

- Ebara M, *et al.* Percutaneous ethanol injection for small hepatocellular carcinoma: therapeutic efficacy based on 20-year observation. *J Hepatol* 2005; **43**: 458–64.
- Payne-James JJ, *et al.* Use of ethanol-induced tumor necrosis to palliate dysphagia in patients with esophagogastric cancer. *Gastrointest Endosc* 1990; **36**: 43–6.
- Stanners AJ, *et al.* Alcohol injection for palliation of malignant oesophageal disease. *Lancet* 1993; **341**: 767.
- Larsen TB, *et al.* Single-session alcohol sclerotherapy in symptomatic benign hepatic cysts: long-term results. *Acta Radiol* 1999; **40**: 636–8.
- Mohsen T, Gomha MA. Treatment of symptomatic simple renal cysts by percutaneous aspiration and ethanol sclerotherapy. *BJU Int* 2005; **96**: 1369–72.
- Asfar S, *et al.* Percutaneous sclerosis of gallbladder. *Lancet* 1989; **ii**: 387.
- Meirelles-Santos JO, *et al.* Absolute ethanol and 5% ethanolamine oleate are comparable for sclerotherapy of esophageal varices. *Gastrointest Endosc* 2000; **51**: 573–6.
- Ferrari AP, *et al.* Efficacy of absolute alcohol injection compared with band ligation in the eradication of esophageal varices. *Arq Gastroenterol* 2005; **42**: 72–6.
- Bhargava DK, *et al.* Endoscopic sclerotherapy using absolute alcohol. *Gut* 1986; **27**: 1518.
- Chung SCS, *et al.* Injection of alcohol to control bleeding from ruptured hepatomas. *BMJ* 1990; **301**: 421.
- Lin HJ, *et al.* Heat probe thermocoagulation and pure alcohol injection in massive peptic ulcer haemorrhage: a prospective, randomised controlled trial. *Gut* 1990; **31**: 753–7.
- Deveikis JP. Percutaneous ethanol sclerotherapy for vascular malformations in the head and neck. *Arch Facial Plast Surg* 2005; **7**: 322–5.
- Sigwart U. Non-surgical myocardial reduction for hypertrophic obstructive cardiomyopathy. *Lancet* 1995; **346**: 211–14.

Preparations

USP 31: Alcohol in Dextrose Injection; Dehydrated Alcohol Injection; Rubbing Alcohol.

Proprietary Preparations (details are given in Part 3)

Austral: Microshield Antimicrobial Hand Gel; **Canad:** Avagard D; Biobase; Dial; Duonal-E Mild; Instant Hand Sanitizer; One Step Hand Sanitizer; President's Choice Hand Sanitizer; Purell; **Fr:** Curethyl; Optrex; Pharmadose alcohol; **Ger:** AHD 2000; Amphisept E; Fugaten; Klosterfrau Franzbranntwein Menthol; Manusept HD; Sterillium Virugard; **Hung:** Salletanol Df; **Indon:** Handy Clean; **Malaysia:** QuickClean; **Philipp:** AHD 2000; **Switz:** Amphisept; **USA:** Alcare; Bodi Line Action; Gel-Stat; Kleen-Handz.

