deficiency, such as certain types of osteomalacia and rickets (p.1084). Oral doses of 1 to 3 g of calcium daily are used in osteomalacia.

Oral calcium supplements can also be used as an adjunct in the management of osteoporosis (p.1084) and corticosteroid-induced osteoporosis (see Effects on Bones and Joints, under Corticosteroids, p.1491).

**Cramps.** Calcium salts are one of a number of interventions that have been tried in the management of cramps (see Muscle Spasm, p.1887). However, evidence for these interventions is mostly lacking and a small systematic review concluded that oral calcium was not of benefit for leg cramps during pregnancy.[1]

1. Young GL, Jewell D. Interventions for leg cramps in pregnancy. Available in The Cochrane Database of Systematic Reviews; Issue 1. Chichester: John Wiley; 2002 (accessed 21/06/05).

**Diagnosis of insulinoma.** Calcium stimulates the release of insulin from insulinomas. Intra-arterial calcium gluconate, followed by hepatic venous sampling, has been found to be accurate and sensitive in the diagnosis and localisation of insulinomas,[1-4] even when other investigations have been negative.[5,6]

1. Doppman JL, *et al.* Localization of insulinomas to regions of the pancreas by intra-arterial stimulation with calcium. *Ann Intern Med* 1995; **123:** 269–73.
2. Lo CY, *et al.* Value of intra-arterial calcium stimulated venous sampling for regionalization of pancreatic insulinomas. *Surgery* 2000; **128:** 903–9.
3. Brändle M, *et al.* Assessment of selective arterial calcium stimulation and hepatic venous sampling to localize insulin-secreting tumours. *Clin Endocrinol (Oxf)* 2001; **55:** 357–62.
4. Grant CS. Insulinoma. *Best Pract Res Clin Gastroenterol* 2005; **19:** 783–98.
5. O'Shea D, *et al.* Localization of insulinomas by selective intraarterial calcium injection. *J Clin Endocrinol Metab* 1996; **81:** 1623–7.
6. Pereira PL, *et al.* Insulinoma and islet cell hyperplasia: value of the calcium intraarterial stimulation test when findings of other preoperative studies are negative. *Radiology* 1998; **206:** 703–9.

**Fluoride toxicity.** Inorganic fluoride is corrosive to skin and mucous membranes and acute intoxication disrupts many physiological systems; severe burns and profound hypocalcaemia may ensue. Absorption of the fluoride can be prevented by conversion to an insoluble form such as calcium fluoride and thus irrigation of skin (or gastric lavage as appropriate) with lime water, milk, or a 1% solution of calcium gluconate is recommended. Immediate treatment should also consist of 10 mL of calcium gluconate 10% intravenously, repeated after one hour; 30 mL should be given if tetany is present. In the short term affected skin and tissue should be injected with a 10% solution of calcium gluconate at a dose of 0.5 mL/cm$^2$ and burnt skin treated with a calcium gluconate 2.5% gel.[1]

See also under Hydrofluoric Acid, p.2322.

1. McIvor ME. Acute fluoride toxicity: pathophysiology and management. *Drug Safety* 1990; **5:** 79–85.

**Hypertension.** Meta-analysis suggests that calcium supplementation results in a small reduction in systolic and diastolic blood pressure.[1] Although the effect was too small to support the use of calcium supplementation for preventing or treating hypertension (p.1171), it is possible that calcium supplementation might have beneficial effects on blood pressure in those with an inadequate intake. In a controlled trial, calcium with vitamin D supplementation reduced systolic blood pressure more effectively than calcium alone.[2]

1. Griffith LE, *et al.* The influence of dietary and nondietary calcium supplementation on blood pressure: an updated metaanalysis of randomized controlled trials. *Am J Hypertens* 1999; **12:** 84–92.
2. Pfeifer M, *et al.* Effects of a short-term vitamin D and calcium supplementation on blood pressure and parathyroid hormone levels in elderly women. *J Clin Endocrinol Metab* 2001; **86:** 1633–7.

