoxide). A yellow or pale brown oily liquid. Very slightly soluble in water; miscible with alcohol, with chloroform, with ether, and with petroleum oils.

**Profile**

Piperonyl butoxide is used as a synergist for pyrethrin and pyrethroid insecticides. Mixtures of piperonyl butoxide and pyrethrins or pyrethroids are used in the treatment of pediculosis (p.2034).

The symbol † denotes a preparation no longer actively marketed

Piperonyl butoxide is considered to cause a variety of gastrointestinal effects as well as mild CNS depression.

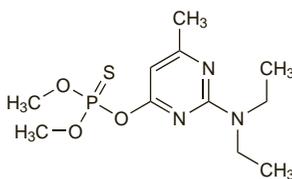
**Preparations**

**Proprietary Preparations** (details are given in Part 3)

**Multi-ingredient Arg.:** Acardust†; Aero Helpp Forte†; Capitist†; Deca-Scab†; Hexa-Defital NF; Limpacid; Nopucid Compuesto; Para Plojicida; Para Plus; Quitosol†; Scabiobderm; **Austral.:** Banlice; Parallice†; **Belg.:** Para; Para Plus; Shampoo; **Braz.:** Deltacid Plus; Pliohol†; Sarnapent†; **Canad.:** Licetrol†; Paraf†; Pronto; R & C; Scabene†; **Chile:** Launol; **Cz.:** Charlieu Anti-Poux†; **Fr.:** A-Par; Acardust; Anti-Act†; Aspipur; Charlieu Anti-Poux; Para Plus; Para Special Poux; Pyreflor; Spray-Pax; Spregal; **Ger.:** Goldgeist; Jacutin N; Spregal; **Gr.:** Para-plus; Runde; Spregal; **Israel:** A-200†; Acardust; Kin Soff; Para Plus; **Ital.:** Baygon; Cruzz; Milice; Mom Piretro Emulsionet; Sinezan; **Neth.:** Para-Special; Spregal; Zinkan; **NZ:** Para Plus; **Port.:** Para-Pio†; **Rus.:** Para Plus (Пара Плюс); Pedilin Ko (Педилин Ко); Spray-Pax (Спрей-пакс); Spregal (Спрегаль); **S.Afr.:** Nitagon; Spregal; **Turk.:** Kwell-P; **UK:** Fortefog; Prevent; **USA:** Blue; Licide; Pronto; Pyrinyl II; Pyrinyl Plus; RID; Tisit.

**Pirimiphos-Methyl**

Metilpirimifós. *O*-2-Diethylamino-6-methylpyrimidin-4-yl *O,O*-dimethyl phosphorothioate.  
 $C_{11}H_{20}N_3O_3PS = 305.3$ .  
 CAS — 29232-93-7.

**Profile**

Pirimiphos-methyl is an organophosphorus insecticide (p.2047). It is used in agriculture and domestically.

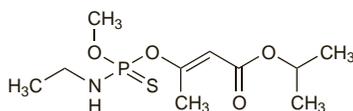
**Preparations**

**Proprietary Preparations** (details are given in Part 3)

**Multi-ingredient Fr.:** Anti-Act†.

**Propetamphos** (BAN)

Propetamfós; Propetamfos. Isopropyl (E)-3-[(ethylamino)(methoxy)phosphinothio-oxy]but-2-enoate.  
 $C_{10}H_{20}NO_4PS = 281.3$ .  
 CAS — 31218-83-4.  
 ATC Vet — QP53AF09.

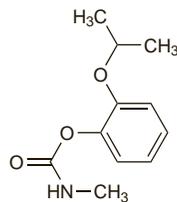
**Profile**

Propetamphos is an organophosphorus insecticide (p.2047) used as a topical ectoparasiticide in veterinary practice.

**Propoxur** (BAN)

2-Isopropoxyphenyl methylcarbamate.

$C_{11}H_{15}NO_3 = 209.2$ .  
 CAS — 114-26-1.  
 ATC Vet — QP53AE02.

**Profile**

Propoxur is a carbamate insecticide (p.2037) used as a topical ectoparasiticide in veterinary practice. It is also used as a fumigant in agriculture.