Multi-ingredient: **Austral:** Dermatech Liquid; Johnsons Clean & Clear Invisible Blemish Treatment; Johnsons Clean & Clear Oil Controlling Toner; Microshield Handrub; Microshield Tincture; **Austria:** Dodesept; Dodesept Gefarbt; Dodesept N; Skinsept; Skinsept mucosa; **Belg:** Sabenyl; Solution Antiseptique Stella; **Canad:** Avagard CHG; Biobase-G; Chase Kolik Gripe Water; Dilusol AHA; Dilusol; Duonal-E; Franzbranntwein; Green Antiseptic Mouthwash & Gargle; Mouthwash Antiseptic & Gargle; MRX; Sans-Acne; **Chile:** Abboderm; Acnoxyl Lotion Tonica; Alcole; Listerine; Listermint Con Fluor; Oralfresh Citrus; Oralfresh Clasico; Oralfresh Menta; **Cz:** Promanum N; Skinsept mucosa; Softa-Man; **Fin:** Oti-borin; Sormanol + Ethanol; **Fr:** Alco-Aloe; Aniospray 29; Chlorspray; Parogencyl genévies fragilisées; **Ger:** Aerodesin; Autoderm Extra; Bacillol; Bacillol AF; Betaseptic; Desderman N; Franzbranntwein mit Fichtenadelöl; Freka-Not; Freka-Sept 80; Hospidermin; Hospisept; Incidin; Incidin Spezial; Incidur Spray; Klosterfrau Franzbranntwein; Klosterfrau Franzbranntwein Latschenkiefer; Mucasept-A; Promanum N; Riwa Franzbranntwein; Skinsept G; Skinsept mucosa; Softa Man; Softasept N; Spitacid; **Gr:** Faragel-Forte; **Hong Kong:** Listerine; Listerine Tartar Control; **Hung:** Fructosol Ef; **India:** Daslin; Dettolin; **Indon:** Allen; Benadryl CM; Berilifed; Chlorphem; Conicidin; Dactylin; Domeryl; Eksdryl Expectoant; Inadryl; Inadryl Plus; Koffex; Listerine; Listerine Coolmint; Neo Novapon; Nichodryl; OBH; Paradryl; **Israel:** Alcolsept; Oxy Clean Medicated; Saliso; Septadine; Spirit Salicyl; V-Tabur; **Ital:** Bemonalcol; Citrodorex; Citromed 80 and 85; Citromed Chinirgico; Citrosil Alcolico Azzuro; Citrosil Alcolico Bruno; Citrosil Alcolico Incolore; Citrosil Strument; Clorexan Ferri; Eso Ferri Alcolico; Esoalcolico Incolore; Esoform Alcolico; Forbrand; Formedico; Incidin Spezial; Incidur Spray; Jodieci; Melsept Spray; Neomedi; Panseptil; Sekumatic; Simptotantacique; Softa Man; **Neth:** Softa-Man; **Philipp:** BSI Medicated Spray; Dermablend Clarifying; Listerine Coolmint; Listerine Original; Zilactin; Ziladent; **Port:** Promanum; Softasept N; **S.Afr:** Clearasil Medicated Facial Cleanser; Dry & Clear Medicated Skin Cleanser; Listerine Antiseptic; Oxipor VHC; Specific Nerve Pain Remedy; **Singapore:** Hexadone Handrub; Listerine; Listerine Cool Mint; Listerine Fresh Burst; Listerine Tartar Control; Tri-Cidal; **Spain:** Alcohocel; Alcohol Benzalcol; Alcohol Cetilj; Alcohol Cetilpi Cuve; Alcohol CL Benz; Alcohol Poteri; Alcohol Potenciano; Beta Alcanforado; Beta Romero; Embrocacion Gras; Farnalcol; Linimento Naion; Menalcol; Mercrotona; **Switz:** Betaseptic; Desitur; Frekaderm; Promanum N; Sclerovein; Softasept N; **Thai:** Hand Joy; **UK:** Brushtox; Clearasil Pore Cleansing Lotion; Medi-Wipe; Oxy Cleanser; Oxy Duo Pads; Spectrum; **USA:** Banadyne-3; Clearasil Double Clear; Clearasil Double Textured Pads; Lipmagik; Maximum Strength Anbesol; Orasol; Stri-Dex Pads; **Venez:** Frixonil.

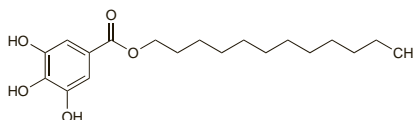
Alkyl Gallates

Galatos de alquilo.

Dodecyl Gallate

Dodecilo galatas; Dodecyle, gallate de; Dodecylgallat; Dodecylgallát; Dodecylis gallas; Dodecylgallaati; E312; Galato de dodecilo; Lauryl Gallate; Laurylum Gallicum. Dodecyl 3,4,5-trihydroxybenzoate.

$C_{19}H_{30}O_5 = 338.4$
CAS — 1166-52-5.



Pharmacopoeias. In *Eur.* (see p.vii).

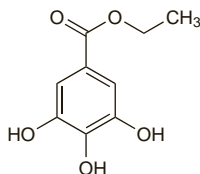
Ph. Eur. 6.2 (Dodecyl Gallate). A white or almost white crystalline powder. M.p. about 96°. Very slightly soluble or practically insoluble in water; freely soluble in alcohol; slightly soluble in dichloromethane. Store in nonmetallic containers. Protect from light.

Ethyl Gallate

Galato de etilo. Ethyl 3,4,5-trihydroxybenzoate.