***PREGNANCY.*** Despite an earlier meta-analysis[1] which concluded that calcium supplementation during pregnancy reduced systolic and diastolic blood pressure and the incidence of pre-eclampsia and hypertension, results from a double-blind, placebo-controlled trial in a total of 4589 women indicated that calcium supplementation during normal pregnancy did not prevent pre-eclampsia, pregnancy-associated hypertension without pre-eclampsia, or a number of other related disorders.[2] A subsequent review[3] found that calcium supplementation was beneficial, but it was noted that there was a wide variation in results between different studies; most of the effect was in studies including women identified as being at high risk for pre-eclampsia, and results from studies including lower-risk women found that calcium had no effect. The high-risk studies were carried out in areas with a low dietary calcium intake, suggesting that benefit might be greatest in such populations. However, a further study[4] in 8325 women living in areas with a low calcium intake but not specifically at high risk found that calcium supplementation had no significant effect on the incidence of pre-eclampsia, although it did reduce the risk of severe pre-eclamptic complications. An updated meta-analysis,[5] which included this study, concluded that calcium supplementation during pregnancy was safe and that it did reduce the incidence of pre-eclampsia and serious complications, particularly in high-risk women.

For discussions of hypertension in pregnancy and eclampsia and pre-eclampsia, see p.1171 and p.470, respectively.

1. Bucher HC, *et al.* Effect of calcium supplementation on pregnancy-induced hypertension and preeclampsia: a meta-analysis of randomized controlled trials. *JAMA* 1996; **275:** 1113–17. Correction. *ibid.*; **276:** 1388.
2. Levine RJ, *et al.* Trial of calcium to prevent preeclampsia. *N Engl J Med* 1997; **337:** 69–76.
3. DerSimonian R, Levine RJ. Resolving discrepancies between a meta-analysis and a subsequent large controlled trial. *JAMA* 1999; **282:** 664–70.
4. Villar J, *et al.* World Health Organization Calcium Supplementation for the Prevention of Preeclampsia Trial Group. World Health Organization randomized trial of calcium supplementation among low calcium intake pregnant women. *Am J Obstet Gynecol* 2006; **194:** 639–49.
5. Hofmeyr GJ, *et al.* Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Available in The Cochrane Database of Systematic Reviews; Issue 3. Chichester: John Wiley; 2006 (accessed 17/01/08).

**Malignant neoplasms.** There is some evidence that calcium supplementation may modestly reduce the risk[1-3] of colorectal cancer and its recurrence.[4-6] This protective effect appears to be more pronounced for advanced colorectal lesions,[7] and when serum concentrations of vitamin D are in the higher range.[8]

1. Wu K, *et al.* Calcium intake and risk of colon cancer in women and men. *J Natl Cancer Inst* 2002; **94:** 437–46.
2. McCullough ML, *et al.* Calcium, vitamin D, dairy products, and risk of colorectal cancer in the Cancer Prevention Study II Nutrition Cohort (United States). *Cancer Causes Control* 2003; **14:** 1–12.
3. Cho E, *et al.* Dairy foods, calcium, and colorectal cancer: a pooled analysis of 10 cohort studies. *J Natl Cancer Inst* 2004; **96:** 1015–22. Correction. *ibid.*; 1724.
4. Baron JA, *et al.* Calcium supplements for the prevention of colorectal adenomas. *N Engl J Med* 1999; **340:** 101–7.
5. Bonithon-Kopp C, *et al.* Calcium and fibre supplementation in prevention of colorectal adenoma recurrence: a randomised intervention trial. *Lancet* 2000; **356:** 1300–6.
6. Martínez ME, *et al.* Calcium, vitamin D, and risk of adenoma recurrence (United States). *Cancer Causes Control* 2002; **13:** 213–20.
7. Wallace K, *et al.* Effect of calcium supplementation on the risk of large bowel polyps. *J Natl Cancer Inst* 2004; **96:** 921–5.
8. Grau MV, *et al.* Vitamin D, calcium supplementation, and colorectal adenomas: results of a randomized trial. *J Natl Cancer Inst* 2003; **95:** 1765–71.

