4. Archibald LK, *et al.* Albendazole is effective treatment for chronic strongyloidiasis. *Q J Med* 1993; **86:** 191–5.
5. Pornsuriyasak P, *et al.* Disseminated strongyloidiasis successfully treated with extended duration ivermectin combined with albendazole: a case report of intractable strongyloidiasis. *Southeast Asian J Trop Med Public Health* 2004; **35:** 531–4.
6. Singthong S, *et al.* Randomized comparative trial of two high-dose albendazole regimens for uncomplicated human strongyloidiasis. *Southeast Asian J Trop Med Public Health* 2006; **37** (suppl 3): 32–4.

Toxocariasis. Albendazole is one of the drugs that might be used for the treatment of toxocariasis (p.139) and in a small study[1] it produced improvement similar to that achieved with tiabendazole but with fewer problems.

1. Stürchler D, *et al.* Thiabendazole vs albendazole in treatment of toxocariasis: a clinical trial. *Ann Trop Med Parasitol* 1989; **83:** 473–8.

Trichinosis. Albendazole may be effective in the treatment of trichinosis (p.139). A retrospective study in 44 patients with trichinosis comparing albendazole treatment with tiabendazole found that, while the two drugs were of comparable efficacy, albendazole was the better tolerated.[1] Albendazole has been used to treat a patient infected with *Trichinella pseudospiralis*, an organism related to *T. spiralis*, the usual cause of trichinosis.[2]

1. Cabié A, *et al.* Albendazole versus thiabendazole as therapy for trichinosis: a retrospective study. *Clin Infect Dis* 1996; **22:** 1033–5.
2. Andrews JRH, *et al.* Trichinella pseudospiralis in humans: description of a case and its treatment. *Trans R Soc Trop Med Hyg* 1994; **88:** 200–3.

Trichostrongyliasis. Albendazole in a single dose of 400 mg has been suggested[1] as an alternative to pyrantel embonate or mebendazole in the treatment of trichostrongyliasis (p.139).

1. Abramowicz M, ed. *Drugs for parasitic infections*. 1st ed. New Rochelle NY: The Medical Letter, 2007.

Trichuriasis. Albendazole is used in the treatment of trichuriasis (p.139). It is normally given in a single dose and is often used in mixed intestinal nematode infections.[1] However, it has been reported[1-3] that in children with mixed intestinal worm infections single doses of albendazole are ineffective in eliminating *Trichuris trichiura* and multiple doses are required to produce worthwhile reductions in egg production. Treatment for 3 days has been used[4] (but for a suggestion that such regimens may be associated with impaired growth in less heavily infected children, see Effects on Growth under Adverse Effects, above). Combined use of albendazole with ivermectin may prove useful.[5]

1. Hall A, Anwar KS. Albendazole and infections with Trichuris trichiura and Giardia intestinalis. *Southeast Asian J Trop Med Public Health* 1991; **22:** 84–7.
2. Hall A, Nahar Q. Albendazole and infections with Ascaris lumbricoides and Trichuris trichiura in children in Bangladesh. *Trans R Soc Trop Med Hyg* 1994; **88:** 110–12.
3. Albonico M, *et al.* A randomized controlled trial comparing mebendazole and albendazole against Ascaris, Trichuris and hookworm infections. *Trans R Soc Trop Med Hyg* 1994; **88:** 585–9.
4. Abramowicz M, ed. *Drugs for parasitic infections*. 1st ed. New Rochelle NY: The Medical Letter, 2007.
5. Ismail MM, Jayakody RL. Efficacy of albendazole and its combinations with ivermectin or diethylcarbamazine (DEC) in the treatment of Trichuris trichiura infections in Sri Lanka. *Ann Trop Med Parasitol* 1999; **93:** 501–4.

Preparations

USP 31: Albendazole Tablets.