$C_9H_{10}O_5 = 198.2$

CAS — 831-61-8.



Pharmacopoeias. In *Br.*

BP 2008 (Ethyl Gallate). A white to creamy-white, odourless or almost odourless, crystalline powder. Slightly soluble in water; freely soluble in alcohol and in ether; practically insoluble in arachis oil. Protect from light. Avoid contact with metals.

Octyl Gallate

E311; Galato de octilo; Octyl Gallate; Octyle, gallate d'; Octylis gallas; Oktilio galatas; Oktylgallat; Oktyl-gallát; Oktylygallaatti. Octyl 3,4,5-trihydroxybenzoate.

$C_{15}H_{22}O_5 = 282.3$

CAS — 1034-01-1.

Pharmacopoeias. In *Eur.* (see p.vii).

Ph. Eur. 6.2 (Octyl Gallate). A white or almost white crystalline powder. Practically insoluble in water and in dichloromethane; freely soluble in alcohol. Store in nonmetallic containers. Protect from light.

Propyl Gallate

E310; Galato de propilo; Propil-gallát; Propilo galatas; Propyle, gallate de; Propylgallat; Propyl-gallát; Propylis gallas; Propylu galusan; Propylum Gallicum; Propylgallaatti. Propyl 3,4,5-trihydroxybenzoate.

$C_{10}H_{12}O_5 = 212.2$

CAS — 121-79-9.

Pharmacopoeias. In *Eur.* (see p.vii). Also in *USNF*.

Ph. Eur. 6.2 (Propyl Gallate). A white or almost white, crystalline powder. Very slightly soluble in water; freely soluble in alcohol; dissolves in dilute solutions of alkali hydroxides. Protect from light.

USNF 26 (Propyl Gallate). A white crystalline powder with a slight characteristic odour. Slightly soluble in water; freely soluble in alcohol. Store in airtight containers. Avoid contact with metals. Protect from light.

Adverse Effects and Precautions

The alkyl gallates may cause contact sensitivity and skin reactions.

Effects on the blood. Methaemoglobinaemia associated with the antioxidants (butylated hydroxyanisole, butylated hydroxytoluene, and propyl gallate) used to preserve the oil in a soybean infant feed formula has been reported.¹ Propyl gallate was suspected of being the most likely cause because its chemical structure is similar to pyrogallol (p.1611), a methaemoglobinaemia inducer.

- Nitzan M, *et al.* Infantile methemoglobinemia caused by food additives. *Clin Toxicol* 1979; **15**: 273–80.

Uses

The alkyl esters of gallic acid (3,4,5-trihydroxybenzoic acid) have antioxidant properties and are used as preservatives in pharmaceuticals and cosmetics. Alkyl gallates are also used as antioxidants in foods and are useful in preventing deterioration and rancidity of fats and oils. They are used in concentrations of 0.001 to 0.1%.

To improve acceptability and efficacy, the alkyl gallates are frequently used with other antioxidants such as butylated hydroxyanisole or butylated hydroxytoluene and with sequestrants and synergists such as citric acid and zinc salts.

The alkyl gallates have also been reported to have limited antibacterial and antifungal activity.

Ambazone (BAN, rINN)

Ambatson; Ambazon; Ambazona; Ambazonum. 4-Amidinohydrozono[1,4-dien-3-one thiosemicarbazone monohydrate.

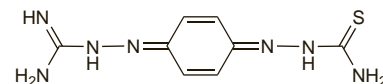
Амбазон

$C_8H_{11}N_7S \cdot H_2O = 255.3$

CAS — 539-21-9 (anhydrous ambazone); 6011-12-7 (ambazone monohydrate).

ATC — R02AA01.

ATC Vet — QR02AA01.



Profile

Ambazone is an antiseptic that is used in the form of lozenges for minor infections of the mouth and pharynx.

Preparations

Proprietary Preparations (details are given in Part 3)

Cz: Faringosept; **Hung:** Faringosept; **Pol:** Faringosept; **Rus:** Faringosept (Фарингосепт).

