3. Roberts NM, *et al.* Effect of a PAF antagonist, BN52063, on PAF-induced bronchoconstriction in normal subjects. *Br J Clin Pharmacol* 1988; **26:** 65–72.
4. Kleijnen J, Knipschild P. Ginkgo biloba. *Lancet* 1992; **340:** 1136–9.
5. Houghton P. Ginkgo. *Pharm J* 1994; **253:** 122–3.
6. Brochet B, *et al.* The Ginkgolide Study Group in Multiple Sclerosis. Double blind placebo controlled multicentre study of ginkgolide B in treatment of acute exacerbations of multiple sclerosis. *J Neurol Neurosurg Psychiatry* 1995; **58:** 360–2.
7. Maclennan KM, *et al.* The CNS effects of Ginkgo biloba extracts and ginkgolide B. *Prog Neurobiol* 2002; **67:** 235–57.

Preparations

Proprietary Preparations (details are given in Part 3)
Turk. Bilokan; Seremaks; Tebokan.

Ginseng

Ginseng radix; Ginzenggyökér; Jintsam; Ninjin; Panax; Pannag; Renshen; Schinsent; Všehojový kořen; Ženšenių šaknys.

Description. Ginseng is the dried root of *Panax ginseng* (*P. schinseng*) (Araliaceae). Other varieties of ginseng include *Panax quinquefolius* (American Ginseng) and *P. pseudoginseng*. The root commonly known as Siberian or Russian ginseng belongs to the same family, Araliaceae, but is an entirely different plant, *Eleutherococcus senticosus* (see Siberian Ginseng, p.2386). Brazilian ginseng is reported to be derived from another unrelated plant, *Pfaffia paniculata*.
Ginseng contains complex mixtures of saponins termed ginsenosides or panaxosides. At least 13 saponins have been isolated from extracts of *P. ginseng* roots.

Pharmacopoeias. In *Chin.*, *Eur.* (see p.vii), and *Jpn*. Also in *US* (as Asian Ginseng and American Ginseng). *US* includes additionally powdered forms of these two varieties of ginseng.
Jpn also includes Red Ginseng, the dried root of *P. ginseng* which has been steamed.
Chin. and *Jpn* also include Rhizoma Panacis Japonica from *Panax japonicus*. *Eur.* (see p.vii) also includes Notoginseng Root from *P. notoginseng*. *Chin.* also includes Radix Notoginseng from *P. notoginseng*, and Rhizoma Panacis Majoris from *P. japonicus* var. *major* and *P. japonicus* var. *bipinnatifidus*.
Ph. Eur. 6.2 (Ginseng). The whole or cut dried root of *Panax ginseng*. It contains not less than 0.4% of combined ginsenosides, Rg1 ($C_{42}H_{72}O_{14},2H_2O$ = 837.0) and Rb1 ($C_{54}H_{92}O_{23},3H_2O$ = 1163.3), calculated with reference to the dried drug. Protect from light.
USP 31 (Asian Ginseng). The dried roots of *Panax ginseng* (Araliaceae). It contains not less than 0.2% of ginsenoside Rg_1 and not less than 0.1% of ginsenoside Rb_1, both calculated on the dried basis. Store in a dry place at a temperature of 8° to 15°.
USP 31 (American Ginseng). The dried roots of *Panax quinquefolius* (Araliaceae). It contains not less than 4.0% of total ginsenosides, calculated on the dried basis. Store in airtight containers. Protect from light and heat.

Adverse Effects

◊ A 2-year study[1] of ginseng in 133 subjects who had used commercial preparations including roots, capsules, tablets, teas, extracts, cigarettes, chewing gum, and candies reported that the majority of preparations were taken orally, but a few subjects had experimented with intranasal or parenteral routes, and topical preparations had also been used. The stimulant effects of ginseng were confirmed but there was also a high incidence of adverse effects including 47 cases of morning diarrhoea, 33 of skin eruptions, 26 of sleeplessness, 25 of nervousness, 22 of hypertension, 18 of euphoria, and 14 of oedema. The 'ginseng abuse syndrome' defined as hypertension together with nervousness, sleeplessness, skin eruptions, and morning diarrhoea was experienced by 14 subjects who took ginseng orally in an average daily dose of 3 g. Abrupt withdrawal precipitated hypotension, weakness, and tremor in 1 user. About 50% of the subjects had stopped the use of ginseng within the 2 years. Oestrogenic effects have also been reported from the use of ginseng,[2-4] and a case of Stevens-Johnson syndrome has also occurred.[5]
A systematic review[6] of some of these and other studies and case reports concluded that single-ingredient preparations of ginseng were well tolerated when data from clinical studies were examined. Adverse effects were generally mild and reversible, the most common being headache, sleep disturbances, and gastrointestinal disorders. It was more difficult to determine causality from the evidence given in isolated case reports; likewise, interpretation of data involving combination products was difficult.