**Premenstrual syndrome.** Calcium supplementation was effective in relieving the luteal phase symptoms of premenstrual syndrome (p.2099) in 1 study.[1] A review of this and other studies suggested that calcium supplementation at a dose of 1.2 to 1.6 g daily should be considered in patients with premenstrual syndrome.[2]

1. Thys-Jacobs S, *et al.* Calcium carbonate and the premenstrual syndrome: effects on premenstrual and menstrual symptoms. *Am J Obstet Gynecol* 1998; **179:** 444–52.
2. Ward MW, Holimon TD. Calcium treatment for premenstrual syndrome. *Ann Pharmacother* 1999; **33:** 1356–8.

## Preparations

***BP 2008:*** Calcium and Ergocalciferol Tablets; Calcium Chloride Injection; Calcium Gluconate Injection; Calcium Gluconate Tablets; Calcium Lactate Tablets; Effervescent Calcium Gluconate Tablets;
***BPC 1973:*** Calcium with Vitamin D Tablets;
***USP 31:*** Aluminum Sulfate and Calcium Acetate for Topical Solution; Aluminum Sulfate and Calcium Acetate Tablets for Topical Solution; Calcium Acetate Tablets; Calcium Chloride Injection; Calcium Glubionate Syrup; Calcium Gluceptate Injection; Calcium Gluconate Injection; Calcium Gluconate Tablets; Calcium Lactate Tablets; Calcium Levulinate Injection; Calcium with Vitamin D Tablets; Dibasic Calcium Phosphate Tablets; Half-strength Lactated Ringer's and Dextrose Injection; Lactated Ringer's and Dextrose Injection; Lactated Ringer's Injection; Potassium Chloride in Lactated Ringer's and Dextrose Injection.

**Proprietary Preparations** (details are given in Part 3)
***Arg.:*** Calcimax; Calcio Cit Simple; Calcional Citrato; Calcium-Sandoz; Citramar; Findeclin Combi; Ostram; Procalcio; Raffo-Ca; Regucal; Royen; Sigmacal; ***Austral.:*** Celloids CP 57; Citracal†; Sandocal; ***Austria:*** Calcium Fresenius; Calcium-Sandoz; Mono Kalz; Ostram; Phos-Ex; ***Belg.:*** Sandoz Calcium; ***Braz.:*** Calcium-Sandoz; Calcium-Sandoz F; Miocalven; Osteocalcic†; ***Canad.:*** Calciject; Calcium-Rougier†; Calcium-Sandoz†; Osteocit; ***Chile:*** Calcimin; Elcal I†; Kaplus; Ostram; Phoslo; ***Cz.:*** Phosphosorb; ***Denm.:*** Calcium-Sandoz; Phos-Ex; ***Fin.:*** Calcium-Sandoz; Phos-Ex; ***Fr.:*** CAL Ocean; Calcium-Sandoz; Kalcikidz†; Ostram; ***Ger.:*** Calciretard; Calcitrat; Calcium Eifelfango†; Calcium Fresenius†; Calcium-Sandoz; Cerasorb; Eubiolac; Phos-Ex; ***Gr.:*** Neocalcit; Osteorel; Osteus; ***Hong Kong:*** Calcium Unison; Calcium Vida; Calcium-Sandoz†; Citracal; Gluco-Calcium†; Mega-Cal; ***Hung.:*** Bano; Calcimusc; Calcium-Sandoz; Citrokalcium; ***India:*** Calcium-Sandoz; Phosforid; ***Indon.:*** Dumocalcin; Licokalk; ***Irl.:*** Calcium-Sandoz†; Sandocal; ***Israel:*** Calcium-Sandoz; ***Ital.:*** Calcetat; Calcium-Sandoz; ***Malaysia:*** Ca Lac†; Citracal†; Trocium†; ***Mex.:*** Bionokaltran; Bon-Ker†; Calcidef; Calcifox; Calcigenol Doble; Calciofem; Calcium-Sandoz; Calcival; Ostram†; ***Neth.:*** Calcium-Sandoz; Phos-Ex; ***Norw.:*** Calcium-Sandoz; Phos-Ex; ***NZ:*** Calcium-Sandoz; ***Philipp.:*** Calcebone; United Home Calactate; ***Pol.:*** Calcium Calfit; Calcium Syrop; Ostical; Ostram; Sanosvit Calcium; Satural; ***Port.:*** Calcium-Sandoz; Phosphosorb; Sandocal; ***Rus.:*** Calcium-Sandoz Forte (Кальций-Сандоз Форте); ***S.Afr.:*** Calcium-Sandoz; Glucal; ***Singapore:*** Calcium-Sandoz; Citracal; Hydrofluoric Acid Antidote†; Os-Cal; Vitacal; ***Spain:*** Calcio 20 Emulsion; Calcium-Sandoz Forte; Calcium-Sandoz†; Ibercal; Oseofort; Ostram; Royen; Tepox Cal; ***Swed.:*** Calcium-Sandoz; Phos-Ex; ***Switz.:*** Calcium-Sandoz; ***Thai.:*** Calcibon†; Calcium Unison; Calcium-Sandoz; Calsorp; Calvin; Kal-Forte; Lo-P-Caps; ***Turk.:*** Anti-Fosfat Ca; Calcium-Sandoz; Phos-Ex; ***UK:*** BioCalth; Calcium-Sandoz; Ostram; Phos-Ex; Sandocal; ***USA:*** Cal-C; Cal-Citrate; Cal-G; Cal-Lac; Calphron; Citracal; Oyster Calcium; PhosLo; Posture; ***Venez.:*** Calcibon; Calcitrex; Calcium-Sandoz; Citracal; Maxical; Oscale.