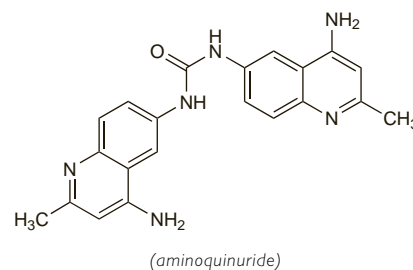
Aminoquinuride Hydrochloride (rINN)

Aminoquinuride, Chlorhydrate d'; Aminoquinuridi Hydrochloridum; Hydrochloruro de aminoquinuride. 1,3-Bis(4-amino-2-methyl-6-quinoly)urea dihydrochloride.

Аминохинурида Гидрохлорида

$C_{21}H_{20}N_6O_2 \cdot 2HCl = 445.3$

CAS — 3811-56-1 (aminoquinuride); 5424-37-3 (aminoquinuride hydrochloride).



Profile

Aminoquinuride hydrochloride is an antiseptic that has been used in topical preparations for the treatment of mouth and skin disorders.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: **Austria:** Herviros; **Ger:** Herviros.

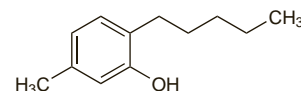
Amylmetacresol (BAN, rINN)

Amilmetacresol; Amilmetakrezol; Amylmétacrésol; Amylmetacresolum; Amylmetakresol; Amylmetakresoli. 6-Pentylm-cresol; 5-Methyl-2-pentylphenol.

Амилметакрезол

$C_{12}H_{18}O = 178.3$

CAS — 1300-94-3.



Pharmacopoeias. In *Br.*

BP 2008 (Amylmetacresol). A clear or almost clear liquid or a solid crystalline mass with a characteristic odour, colourless or slightly yellow when freshly prepared; it darkens on keeping. F.p. about 22°. Practically insoluble in water; soluble in alcohol, in ether, and in fixed and volatile oils. Protect from light.

Profile

Amylmetacresol is a phenolic antiseptic used chiefly as an ingredient of lozenges in the treatment of minor infections of the mouth and throat.

Preparations

Proprietary Preparations (details are given in Part 3)

UK: Antiseptic Throat Lozenges; Throaties Anti-Bacterial Pastilles.

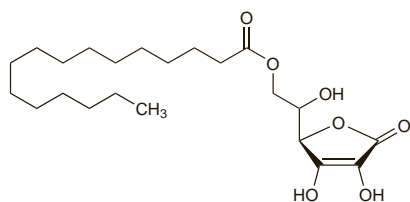
Multi-ingredient: **Austral:** Sore Throat Chewing Gum; Strepsils; Strepsils Plus; **Austria:** Coldangin; Neo-Angin; **Belg:** Strepsils; Strepsils + Lidocaine; Strepsils Menthol; Strepsils Vit C; **Canad:** Strepsils; Strepsils Cherry; **Cz:** Neo-Angin; Strepsils; Strepsils Menthol a Eucalyptus; Strepsils Plus; Strepsils Vitamin C; **Denm:** Strepsils; **Fin:** Strepsils; Strepsils Menthol;

Fr.: Strepsils; Strepsils Lidocaine; Strepsils Miel-Citron; Strepsils Vitamine C; Strepsilspray Lidocaine; **Ger.:** Dobendan Synergie; Neo-Angin; **Gr.:** Strepsils; **Hong Kong:** Strepsils; Strepsils Dual Action; **Hung.:** Neo-Angin; Strepsils; Strepsils Menthol and Eucalyptus; Strepsils Plus; Strepsils Vitamin C; **India:** Cof-Q; Cofsil†; **Ir.:** Strepsils; Strepsils Plus; **Israel:** Strepsils; Strepsils Dual Action; Strepsils Vitamin C; **Italy:** Strepsils; Strepsils Plus; Strepsils with Menthol and Eucalyptus; Strepsils with Vitamin C; **Japan:** Benagol; Benagol Mentolo-Eucalyptolo; Benagol Vitamina C; **Malaysia:** Chericof; Strepsils; Strepsils Dual Action; **Neth.:** Strepsils; Strepsils Menthol en Eucalyptus; Strepsils Sinaasappel en Vitamine C; **NZ:** Strepsils; Strepsils Plus Anaesthetic; Strepsils with Vitamin C; **Philipp.:** Strepsils; **Pol.:** Neo-Angin; Strepsils; **Rus.:** Astrasept (Астрасепт); Coldact Loripils (Колдакт Лорпилс); Rinza Lorsept (Ринза Лорсепт); Strepsils (Стрепсилс); Strepsils Plus (Стрепсилс Плюс); Suprima-Lor (Суприма-Лор); **S.Afr.:** Strepsils; Strepsils Eucalyptus Menthol; Strepsils Orange-C; Strepsils Plus; Strepsils Soothing Honey & Lemon; **Singapore:** Strepsils; Strepsils Dual Action; **Spain:** Strepsils; Strepsils con Vitamina C; Strepsils Lidocaina; **Swed.:** Strepsils; **Switz.:** Neo-Angin au miel et citron; Neo-Angin avec vitamin C sans sucre; Neo-Angin sans sucre; **Thai.:** Strepsils Butter Menthol Capsicum; Strepsils Plus Anaesthetic; Strepsils Plus Vit C; Strepsils Sugar Free; Throatil; **Turk.:** Strepsils; Strepsils C; Strepsils Mentollu; **UK:** Strepsils; Strepsils with Vitamin C.