1. Siegel RK. Ginseng abuse syndrome: problems with the panacea. *JAMA* 1979; **241:** 1614–15.
2. Palmer BV, *et al.* Gin Seng and mastalgia. *BMJ* 1978; **1:** 1284.
3. Punnonen R, Lukola A. Oestrogen-like effect of ginseng. *BMJ* 1980; **281:** 1110.
4. Greenspan EM. Ginseng and vaginal bleeding. *JAMA* 1983; **249:** 2018.
5. Dega H, *et al.* Ginseng as a cause for Stevens-Johnson syndrome? *Lancet* 1996; **347:** 1344.
6. Coon JT, Ernst E. Panax ginseng: a systematic review of adverse effects and drug interactions. *Drug Safety* 2002; **25:** 323–44.

Interactions

◊ For reports of interactions between *phenelzine* and ginseng, see p.419. For details of an interaction between *warfarin* and ginseng, see p.1431. For a suggestion that ginseng may interfere with *digoxin* assays, see p.1260.

Uses and Administration

Ginseng is reported to enhance the natural resistance and recuperative power of the body and to reduce fatigue. It is available commercially as roots, powdered roots, tablets, capsules, teas, oils, or extracts.

Preparations

USNF 26: American Ginseng Capsules;
USP 31: American Ginseng Tablets; Asian Ginseng Tablets.

Proprietary Preparations (details are given in Part 3)
Arg.: Ginsana; Herbaccion Bioenergizante; Juvitan†; Transformal†; Vitagenol†; ***Austral.:*** Herbal Stress Relief†; ***Austria:*** Ginsana; ***Belg.:*** Ginsana†; ***Braz.:*** Enerseng; Fortilan; Ginsana; Ginsex; ***Canad.:*** Ginsana†; ***Cz.:*** Ginsana; ***Fr.:*** Gerimax Tonique; Ginsana†; ***Ger.:*** Ardey-aktiv; Coriosta Vitaltonikum N†; Ginsana; Hevert-Aktivon Mono†; IL HWA; Orgaplasma; ***Ital.:*** Fon Wan Ginsenergy; Gi-Sen†; Ginsana; ***Malaysia:*** Ginsana; ***Mex.:*** Gincaps†; Raigin†; Rutying; Sanjin Royal Jelly; ***Pol.:*** Ginsana; Ginsenol; Panaxan; ***Port.:*** Ginsana; ***Rus.:*** Gerimax Ginseng (Геримакс Женьшень); Ginsana (Гинсана); ***Singapore:*** Ginsana; ***Spain:*** Bio Star; Ginsana†; ***Switz.:*** Ginsana; Ginsavita†; KintaVital; ***Thai.:*** Ginsana; Ginsroy; ***UK:*** Korseng; Red Kooga.