Proprietary Preparations (details are given in Part 3)

Arg.: Vastus; ***Austral.:*** Eskazole; Zentel; ***Austria:*** Eskazole; ***Braz.:*** Alba-3; Albel; Alben†; Albendrox†; Albendy†; Albenix†; Albentel; Albenzonil; Albezin†; Alib†; Alin; Alzoben†; Bentiamin†; Benzol; Imavermil; Mebenix; Monozol; Neo Bendazol; Parasin; Parazol; Totelmin†; Verdazol†; Vermiclase; Vermital; Zentel; Zolben; Zoldan†; ***Chile:*** Ceprazol; Vermoil; Zentel; ***Cz.:*** Zentel; ***Fr.:*** Zentel; ***Ger.:*** Eskazole; ***Gr.:*** Eskazole; Zentel; ***India:*** Albezole; Bendex; Combantrin-A; Emanthal; Nemozole; Olworm; Zentel; ***Israel:*** Eskazole; ***Ital.:*** Zentel; ***Malaysia:*** Albendol; Champs D-Worms; Thelban†; Vemizol; Zentel; Zoben; ***Mex.:*** Albensil; Aldamin; Alfazol; Bendapar; Bradelmin; Dazocan; Dazolin; Dezabil; Digezanol; Entoplus; Eskazole; Euralben; Flatezol†; Gascop; Helmisons; Kolexan; Loveral; Lurdex; Olbendital; Rivazol; Serbendazol; Synparyn; Tenibex; Veranzol; Vermilan†; Vermin Plus; Vermisen; Zelfin; Zenaxin; Zentel; ***Neth.:*** Eskazole; ***Philipp.:*** Zentel; ***Pol.:*** Zentel; ***Port.:*** Zentel; ***Rus.:*** Nemozole (Немозол); ***S.Afr.:*** Bendex; Zentel; ***Singapore:*** Alzental; Zentel; ***Spain:*** Eskazole; ***Switz.:*** Zentel; ***Thai.:*** Abentel; Albatel; Alben; Albenda; Alda†; Alfuca; Alzol; Anthel†; Gendazel; Labenda; Leo-400; Manoverm; Masaworm†; Mesin; Mycotel; Vermixide; Zeben; Zela; Zentel; Zenzera; ***Turk.:*** Andazol; ***UAE:*** Albenda; ***USA:*** Albenza; ***Venez.:*** Albezol; Albicar; Bevindazol; Helal; Sostril; Taron; Vendazol; Zentel.

Multi-ingredient: ***Mex.:*** Oxal.

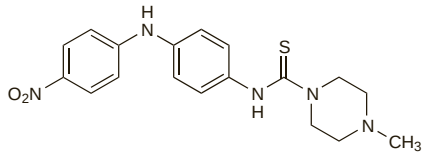
Amocarzine *(rINN)*

Amocarzina; Amocarzinum; CGP-6140. 4-Methyl-4′-(*p*-nitroanilino)thio-1-piperazinecarboxanilide.

Амокарзин

$C_{18}H_{21}N_5O_2S$ = 371.5.

CAS — 36590-19-9.



NOTE. Amocarzine has sometimes been referred to as thiocarbamazine.

Profile

Amocarzine is an antifilarial anthelmintic that is active against the adult worms of *Onchocerca volvulus.* It has been studied for the oral treatment of onchocerciasis (p.137).

◊ References.

1. Poltera AA, *et al.* Onchocercacidal effects of amocarzine (CGP 6140) in Latin America. *Lancet* 1991; **337:** 583–4.
2. Cooper PJ, *et al.* Onchocerciasis in Ecuador: evolution of chorioretinopathy after amocarzine treatment. *Br J Ophthalmol* 1996; **80:** 337–42.
3. Awadzi K, *et al.* The safety and efficacy of amocarzine in African onchocerciasis and the influence of ivermectin on the clinical and parasitological response to treatment. *Ann Trop Med Parasitol* 1997; **91:** 281–96.

Trivalent Antimony Compounds

Compuestos de antimonio trivalente.