Ascorbyl Palmitate

Ascorbilo, palmitato de; Ascorbyle, palmitate d'; Ascorbyl palmitat; Askorbilo palmitatas; Askorbilpalmitat; Askorbilpalmitat; Askorbilyu palmitinyan; Askorbilylpalmitaati; Aszkorbilpalmitat; Vitamin C Palmitate. L-Ascorbic acid 6-hexadecanoate; L-Ascorbic acid 6-palmitate; 3-Oxo-L-gulofuranolactone 6-palmitate.

C₂₂H₃₈O₇ = 414.5.
CAS — 137-66-6.



NOTE. The code E304 is used for fatty acid esters of ascorbic acid, which include ascorbyl palmitate.

Pharmacopoeias. In *Eur.* (see p.vii). Also in *USNF*.
Ph. Eur. 6.2 (Ascorbyl Palmitate). A white or yellowish-white powder. Practically insoluble in water; freely soluble in alcohol and in methyl alcohol; practically insoluble in dichloromethane and in fatty oils. Store in airtight containers. Protect from light.
USNF 26 (Ascorbyl Palmitate). A white to yellowish-white powder with a characteristic odour. Very slightly soluble in water, in chloroform, in ether, and in vegetable oils; soluble 1 in 125 of alcohol. Store at 8° to 15° in airtight containers.

Profile

Ascorbyl palmitate is an antioxidant used as a preservative in pharmaceutical products and foods. It is often used with alpha tocopherol (p.1992), and this combination shows marked synergy. As it is a fat-soluble derivative of vitamin C (ascorbic acid, p.1983), ascorbyl palmitate is sometimes used as a source of vitamin C in nutritional supplements.

Preparations

Proprietary Preparations (details are given in Part 3)

Chile: Neolucid-C.

Multi-ingredient: **Hong Kong:** Proflavanol†; **Malaysia:** Proflavanol; **Port.:** Thiospot; **Singapore:** Proflavanol.

Benzalkonium Chloride (BAN, rINN)

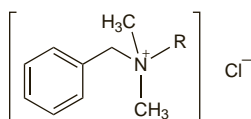
Benzalkoniumklorid; Bentsalkoniumkloridi; Benzalconio Cloruro; Benzalkonii chloridum; Benzalkonium chloridas; Benzalkoniowy chlorek; Benzalkonium Chloratum; Benzalkonium, chlorure de; Benzalkonium-chlorid; Benzalkónium-klorid; Benzalkonyum Klorür; Cloreto de Benzalconio; Cloruro de benzalconio.

Бензалкония Хлорид

CAS — 8001-54-5.

ATC — D08AJ01; D09AA11; R02AA16.

ATC Vet — QD08AJ01; QD09AA11; QR02AA16.



R = C₈H₁₇ to C₁₈H₃₇

Pharmacopoeias. In *Chin.*, *Eur.* (see p.vii), *Int.*, and *Jpn.* Also in *USNF*. Some pharmacopoeias also have a monograph for a solution.

Chin. also includes benzalkonium bromide.

Ph. Eur. 6.2 (Benzalkonium Chloride). A mixture of alkylbenzyltrimethylammonium chlorides, the alkyl groups having chain lengths of C₈ to C₁₈. It contains not less than 95% and not more than 104% of alkylbenzyltrimethylammonium chlorides, calculated as C₂₂H₄₀ClN with reference to the anhydrous substance. A white or yellowish-white powder, or gelatinous yellowish-white pieces, hygroscopic and soapy to the touch. It forms a clear molten mass on heating. It contains not more than 10% of water. Very soluble in water and in alcohol. An aqueous solution froths copiously when shaken.