Multi-ingredient: ***Arg.:*** Dynamisan; Energy Plus; Galenic Restaurador Capilar; Ginseng Bioplus Diates; Herbaccion Ginseng Y Magnesio; Holomagnesio Vital; Inteligen Ginseng†; Neuroton; Optimina Plus; Top Life Memory†; Total Magnesiano con Ginseng; Total Magnesiano con Vitaminas y Minerales; Vifortol; ***Austral.:*** Bioglan Ginsynergy; Clements Tonic; Extralife Extra-Brite; Ginkgo Biloba Plus†; Ginkgo Complex†; Glycyrrhiza Complex†; Infant Tonic†; Irontona; Nervatona Focus; Panax Complex†; Vig; Vitatona; ***Austria:*** Gerimax Plus; ProAktiv; ***Braz.:*** Gerin; Poliseng; ***Canad.:*** Damiana-Sarsaparilla Formula†; Energy Plus†; Ginkoba†; ***Chile:*** Gincosan; Mentania; Nectaday; ***Cz.:*** Gincosan; ***Fr.:*** Gintonal†; Nostress; Notabac; Thalgo Tonic; Tonactil†; ***Ger.:*** Cardibisana†; Doppelherz Ginseng Aktiv†; Ginseng-Complex "Schuh"†; Peking Ginseng Royal Jelly N; ***Hong Kong:*** Cervusen; GinsengSure†; Sanjukei Panax Ginseng; ***Indon.:*** Armovit; Cerebrovit Active; Ginokan; Hemaviton Brain Nutrient; Hemaviton Energy Drink; Hemaviton Jreng; Instink; Maxirex; Menolia; Neo Hormoviton; Neo Hormoviton Greng; Procur Plus; Proseval; Provital; Provital Plus; Ratax; Sirec; Tripid; Tristan; ***Ital.:*** Alvear con Ginseng; Apergan; Bioton; Fon Wan Ginsenergy; Forticrin; Fosfarsile Forte; Four-Ton; Ginsana Ton; Neoplus; Ottovis; Pollingel Ginseng†; ***Jpn:*** Eki Cabe; ***Malaysia:*** 30 Plus; Adult Citrex Multivitamin + Ginseng + Omega 3; Cerestar†; Ginsomin; Imuvit; Total Man†; ***Philipp.:*** BSI Medicated Spray; Ginsomin; Homtamin-G Plus; Immuvit; K-A Plus; Korgivit-E; Nutrotal; ***Pol.:*** Bioginko; Doppelherz Vital Kapseln; Ginjal; Intelektan; ***Rus.:*** Doppelherz Ginseng Aktiv (Доппельгерц Женьшень Актив); Doppelherz Vitalotonik (Доппельгерц Виталотоник); ***S.Afr.:*** Activex 40 Plus; ***Singapore:*** Gin-Vita; Immuvital; ***Spain:*** Energysor†; Esforza†; Redseng Polivit; Ton Was; Vigortonic; ***Switz.:*** Biovital Ginseng; Burgerstein TopVital; Geri; Gincosan; Imuvit; Supradyn Vital 50+; Triallin; Vigoran†; ***Thai.:*** Imugins; Imuvit; Multilim RG; Revitan; ***UK:*** Red Kooga Co-Q-10 and Ginseng; Regina Royal Concorde; ***Venez.:*** Hivit; Pharmorat; Sengobil; Vigoran.

Glatiramer Acetate *(BAN, USAN)*

COP-1; Copolymer 1; Glatirameeriasetaatti; Glatiramer, acetato de; Glatiramer Asetat; Glatirameracetat; Glatirameri Acetas. L-Glutamic acid polymer with L-alanine, L-lysine and L-tyrosine, acetate.

Глатирамер Ацетат

CAS — 28704-27-0 (glatiramer); 147245-92-9 (glatiramer acetate).
ATC — L03AX13.
ATC Vet — QL03AX13.

Adverse Effects and Precautions

Immediate post-injection reactions are common with glatiramer acetate and include chest pain, palpitations or tachycardia, dyspnoea, throat constriction, urticaria, flushing (vasodilatation), and anxiety. These reactions are generally short-lived and resolve spontaneously. They have generally occurred only some months after treatment with glatiramer was started. Other common adverse effects include asthenia, nausea, constipation, diarrhoea, rash, sweating, arthralgia, hypertonia, and dizziness. Convulsions and anaphylactoid reactions have been reported rarely. Antibodies to the drug develop with chronic therapy but are of unknown clinical significance. Pain, erythema, inflammation, mass, pruritus, and induration may occur at the injection site; localised lipoatrophy and, rarely, skin necrosis has also been reported.

Glatiramer acetate should be given with caution to patients with pre-existing cardiac disorders; such patients should be followed up regularly during treatment.

◊ References.

1. Ziemssen T, *et al.* Risk-benefit assessment of glatiramer acetate in multiple sclerosis. *Drug Safety* 2001; **24:** 979–90.

Anaphylaxis. A systemic anaphylactic reaction to glatiramer acetate developed in a patient who showed a strong immunoglobulin response including specific immunoglobulin E.[1]

1. Rauschka H, *et al.* Severe anaphylactic reaction to glatiramer acetate with specific IgE. *Neurology* 2005; **64:** 1481–2.

Effects on the skin. Localised lipoatrophy at the injection site developed in 6 patients receiving glatiramer acetate.[1] Examination of 76 patients over a 6-month period in one centre[2] revealed evidence of lipoatrophy in at least one injection site in 34 patients; of these, 5 cases were severe. Prevalence of lipoatrophy was much higher than expected, and in some cases, it occurred only a few months after treatment started.[2]
Erythema nodosum confirmed by biopsy has been reported in one patient;[3] spontaneous resolution occurred without stopping treatment.