**Multi-ingredient:** ***Arg.:*** Anartrit; Anusol-A; Beriplast P; Calcimax D3; Calcio Cit; Calcional D3; Calcium D†; Cavirox Cit; Citramar D; Flucalin; Isaflavon; Magnesio Incaico; Noacid Diates; Ostram D3; Regucal D; Sojar Plus-Calcio; Tissucol; Tissucol Duo Quick†; ***Austral.:*** Bioglan Cirflo†; Bioglan Mens Super Soy/Clover; Bioglan Soy Power Plus; Cardioplegia A; Celloid Compounds Magcal Plus; Celloid Compounds Sodical Plus; Chelated Cal-Mag; Duo Celloids CPIP; Duo Celloids CPMP; Duo Celloids PCCP; Duo Celloids SPCP; Extralife Meno-Care; Extralife Sleep-Care; FAB Tri-Cal; Magnesium Plus†; PhytoLife; Prosteo†; Silicic Complex†; Soy Forte with Black Cohosh†; Tisseel Duo; Tyrosenġ†; ***Austria:*** Beriplast; Calcipot C; Calcipot D ; Calcisan; Calcisan B + C; Calcisan C; Calcisan D; Centramin; Coldargan; Coldistan; EST; Famel cum Codein; Famel cum Ephedrin; Lactolavol; Macalvit; Maxi-Kalz; Mega-Calcium; Orocholin; Ruticalzon; Tissucol; Tissucol Duo Quick; ***Belg.:*** Sandoz Calcium + Vitamine C†; Tissucol Duo; Topcal D3†; ***Braz.:*** Alergo Glucalbet†; Beriplast P; Calcifix B12; Calcifix Irradiado; Calcigenol; Calcinol Complexo; Calcium D3; Calcium-Sandoz + Vitamina C; Miocalven D; OsteoNutri; Regulador Xavier N-1†; Rhum Creosotado; Tissucol†; ***Canad.:*** Calcium Magnesium Plus†; Calcium Stanley†; Kid's Chewable Cal-Mag†; Mega Cal Calcium†; Tisseel; ***Chile:*** Beriplast P; C-1000-C†; Calcigran; Calcimax D3; Calcio 520; Calcio Cm; Calcio Nil Forte†; Calcio Nil†; Calciovit Puro; Calcium-Sandoz Forte D; Caprimida D Balance; Crevet Calcio + D3 + C; Elcal-D; Kaplus-D; Ostram D3; Trical-D; Tridin†; ***Cz.:*** Calcium C Neo; Calcium C†; Calcium-Sandoz FF; Calcium-Sandoz Forte; Methiaden Calcium†; OsvaRen; Tissucol; Tridin; ***Denm.:*** Tisseel Duo Quick; ***Fin.:*** D-Calsor; Mega-Calcium; Ostram-Vit D †; Tisseel Duo Quick; ***Fr.:*** Beriplast; Ca-C†; Calciforte; Carbophos; Cataridol†; Chloro-Magnesion†; Cristopal†; Curasten; Desintex