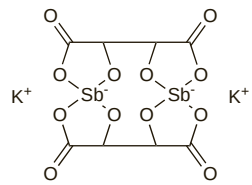
Antimony Potassium Tartrate

Antim. Pot. Tart.; Antimónico potásico, tartrato; Antymonu potasu winian; Brechweinstein; Kalii Stibyli Tartras; Potassium Antimonyltartrate; Stibii et Kalii Tartras; Tartar Emetic; Tartarus Stibiatus. Dipotassium bis{μ-[2,3-dihydroxybutanedioato(4-)-O^1,O^2:O^3,O^4]}-diantimonate(2-) trihydrate; Dipotassium bis[μ-tartrato(4-)]diantimonate(2-) trihydrate.

Антимонил-тартрат Калия

$C_8H_4K_2O_{12}Sb_2,3H_2O$ = 667.9.

CAS — 11071-15-1 (anhydrous antimony potassium tartrate); 28300-74-5 (antimony potassium tartrate trihydrate).



Pharmacopoeias. In *US*.

USP 31 (Antimony Potassium Tartrate). Odourless, colourless, transparent crystals or white powder. The crystals effloresce on exposure to air and do not readily rehydrate even on exposure to high humidity. Soluble 1 in 12 of water, 1 in 3 of boiling water, and 1 in 15 of glycerol; insoluble in alcohol. Its solutions are acid to litmus.

Antimony Sodium Tartrate

Antim. Sod. Tart.; Antimónico sódico, tartrato; Sodium Antimonyltartrate; Stibium Natrium Tartaricum. Disodium bis{μ-[2,3-dihydroxybutanedioato(4-)-O^1,O^2:O^3,O^4]}diantimonate(2-); Disodium bis{μ-[L-(+)-tartrato(4-)]}diantimonate(2-).

Антимонил-тартрат Натрия

$C_8H_4Na_2O_{12}Sb_2$ = 581.6.

CAS — 34521-09-0.

Pharmacopoeias. In *Int.* (as $C_4H_4NaO_7Sb$ = 308.8) and *US*.

USP 31 (Antimony Sodium Tartrate). Odourless, colourless, transparent crystals or white powder. The crystals effloresce on exposure to air. Freely soluble in water; insoluble in alcohol.

Sodium Stibocaptate *(BAN, rINN)*

Antimony Sodium Dimercaptosuccinate; Estibocaptato de sodio; Natrii Stibocaptas; Ro-4-1544/6; Sb-58; Stibocaptate; Stibocaptate de Sodium; TWSb/6. Antimony sodium *meso*-2,3-dimercaptosuccinate. The formula varies from $C_{12}H_{11}NaO_{12}S_6Sb_2$ = 806.1 to $C_{12}H_6Na_6O_{12}S_6Sb_2$ = 916.0.

Натрия Стибокаптат

CAS — 3064-61-7 ($C_{12}H_6Na_6O_{12}S_6Sb_2$).

Stibophen

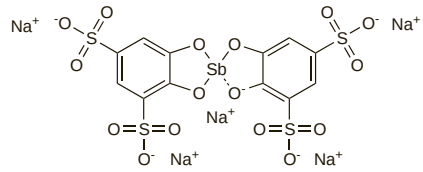
Estibofeno; Fouadin; Stibophenum. Bis[4,5-dihydroxybenzene-1,3-disulphonato(4–)-O^4,O^5]antimonate(5–) pentasodium heptahydrate.

Стибофен

$C_{12}H_4Na_5O_{16}S_4Sb,7H_2O$ = 895.2.

CAS — 15489-16-4 (stibophen heptahydrate).

ATC — P02BX03.



Adverse Effects and Treatment

Trivalent antimony compounds are more toxic than pentavalent antimonials such as sodium stibogluconate, possibly because they are excreted much more slowly. The most serious adverse effects are on the heart and liver. There are invariably ECG changes during treatment, but hypotension, bradycardia, and cardiac arrhythmias are more serious. Sudden death or cardiovascular collapse may occur at any time. Elevated liver enzyme values are common; liver damage with hepatic failure and death is more likely in patients with pre-existing hepatic disease.