1. Drago F, *et al.* Localized lipoatrophy after glatiramer acetate injection in patients with remitting-relapsing multiple sclerosis. *Arch Dermatol* 1999; **135:** 1277–8.
2. Edgar CM, *et al.* Lipoatrophy in patients with multiple sclerosis on glatiramer acetate. *Can J Neurol Sci* 2004; **31:** 58–63.
3. Thouvenot E, *et al.* Erythema nodosum and glatiramer acetate treatment in relapsing-remitting multiple sclerosis. *Multiple Sclerosis* 2007; **13:** 941–4.

Interactions

UK licensed product information reports that an increased incidence of injection-site reactions to glatiramer acetate has been seen in patients also given corticosteroids.

Pharmacokinetics

A substantial fraction of a subcutaneous dose of glatiramer is believed to be hydrolysed locally. Some of the injected dose is also presumed to enter the lymphatic system, either intact or partially hydrolysed.

Uses and Administration

Glatiramer acetate, a random polymer of L-alanine, L-glutamic acid, L-lysine, and L-tyrosine, is a polypeptide that has some structural resemblance to myelin basic protein, and is used to reduce the frequency of relapses in the management of relapsing-remitting multiple sclerosis (p.892). It is given by subcutaneous injection in a dose of 20 mg daily. It should not be given by the intravenous or intramuscular route. An oral formulation has been investigated with disappointing results.

Multiple sclerosis. Reviews[1,2] and a meta-analysis[3] of controlled studies of glatiramer acetate in the treatment of multiple sclerosis concluded that it is of benefit, although one systematic review[4] questions this and failed to find evidence to support its routine use. The mechanism of glatiramer acetate has also been reviewed.[5]

1. Simpson D, *et al.* Glatiramer acetate: a review of its use in relapsing-remitting multiple sclerosis. *CNS Drugs* 2002; **16:** 825–50.
2. Ruggieri M, *et al.* Glatiramer acetate in multiple sclerosis: a review. *CNS Drug Rev* 2007; **13:** 178–91.
3. Boneschi FM, *et al.* Effects of glatiramer acetate on relapse rate and accumulated disability in multiple sclerosis: meta-analysis of three double-blind, randomized, placebo-controlled clinical trials. *Multiple Sclerosis* 2003; **9:** 349–55.
4. Munari L, *et al.* Therapy with glatiramer acetate for multiple sclerosis. Available in The Cochrane Database of Systematic Reviews; Issue 4. Chichester: John Wiley; 2003 (accessed 09/01/08).
5. Schrempf W, Ziemssen T. Glatiramer acetate: mechanisms of action in multiple sclerosis. *Autoimmun Rev* 2007; **6:** 469–75.

Preparations

Proprietary Preparations (details are given in Part 3)
Arg.: Copaxone; ***Austral.:*** Copaxone; ***Austria:*** Copaxone; ***Belg.:*** Copaxone; ***Braz.:*** Copaxone; ***Canad.:*** Copaxone; ***Cz.:*** Copaxone; ***Denm.:*** Copaxone; ***Fin.:*** Copaxone; ***Fr.:*** Copaxone; ***Ger.:*** Copaxone; ***Gr.:*** Copaxone; ***Hung.:*** Copaxone; ***Irl.:*** Copaxone; ***Israel:*** Copaxone; ***Ital.:*** Copaxone; ***Mex.:*** Copaxone; ***Neth.:*** Copaxone; ***Norw.:*** Copaxone; ***NZ:*** Copaxone; ***Pol.:*** Copaxone; ***Port.:*** Copaxone; ***Rus.:*** Copaxone (Копаксон); ***Spain:*** Copaxone; ***Swed.:*** Copaxone; ***Switz.:*** Copaxone; ***Turk.:*** Copaxone; ***UK:*** Copaxone; ***USA:*** Copaxone.

Glicofosfopeptical

AM-3; Fosfoglicopeptical; Glycophosphopeptical; Immunoferon.

Иммуноферон

CAS — 87139-86-4.

Profile

Glicofosfopeptical is a polysaccharide-protein complex that is reported to possess immunostimulant properties. It has been given orally in doses of 1 g every eight hours.

◊ References.

1. Alvarez-Mon M, *et al.* Treatment with the immunomodulator AM3 improves the health-related quality of life of patients with COPD. *Chest* 2005; **127:** 1212–18.

