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†.

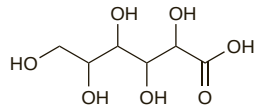
Gluconic Acid

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.



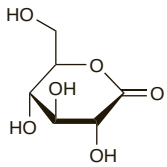
Gluconolactone

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.

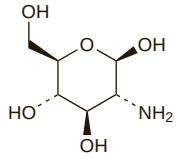
Глюкозамин

$C_6H_{13}NO_5$ = 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.