USNF 26 (Benzalkonium Chloride). A mixture of alkylbenzyltrimethylammonium chlorides of the general formula [C₆H₅.C₂H₄.N(CH₃)₃.R]Cl, in which R represents a mixture of the alkyls having chain lengths from C₈ to C₁₆. It contains not less than 40% of the C₁₂H₂₅ compound, calculated on the anhydrous substance, not less than 20% of the C₁₄H₂₉ compound, and not less than 70% of the 2 compounds together.

A white or yellowish-white, thick gel, or gelatinous pieces with a mild aromatic odour. It contains not more than 15% of water. Very soluble in water and in alcohol; the anhydrous form is soluble 1 in 100 of ether and 1 in 6 of benzene. A solution in water is usually slightly alkaline and foams strongly when shaken. Store in airtight containers.

Incompatibility. Benzalkonium chloride is incompatible with soaps and other anionic surfactants, citrates, iodides, nitrates, permanganates, salicylates, silver salts, tartrates, and zinc oxide and sulfate. Incompatibilities have been demonstrated with ingredients of some commercial rubber mixes or plastics. Incompatibilities have also been reported with other substances including aluminium, cotton dressings, fluorescein sodium, hydrogen peroxide, hypromellose, kaolin, hydrous wool fat, and some sulfonamides.

Adverse Effects, Treatment, and Precautions

As for Cetrimide, p.1634. Because some rubbers are incompatible with benzalkonium chloride silicone rubber teats should be used on eye drop containers unless the suitability has been established.

Catheters and cannulas. For reference to benzalkonium chloride used in the manufacturing process of heparin-bonded catheters interfering with determination of serum concentrations of sodium and potassium, see under Precautions for Heparin, p.1303.

Effects on the eyes. Benzalkonium chloride is one of the most disruptive ophthalmic additives to the stability of the lipid film and to corneal epithelial membranes; toxicity studies have tended to be carried out using relatively high concentrations of benzalkonium chloride² but damage to the tear film and corneal junctional surface have been noted in patients receiving regular long-term treatment for glaucoma with eye drops preserved with benzalkonium chloride in usual concentrations.^{3,4}

Corneal toxicity has also been reported in patients inadvertently exposed to benzalkonium chloride as a preservative in viscoelastic material during cataract surgery.⁵ The use of preservatives in eye drops should generally be avoided and the formulation of such preparations in single-dose containers is desirable.^{1,2} Benzalkonium chloride is not suitable for use in solutions for storing and washing hydrophilic soft contact lenses, as it can bind to the lenses and may later produce ocular toxicity when the lenses are worn.⁶ Similarly, benzalkonium chloride use in anaesthetic eye drops is discouraged, as the anaesthetic component reduces the blink reflex and increases the contact time with the eye drops which may consequently result in increased toxicity due to the preservative. Patients with dry eye syndrome are also at increased risk of toxicity as the corneal epithelium is exposed to the full strength of the eye drops, in addition to which these patients do not produce enough tears to dilute the preservative in the eye drops.

- Burstein NL. The effects of topical drugs and preservatives on the tears and corneal epithelium in dry eye. *Trans Ophthalmol Soc U K* 1985; **104**: 402-9.
- Burstein NL. Corneal cytotoxicity of topically applied drugs, vehicles and preservatives. *Surv Ophthalmol* 1980; **25**: 15-30.
- Herreras JM, *et al.* Ocular surface alteration after long-term treatment with an antiglaucomatous drug. *Ophthalmology* 1992; **99**: 1082-8.
- Kuppens EVMJ, *et al.* Effect of timolol with and without preservative on the basal tear turnover in glaucoma. *Br J Ophthalmol* 1995; **79**: 339-42.
- Eleftheriadis H, *et al.* Corneal toxicity secondary to inadvertent use of benzalkonium chloride preserved viscoelastic material in cataract surgery. *Br J Ophthalmol* 2002; **86**: 299-305.
- Gasset AR. Benzalkonium chloride toxicity to the human cornea. *Am J Ophthalmol* 1977; **84**: 169-71.