Preparations

Proprietary Preparations (details are given in Part 3)
Mex.: Inmunol; ***Port.:*** Imunoferon; ***Spain:*** Inmunoferon.

Glucomannan

E425; Glucomanano; Harina de Konjac; Konjac Flour; Konjac Mannan.

Profile

Glucomannan, a powdered extract from the tubers of *Amorphophallus konjac*, has been promoted as an anorectic. It has been claimed to reduce the appetite by absorbing liquid in the gastrointestinal tract. It is also used in the treatment of constipation and hyperlipidaemia. Glucomannan has been investigated as a dietary adjunct in the management of diabetes mellitus.

There is a risk of intestinal or oesophageal obstruction and faecal impaction, especially if it is swallowed dry. Therefore, it should always be taken with sufficient fluid and should not be taken

immediately before going to bed. It should be avoided in patients who have difficulty swallowing.

◊ References.

1. Henry DA, *et al*. Glucomannan and risk of oesophageal obstruction. *BMJ* 1986; **292:** 591–2.
2. Renard E, *et al*. Noninsulin-dependent diabetes and glucose intolerance: effect of glucomannan fibre on blood glucose and serum insulin. *Sem Hop Paris* 1991; **67:** 153–7.
3. Vuksan V, *et al*. Beneficial effects of viscous dietary fiber from konjac-mannan in subjects with the insulin resistance syndrome: results of a controlled metabolic trial. *Diabetes Care* 2000; **23:** 9–14.
4. Staiano A, *et al*. Effect of the dietary fiber glucomannan on chronic constipation in neurologically impaired children. *J Pediatr* 2000; **136:** 41–5.
5. Loening-Baucke V, *et al*. Fiber (glucomannan) is beneficial in the treatment of childhood constipation. Abstract: *Pediatrics* 2004; **113:** 259. Full version: http://pediatrics.org/cgi/content/full/113/3/e259 (accessed 23/05/06)
6. Keithley J, Swanson B. Glucomannan and obesity: a critical review. *Altern Ther Health Med* 2005; **11:** 30–4.
7. Vanderbeek PB, *et al*. Esophageal obstruction from a hygroscopic pharmacobezoar containing glucomannan. *Clin Toxicol* 2007; **45:** 80–2.

Preparations

Proprietary Preparations (details are given in Part 3)

Arg.: Modekal†; ***Chile:*** Redicres Rapido†; ***Fr.:*** Muraligne†; ***Ger.:*** bioNorm mit Konjak†; ***India:*** Dietmann; ***Ital.:*** Dicoplus; Dietoman; NormaLine; ***Mex.:*** Dietoman; Esbeltex; Naturalfit†; ***Port.:*** Bioregime†; Florilax†.

Multi-ingredient: ***Arg.:*** KLB6 Fruit Diet; ***Chile:*** Delgadol Fibra; ***Fr.:*** Filigel; ***Ital.:*** Agioslim; Ecamannan; Glucoman; Lactomannan; ***Port.:*** Bioregime Fort†; Bioregime SlimKit†; Excess†.

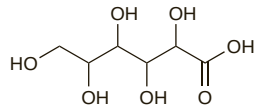
Gluconic Acid

Dextronic Acid; E574; Glycogenic Acid; Maltonic Acid; Pentahydroxycaproic Acid. D-Gluconic acid.

Глюконовая Кислота

$C_6H_{12}O_7$ = 196.2.

CAS — 526-95-4.



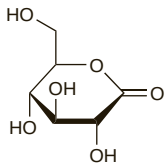
Gluconolactone

E575; Glucono delta-lactone; Glucono-delta-lactone; 1,5-Gluconolactone; D-Glucono-1,5-lactone. D-Gluconic acid δ-lactone.

Глюконолактон

$C_6H_{10}O_6$ = 178.1.

CAS — 90-80-2.



Pharmacopoeias. In *US*.

USP 31 (Gluconolactone). A fine, white, practically odourless, crystalline powder. Freely soluble in water; sparingly soluble in alcohol; insoluble in ether.

Profile

Gluconolactone is hydrolysed to gluconic acid, a polyhydroxy acid. It has similar properties to the alpha hydroxy acids glycolic acid (p.1598) and mandelic acid (p.296) and has been used in skin disorders and for urinary catheter care. Gluconolactone and gluconic acid are also used as food additives.