Adverse effects immediately after intravenous use of trivalent antimonials, in particular the tartrates, have included coughing, chest pain, pain in the arms, vomiting, abdominal pain, fainting, and collapse, especially after rapid injection. Extravasation during injection is extremely painful because of tissue damage. An anaphylactoid reaction characterised by an urticarial rash, husky voice, and collapse has been reported after the sixth or seventh intravenous injection of a course of treatment.

Numerous less immediate adverse effects have occurred including gastrointestinal disturbances, muscular and joint pains, arthritis, pneumonia, dyspnoea, headache, dizziness, weakness, pruritus, skin rashes, facial oedema, fever, haemolytic anaemia, and kidney damage.

Large oral doses of antimony compounds have an emetic action. Continuous treatment with small doses of antimony may give rise to symptoms of subacute poisoning similar to those of chronic arsenical poisoning.

Treatment of severe poisoning with antimony compounds is similar to that for arsenic poisoning (p.2261); dimercaprol may be of benefit.

◊ References.

1. Stemmer KL. Pharmacology and toxicology of heavy metals: antimony. *Pharmacol Ther* 1976; **1:** 157–60.

Precautions

Trivalent antimony therapy has generally been superseded by less toxic treatment. It is contra-indicated in the presence of lung, heart, liver, or kidney disease. Intravenous injections should be given very slowly and stopped if coughing, vomiting, or substernal pain occurs; extravasation should be avoided.

Some antimony compounds such as the tartrates cause severe pain and tissue necrosis and should not be given by intramuscular or subcutaneous injection.

Breast feeding. The American Academy of Pediatrics[1] states that there have been no reports of any clinical effect on the infant associated with the use of antimony by breast-feeding mothers, and that therefore it may be considered to be usually compatible with breast feeding.

1. American Academy of Pediatrics. The transfer of drugs and other chemicals into human milk. *Pediatrics* 2001; **108:** 776–89. Correction. *ibid.*; 1029. Also available at: http://aappolicy.aappublications.org/cgi/content/full/pediatrics%3b108/3/776 (accessed 02/06/04)

Glucose-6-phosphate dehydrogenase deficiency. In the event of trivalent antimony compounds being used, patients with G6PD deficiency should be excluded. WHO lists stibophen[1] among the anthelmintics to be avoided in patients with this deficiency.

1. WHO. Glucose-6-phosphate dehydrogenase deficiency. *Bull WHO* 1989; **67:** 601–11.

Pharmacokinetics

Antimony compounds are poorly absorbed from the gastrointestinal tract. They are slowly excreted, mainly in the urine, after parenteral doses. Antimony accumulates in the body during treatment and persists for several months afterwards. Trivalent antimony has a greater affinity for cell proteins than for plasma proteins.

Uses and Administration

Trivalent antimony compounds were used in the treatment of the protozoal infection leishmaniasis until the advent of the less toxic pentavalent compounds. They continued to be used in the treatment of schistosomiasis, but have now been superseded by less toxic and more easily given drugs such as praziquantel.

Antimony sodium tartrate was formerly used as an emetic. The sodium tartrate and potassium tartrate have also been used as expectorants.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Thai.:*** Brown Mixture.

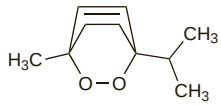
Ascaridole

Ascaridol. 1-Isopropyl-4-methyl-2,3-dioxabicyclo[2.2.2]oct-5-ene.

Аскаридол

$C_{10}H_{16}O_2$ = 168.2.

CAS — 512-85-6.



Profile

Ascaridole is the active principle of chenopodium oil (p.142) and has the same actions.

Handling. Ascaridole is an unstable liquid which is liable to explode when heated or when treated with organic acids.