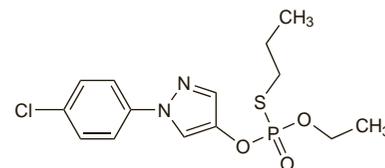
**Preparations**

**Proprietary Preparations** (details are given in Part 3)

**Multi-ingredient Ital.:** Baygon.

**Pyraclufos**

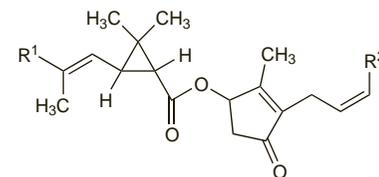
Piraclufós. (RS)-[O-(4-Chlorophenyl)pyrazol-4-yl O-ethyl S-propyl phosphorothioate].  
 $C_{14}H_{18}ClN_2O_3PS = 360.8$ .  
 CAS — 77458-01-6.

**Profile**

Pyraclufos is an organophosphorus insecticide (p.2047) used for the larvicidal treatment of rivers in the control of onchocerciasis (p.137).

**Pyrethrum Flower**

Chrysanthème Insecticide; Dalmatian Insect Flowers; Flor del pelitre; Insect Flowers; Insektenblüten; Piretro; Pyrethri Flos.  
 CAS — 8003-34-7 (pyrethrum); 121-21-1 (pyrethrin I); 121-29-9 (pyrethrin II); 25402-06-6 (cinerin I); 121-20-0 (cinerin II).  
 ATC — P03AC01.  
 ATC Vet — QP53AC01.



	R <sup>1</sup>	R <sup>2</sup>
Pyrethrin-I	CH <sub>3</sub>	CH=CH <sub>2</sub>
Pyrethrin-II	COOCH <sub>3</sub>	CH=CH <sub>2</sub>
Cinerin-I	CH <sub>3</sub>	CH <sub>3</sub>
Cinerin-II	COOCH <sub>3</sub>	CH <sub>3</sub>

**Pharmacopoeias.** In *BP* (Vet), which also includes the extract. *US* includes only the extract.

**BP(Vet) 2008** (Pyrethrum Flower). The dried flowerheads of *Chrysanthemum cinerariaefolium* containing not less than 1% of pyrethrins of which not less than one-half consists of pyrethrin I. It has a faint but characteristic odour.

**BP(Vet) 2008** (Pyrethrum Extract). An extract prepared from Pyrethrum Flower. It contains 24.5 to 25.5% of pyrethrins, of which not less than half consists of pyrethrin I. A dark olive green or brown viscous liquid or, if decolourised, a pale amber liquid. Store in a well-filled container. Protect from light. It should be thoroughly stirred before use.

**USP 31** (Pyrethrum Extract). A mixture of three naturally occurring, closely related insecticidal esters of chrysanthemic acid (pyrethrins I: jasmolin I, cinerin I, and pyrethrin I) and three closely related esters of pyrethric acid (pyrethrins II: jasmolin II, cinerin II, and pyrethrin II). The ratio of pyrethrins I to pyrethrins II is not less than 0.8 and not more than 2.8. It may contain pigments characteristic of chrysanthemum species, triglyceride oils, terpenoids, and carotenoid. It may also contain suitable solvents and antioxidants. It contains no other added substances. It is a pale yellow liquid having a bland, flowery odour. Insoluble in water; soluble in liquid paraffin and in most organic solvents. Store in airtight containers. Protect from light.

**Adverse Effects and Precautions**

Pyrethrum is irritant to the eyes and mucosa. Hypersensitivity reactions have been reported.

◇ References to the potential for toxicity of pyrethrin and pyrethroid insecticides.

1. Ray DE, Forshaw PJ. Pyrethroid insecticides: poisoning syndromes, synergies, and therapy. *J Toxicol Clin Toxicol* 2000; **38**: 95-101.
2. Bateman DN. Management of pyrethroid exposure. *J Toxicol Clin Toxicol* 2000; **38**: 107-9.
3. Bradberry SM, et al. Poisoning due to pyrethroids. *Toxicol Rev* 2005; **24**: 93-106.
4. Proudfoot AT. Poisoning due to pyrethrins. *Toxicol Rev* 2005; **24**: 107-13.
5. Ray DE, Fry JR. A reassessment of the neurotoxicity of pyrethroid insecticides. *Pharmacol Ther* 2006; **111**: 174-93.

**Uses**

Pyrethrum flower is mainly used for the preparation of pyrethrum extracts containing a mixture of chrysanthemic acid and pyrethric acid esters (pyrethrins I and II).