◊ References.

1. Grimes PE, *et al*. The use of polyhydroxy acids (PHAs) in photoaged skin. *Cutis* 2004; **73** (suppl 2): 3–13.

Preparations

Proprietary Preparations (details are given in Part 3)

Ital.: Neostrata.

Multi-ingredient: ***Arg.:*** Neoceuticals Crema Despigmentante de Dia†; Neoceuticals Gel de Limpieza Facial; Neostrata; ***Austral.:*** Neostrata; ***Canad.:*** Neostrata; ***Chile:*** Neostrata; ***Fr.:*** Ruboderm Plus; ***UK:*** Uriflex R; Uro-Tainer Solution R; ***USA:*** Renacidin.

Glucosamine *(USAN, rINN)*

Chitosamine; Glucosamina; Glucosaminum; NSC-758. 2-Amino-2-deoxy-β-D-glucopyranose.

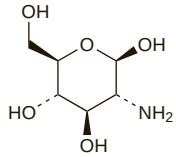
Глюкозамин

$C_6H_{13}NO_5$ = 179.2.

CAS — 3416-24-8.

ATC — M01AX05.

ATC Vet — QM01AX05.



Glucosamine Hydrochloride *(rINNM)*

Chitosamine Hydrochloride; Glucosamine, Chlorhydrate de; Glucosamini Hydrochloridum; Glukozaminy chlorowodorek; Hidrocloruro de glucosamina.

Глюкозамина Гидрохлорид

$C_6H_{13}NO_5$.HCl = 215.6.

CAS — 66-84-2.

Pharmacopoeias. In *US*.

USP 31 (Glucosamine Hydrochloride). A 2% solution in water has a pH of 3.0 to 5.0. Store in airtight containers. Protect from light.

Glucosamine Sulfate Potassium Chloride

$(C_6H_{14}NO_5)_2SO_4$,2KCl = 605.5.

Pharmacopoeias. In *US*.

USP 31 (Glucosamine Sulfate Potassium Chloride). A 2% solution in water has a pH of 3.0 to 5.0. Store in airtight containers. Protect from light.

Glucosamine Sulfate Sodium Chloride

$(C_6H_{14}NO_5)_2SO_4$,2NaCl = 573.3.

Pharmacopoeias. In *US*.

USP 31 (Glucosamine Sulfate Sodium Chloride). A 2% solution in water has a pH of 3.0 to 5.0. Store in airtight containers. Protect from light.

Profile

Glucosamine is a natural substance found in chitin, mucoproteins, and mucopolysaccharides. It is involved in the manufacture of glycosaminoglycan, which forms cartilage tissue in the body; glucosamine is also present in tendons and ligaments. Glucosamine must be synthesised by the body but the ability to do this declines with age. Glucosamine and its salts have therefore been advocated in the treatment of rheumatic disorders including osteoarthritis. Glucosamine may be isolated from chitin or prepared synthetically; glucosamine sulfate and hydriodide, have also been used.

Effects on glucose metabolism. Glucosamine has a role in glucose metabolism, increasing insulin resistance in skeletal muscle,[1,2] which has raised concerns about its safety profile in diabetic patients.[3] However, alteration of glycaemic homoeostasis was not found in a 3-year randomised controlled study in patients without diabetes.[4] A review[5] of the literature found limited data on diabetic patients taking glucosamine supplements, and recommended close monitoring of blood glucose levels in this group until more data are available.

1. Adams ME. Hype about glucosamine. *Lancet* 1999; **354:** 353–4.
2. Chan NN, *et al*. Drug-related hyperglycemia. *JAMA* 2002; **287:** 714–15.
3. Chan NN, *et al*. Glucosamine sulphate and osteoarthritis. *Lancet* 2001; **357:** 1618–9.
4. Reginster JY, *et al*. Long-term effects of glucosamine sulphate on osteoarthritis progression: a randomised, placebo-controlled clinical trial. *Lancet* 2001; **357:** 251–6.
5. Stumpf JL, Lin SW. Effect of glucosamine on glucose control. *Ann Pharmacother* 2006; **40:** 694–8.