Bephenium Hydroxynaphthoate *(BAN, rINN)*

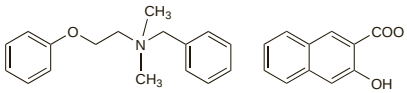
Bephenii Hydroxynaphthoas; Béphénium, Hydroxynaphtoate de; Hidroxinaftoato de befenio; Naphthammonum. Benzyldimethyl(2-phenoxyethyl)ammonium 3-hydroxy-2-naphthoate.

Бефения Гидроксинафтоат

$C_{28}H_{29}NO_4$ = 443.5.

CAS — 7181-73-9 (bephenium); 3818-50-6 (bephenium hydroxynaphthoate).

ATC — P02CX02.



Pharmacopoeias. In *Int.*

Profile

Bephenium hydroxynaphthoate is an anthelmintic formerly used in the treatment of hookworm infections, ascariasis, and trichostrongyliasis.

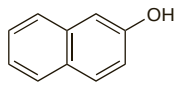
Betanaphthol

β-Naftol; 2-Naftol; Naphthol. Naphth-2-ol.

Бета-нафтол

$C_{10}H_8O$ = 144.2.

CAS — 135-19-3.



Pharmacopoeias. In *Pol.* and *Swiss.*

Profile

Betanaphthol was formerly used as an anthelmintic in hookworm and tapeworm infections, but it has been superseded by less toxic and more efficient drugs.

Betanaphthol has a potent parasiticidal effect and has been used topically in the treatment of scabies, ringworm, and other skin diseases.

Betanaphthyl benzoate has been used in preparations for the treatment of gastrointestinal disorders.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Arg.:*** Hekabetol; ***Austria:*** Salvyl.

Bithionol *(BAN, rINN)*

Bithionololum; Bithionolum; Bitionol; Bitionolol; Bitionololi. 2,2′-Thiobis(4,6-dichlorophenol).

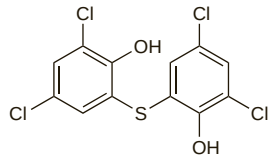
Битионол

$C_{12}H_6Cl_4O_2S$ = 356.1.

CAS — 97-18-7.

ATC — D10AB01; P02BX01.

ATC Vet — QD10AB01; QP52AG07.



Pharmacopoeias. *Fr.* includes bithionol oxide for veterinary use.

Adverse Effects

Adverse effects in patients taking bithionol by mouth include anorexia, nausea, vomiting, abdominal discomfort, diarrhoea, salivation, dizziness, headache, and skin rashes.

Photosensitivity reactions have occurred in persons using soap containing bithionol. Cross-sensitisation with other halogenated disinfectants has also occurred.

Uses and Administration

Bithionol is a chlorinated bis-phenol with bactericidal and anthelmintic properties. It is active against most trematodes (flukes). Bithionol is used in preference to praziquantel in fascioliasis (see Liver Fluke Infections, p.137) and is also used in paragonimiasis (see Lung Fluke Infections, p.137) as an alternative to praziquantel. It may be given in an oral dose of 30 to 50 mg/kg on alternate days for 10 to 15 doses. Alternatively, for fascioliasis, WHO recommends a regimen of 30 mg/kg daily for 5 days.

Bithionol was formerly used topically as a bactericide but this use has declined because of photosensitivity reactions.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Arg.:*** Fonergine.

Bromofenofos *(rINN)*

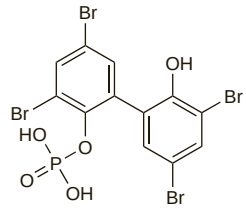
Bromfenofos; Bromofénofos; Bromofenofós; Bromofenofosum; Bromophenophos; Bromphenphos. 3,3′,5,5′-Tetrabromo-2,2′-biphenyldiolmono(dihydrogen phosphate).

Бромофенофос

$C_{12}H_7Br_4O_5P$ = 581.8.

CAS — 21466-07-9.

ATC Vet — QP52AB02.