Effects on the respiratory tract. Hypersensitivity to benzalkonium chloride, used as a preservative in nasal drops, was confirmed in a patient by a challenge that produced nasal congestion

and irritation of the eyes and throat lasting 48 hours.¹ A review² of 18 studies (14 *in vivo*, 4 *in vitro*) where benzalkonium chloride was used as the preservative in multidose nasal products found that 8 studies (all *in vivo*) found no toxic effects, while 10 reported degenerative changes to the nasal epithelia or exacerbation of rhinitis medicamentosa. However, in only 2 of these 10 studies were the differences between benzalkonium chloride and control groups found to be significant, and both of these included the use of oxymetazoline, which is known to cause rhinitis medicamentosa.

Benzalkonium chloride used as a preservative in nebulised solutions of anti-asthma drugs has been reported to cause dose-related bronchoconstriction especially in asthmatic patients,³ and has been associated with the precipitation of respiratory arrest.⁴

- Hillerdal G. Adverse reaction to locally applied preservatives in nose drops. *ORL J Otorhinolaryngol Relat Spec* 1985; **47**: 278-9.
- Marple B, *et al.* Safety review of benzalkonium chloride used as a preservative in intranasal solutions: an overview of conflicting data and opinions. *Otolaryngol Head Neck Surg* 2004; **130**: 131-41.
- Committee on Drugs, American Academy of Pediatrics. "Inactive" ingredients in pharmaceutical products: update. *Pediatrics* 1997; **99**: 268-78.
- Boucher M, *et al.* Possible association of benzalkonium chloride in nebulizer solutions with respiratory arrest. *Ann Pharmacother* 1992; **26**: 772-4.

Interactions

Benzalkonium chloride is not suitable for use in eye drops containing local anaesthetics (see Effects on the Eyes, above).

Uses and Administration

Benzalkonium chloride is a quaternary ammonium antiseptic and disinfectant with actions and uses similar to those of the other cationic surfactants (see Cetrimide, p.1634). It is also used as an antimicrobial preservative for pharmaceutical products. Benzalkonium bromide and benzalkonium saccharinate have also been used.

Solutions of benzalkonium chloride 0.01 to 0.1% are used for cleansing skin, mucous membranes, and wounds. More dilute solutions of 0.005% are suitable for irrigation of deep wounds. A 0.02 to 0.05% solution has been used as a vaginal douche. An aqueous solution containing 0.005 to 0.02% has been used for irrigation of the bladder and urethra and a 0.0025 to 0.005% solution for retention lavage of the bladder.

Creams containing benzalkonium chloride are used in the treatment of napkin rash and other dermatoses.

A 0.2 to 0.5% solution has been used as a shampoo in seborrhoeic dermatitis.

Lozenges containing benzalkonium chloride are used for the treatment of superficial infections of the mouth and throat.

Benzalkonium chloride is used as a preservative in ophthalmic solutions at a concentration of 0.01 to 0.02%, and in nasal and otic solutions at a concentration of 0.002 to 0.02%. Benzalkonium chloride is used for disinfecting rigid contact lenses (p.1622) but is unsuitable as a preservative in solutions for washing and storing hydrophilic soft contact lenses (see also Effects on the Eyes, above).

Benzalkonium chloride is also used as a spermicide.

Solutions of 0.13% are used for disinfection and storage of surgical instruments, sometimes with the addition of sodium nitrite to inhibit rust.

Action. The antibacterial effect of benzalkonium chloride 0.003% was enhanced by 0.175% of benzyl alcohol, phenylpropanol, or phenethyl alcohol.¹ For the use of phenethyl alcohol with benzalkonium chloride as a preservative for ophthalmic solutions, see Antimicrobial Action, under Phenethyl Alcohol, p.1655.

- Richards RME, McBride RJ. Enhancement of benzalkonium chloride and chlorhexidine acetate activity against *Pseudomonas aeruginosa* by aromatic alcohols. *J Pharm Sci* 1973; **62**: 2035-7.

Catheter-related sepsis. Benzalkonium chloride has been investigated^{1,2} for incorporation into catheters to reduce catheter-related sepsis (p.1624).

- Tebbs SE, Elliott TSJ. A novel, antimicrobial central venous catheter impregnated with benzalkonium chloride. *J Antimicrob Chemother* 1993; **31**: 261-71.
- Moss HA, *et al.* A central venous catheter coated with benzalkonium chloride for the prevention of catheter-related microbial colonization. *Eur J Anaesthesiol* 2000; **17**: 680-7.