Osteoarthritis. Glucosamine and its salts are widely available as licensed products or so-called 'health supplements' used for the management of osteoarthritis (p.11); they may be combined with other substances supposed to be of benefit, including chondroitin (p.2280), vitamins, and various herbs. Meta-analyses[1,2] of randomised placebo-controlled studies concluded that while there was some evidence for efficacy of glucosamine and chondroitin in the treatment of osteoarthritis, methodological flaws and publication bias had led to exaggeration of its potential benefit,[1] and that further studies are needed to fully characterise their disease-modifying properties.[2] A systematic review[3] of the use of glucosamine for osteoarthritis that included later controlled studies concluded that glucosamine is as safe as placebo but there was little evidence of improvement in pain or function. A further randomised controlled study[4] in 222 patients with hip osteoarthritis found no benefit after treatment with glucosamine for 2 years compared with placebo, and a meta-analysis[5] of controlled studies of chondroitin for osteoarthritis of the knee or hip concluded that chondroitin had minimal or no benefit. Further research is needed to confirm whether there are differences in efficacy between glucosamine salts, preparations, or routes, and when used with other agents (e.g. chondroitin) or in different patient subgroups.[3] A large multicentre double-blind study[6] in 1583 patients with symptomatic knee osteoarthritis to compare glucosamine and chondroitin, either alone or in combination, found no clear evidence of benefit in pain reduction compared with placebo or celecoxib, although there was a tendency to more positive results in a subset of patients with moderate to severe knee pain.

1. McAlindon TE, *et al*. Glucosamine and chondroitin for treatment of osteoarthritis: a systematic quality assessment and meta-analysis. *JAMA* 2000; **283:** 1469–75.
2. Richy F, *et al*. Structural and symptomatic efficacy of glucosamine and chondroitin in knee osteoarthritis: a comprehensive meta-analysis. *Arch Intern Med* 2003; **163:** 1514–22.
3. Towheed TE, *et al*. Glucosamine therapy for treating osteoarthritis. Available in The Cochrane Database of Systematic Reviews; Issue 2. Chichester: John Wiley; 2005 (accessed 14/05/08).
4. Rozendaal RM, *et al*. Effect of glucosamine sulfate on hip osteoarthritis: a randomized trial. *Ann Intern Med* 2008; **148:** 268–77.
5. Reichenbach S, *et al*. Meta-analysis: chondroitin for osteoarthritis of the knee or hip. *Ann Intern Med* 2007; **146:** 580–90.
6. Clegg DO, *et al*. Glucosamine, chondroitin sulfate, and the two in combination for painful knee osteoarthritis. *N Engl J Med* 2006; **354:** 795–808.

Skin reactions. The Australian Adverse Drug Reactions Advisory Committee (ADRAC)[1] has received 51 reports of allergic skin reactions with glucosamine, including erythematous rash, angioedema, urticaria, rash, and pruritus. It was noted that some preparations contain glucosamine sourced from seafood and therefore people with an allergy to shellfish may be at greater risk for hypersensitivity reactions.

1. Adverse Drug Reactions Advisory Committee (ADRAC). Skin reactions with glucosamine. *Aust Adverse Drug React Bull* 2005; **24:** 23. Also available at: http://www.tga.gov.au/adr/aadrb/aadr0512.pdf (accessed 14/05/08)

Preparations

USP 31: Glucosamine and Chondroitin Sulfate Sodium Tablets; Glucosamine and Methylsulfonylmethane Tablets; Glucosamine Tablets; Glucosamine, Chondroitin Sulfate Sodium, and Methylsulfonylmethane Tablets.

Proprietary Preparations (details are given in Part 3)