Profile

Bromofenofos is an organophosphorus compound (see Organophosphorus Insecticides, p.2047) used as an anthelmintic in veterinary medicine for the treatment of fluke infections.

Cambendazole *(BAN, USAN, rINN)*

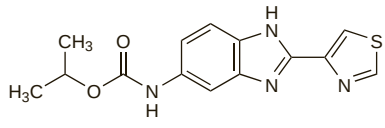
Cambendazol; Cambendazolum; MK-905. Isopropyl 2-(thiazol-4-yl)-1*H*-benzimidazol-5-ylcarbamate.

Камбендазол

$C_{14}H_{14}N_4O_2S$ = 302.4.

CAS — 26097-80-3.

ATC Vet — QP52AC08.



Profile

Cambendazole is a benzimidazole carbamate anthelmintic structurally related to tiabendazole (p.156). It is used in the treatment of strongyloidiasis.

Preparations

Proprietary Preparations (details are given in Part 3)

Braz.: Cambem†.

Multi-ingredient: ***Braz.:*** Exelmin†.

Chenopodium Oil

Aceite de quenopodio; Aetheroleum Chenopodii; Esencia de Quenopodio Vermifuga; Oil of American Wormseed; Wurmsamenöl.

Амброзиевое Масло; Маревое Масло

CAS — 8006-99-3.

Profile

Chenopodium oil is distilled with steam from the fresh flowering and fruiting plants, excluding roots, of *Chenopodium ambrosioides* var. *anthelminticum*. It contains ascaridole. It was formerly used as an anthelmintic for the expulsion of roundworms (*Ascaris*) and hookworms. It is toxic and has caused numerous fatalities.

Handling. Chenopodium oil may explode when heated.

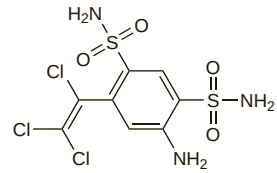
Clorsulon *(BAN, USAN, rINN)*

Clorsulón; Clorsulone; Clorsulonum; MK-401. 4-Amino-6-(trichlorovinyl)benzene-1,3-disulphonamide.

Клорсулон

$C_8H_8Cl_3N_3O_4S_2$ = 380.7.

CAS — 60200-06-8.



Pharmacopoeias. In *US* for veterinary use only.

USP 31 (Clorsulon). A white to off-white powder. Slightly soluble in water; freely soluble in acetonitrile and in methyl alcohol; very slightly soluble in dichloromethane.

Profile

Clorsulon is an anthelmintic used in veterinary medicine for the treatment of liver fluke infections.

Closantel *(BAN, USAN, rINN)*

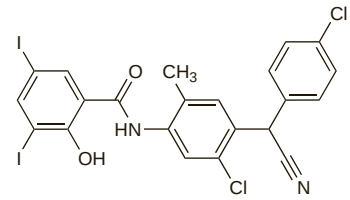
Closantelum; R-31520. 5′-Chloro-4′-(4-chloro-α-cyanobenzyl)-3,5-di-iodosalicyl-*o*-toluidide.

Клозантел

$C_{22}H_{14}Cl_2I_2N_2O_2$ = 663.1.

CAS — 57808-65-8.

ATC Vet — QP52AG09.



Closantel Sodium *(BANM, rINNM)*

Closantel sódico; Closantel sodique; Closantelum natricum; Klosanteelinatrium; Klosantel sodná sůl; Klosantelnatrium; Natrii Closantelum; R-34828.

Натрий Клозантел

$C_{22}H_{14}Cl_2I_2N_2O_2Na$ = 686.1.

Pharmacopoeias. In *Eur.* (see p.vii) as the dihydrate for veterinary use.

Ph. Eur. 6.2 (Closantel Sodium Dihydrate for Veterinary Use; Closantel Sodium Dihydrate BP(Vet) 2008). A yellow, slightly hygroscopic, powder. It exhibits polymorphism. Very slightly soluble in water; freely soluble in alcohol; soluble in methyl alcohol. Store in airtight containers. Protect from light.