Arg.: Adaxil; Artrilase; Asoglutan; Baliartrin; Belmalen Plus; Findol; Gluco Arrumalon; Glucocartiflex; Mecanyl; Ostatac; Pertinar; Vartalon Complemento; Vartalon K; ***Austral.:*** GenFlex; ***Braz.:*** Dinaflex; Glucoreumin; Injeflex; ***Chile:*** Artridol; Bioflex; Dinaflex; Reufin; Viartril†; ***Cz.:*** Dona; Flexove; Gool; Mediflex; Voltadyn; ***Denm.:*** Ledamin; Ledflex†; ***Fin.:*** Arthryl; G-Lenk; Glucadol; Movere; ***Fr.:*** Oscart; ***Ger.:*** Dona 200-S; ***Gr.:*** Anarthril; Donarot; Glucosamil; Glusamon; Nerita; Recosine; Viartril; ***Hong Kong:*** Arthritil; Cartril-S; Chitaq; Doctor's Choice for Joints; Donna; F-Vial; MarinEx; Viartril S; Vidatril; Vitoport; Vocarxil; ***Hung.:*** Dona; Gool; ***Indon.:*** Jointfit Cream; Mediflex; Reflexor; ***Irl.:*** Arthrimel; Dona; ***Ital.:*** Dona; Viartril S†; ***Malaysia:*** Artronil; Cartril-S; Cosamine; Donna; Procosa; Viartril S; ***Mex.:*** Artriman; Faximin; Vartalon; Viartril†; ***Neth.:*** Cartimin; Glucadol; ***Norw.:*** Gluxine; Movere; ***Philipp.:*** Viartril S; ***Pol.:*** Arthryl; ***Port.:*** Arthramina; Glucomed; Glucosine; Glufan; Viartril S; ***Singapore:*** ArthriCare; Artril; Artronil; Gluco-S†; Glutilage; Kudona†; Viartril S; Vital; ***Spain:*** Cartisorb; Ceremir; Coderol; Glufan; Hespercorbin; Obifax†; Xicil; ***Swed.:*** Artrox; Glucomed; Glucosine; ***Thai.:*** Artronil; Athril; Flexsa; Gluco-S; Glucosa; Glusa; Glusamine; Viartril S; ***UK:*** Alateris; Flexeze; Joint-e-Licious; ***Venez.:*** Vartalon; Viartril S.

Multi-ingredient: ***Arg.:*** Artrilase Complex; Artrocaptin; Asotrex; Baliartrin Duo; Car-ti buron flex; Cartiflex Forte; Ecosamina; Etinox; Finartrit; Findol Plus; Gluco Arrumalon Duo; Glucobefol; Glucotrin VL; Mecanyl Duo; Nectar G; Sigmaflex; Vartalon Duo; ***Austral.:*** Bioglan Joint Mobility; GenFlex 3; GenFlex Plus; OsteoEze Bone & Joint Care; ***Braz.:*** Artrolive; Condroflex; ***Canad.:*** Glucosamine Joint & Muscle Cream with MSM†; ***Chile:*** Artridol Duo; Condrosamina†; Dinaflex Duo; Eniflex†; Euroflex; Flexure; Hiperflex; Osteo Bi-Flex; ***Hong Kong:*** Arthritil Plus; Procosamine†; ***India:*** Cosantin†; Kondro; Osteocip; Osteoflex; ***Indon.:*** Aptivium Optimum Joint Formula; Artriox; Artritin; Bonic; Cartin Plus; Chondro-PA; Fitbon; Fitbon Plus; Flexor; Fripos; Joint Care; Jointfit; Maxitrin; Naturica Artro; Naturica Artro Plus; OA; OA Forte; OA Plus; Osamin; Oste; Ostela; Osteoflam; Osteokom; Osteokom Forte; Osteonic; Osteor; Osteor Plus; Osteor-C; Osvion Plus; Rheumatin; Rheumatin Forte; Triflexor; Triostee; Viopor; Viopor-M; Viostin Com; Viostin Com DS; Vosteon; ***Ital.:*** Cartago; Fitogenase; Joint Support; Osteoclar; Reumilase SD; ***Mex.:*** Actiman; Artiflex; Vartalon Compositum; ***Philipp.:*** Flexxbon; Ruflex; ***Port.:*** Synchrocell; Synchrorose; Synchrovit; ***Rus.:*** Artra (Артра); Theraflex (Терафлекс); ***S.Afr.:*** ProFLEX; ProFLEX 750; ***Singapore:*** Arthro-Flex; Articolase (w/glucosamine); Artril C; Cartipro; Flexeze†; Glucocal; Glutilage Plus; Seven Seas JointCare; Seven Seas JointCare Max; ***UK:*** Arheumacare; BackOsamine; Flexeze; GlucOsamax; Healtheries Musseltone & Glucosamine; Joint Action; Jointace; JointCare Max; ***USA:*** Dorofen; ***Venez.:*** Artrosamin; Flexurat.

Glucose Oxidase

Corylophyline; β-D-Glucopyranose aerodehydrogenase; Glucosa oxidasa; Microcide; Notatin; P-FAD.

CAS — 9001-37-0.

Profile

Glucose oxidase is an enzyme obtained from certain fungi, which catalyses the oxidation of glucose to gluconic acid, with the concomitant production of hydrogen peroxide. It is used for its preservative properties as an additive in certain foods, sometimes with catalase (p.2278). It is also used in fertility tests and tests of diabetic control. It has been used as an ingredient of toothpastes for its supposed benefits in the prophylaxis of dental caries.