Infantile; Dops; Estrofort; Frubiose Vitamine D†; Galactogil; Galirene†; Gastropax; Ostram Vitamine D ; Quixil; Tissucol; Vagostabyl; Verrulyse-Methionine; ***Ger.:*** Acidovert†; Beriplast; Calcipot; Calcium Braun; Calcium-dura Vit D ; Calcium-Rutinion†; calcivitase†; Ermsech†; Ferro-C-Calcium; Fluoril; Frubiase Calcium forte 500; Frubiase Calcium T; Hicoton†; Junisana†; Oscevitin-A†; Ossofortin†; Osspulvit S forte†; Osspulvit S†; Quixil; rohasal†; Tissucol Duo S; Tissucol-Kit; Tridin; ***Gr.:*** Beriplast P; Caldesil; Cidominet; Decal; Flavobion-C; Frubiose-N†; Gluta-calcium†; Iodocollyre; Mega-calcium; ***Hong Kong:*** Beriplast P; Ca-C†; Callimon; Caltrate + D; Caltrate Plus; Citracal + D; Liverall†; Magesto; Mega-Cal with Vit D; Osteocare; Scott's Emulsion Orange; Tisseel; Tridin; ***Hung.:*** Beriplast P; Burofix†; Calciphedrin†; Calcium-Sandoz + Vitamin C; Caldea†; Coldargan; Fagifor†; Tissucol-Kit; Tridin; Trypsin†; ***India:*** Alfacip Plus; Aristrol Forte†; Cadisper C; Cafe-Kit†; Calcinol; Cataarest; Cato-Bell; CKP; Cotaryl; Gynae-CVP; Kalpastic; Kalzana; Macalvit; Milical; Milical-XP†; Omilcal; Ossivite; Ostebon; Ostocalcium; Ostocalcium B-12; Sigmacalvit; Siochrome; Styptocid; Styptocip†; ***Indon.:*** Beriplast; Cal-95; Calc-Os; Calcidin; Calcimega; Calcium Ad; Calcium-Sandoz; Calcium-Sandoz Forte; Calcium-Sandoz Vit C; Calosbon; Calsical; Cavit D3; CDR Fortos; Dumocalcin Plus; Hi-Bone; Jointfit; LaktaFit; Licokalk Plus; Menoxa; Osimax; Ossovit; Osteocare; Osteopor; Oxcal; Scott's E Vita; Scott's Emulsion; Steopor; Thymcal; Totilac; Vosteon; ***Irl.:*** Bio-Calcium + D ; Bio-Calcium + D + K; Caltrate Plus; Chocovite; Decal; Osteofos D3; ***Israel:*** Beriplast; Calcium Citrate; Calcium-Sandoz + Vit C; Quixil; Tisseel; ***Ital.:*** Beriplast; Biotassina; Calcio Dobetin; Calciozim†; Calciumcafe; Calisvit; CalplusD3; Caltrate; Famel†; Foscald3; Ginvapast; Jodo Calcio Vitaminico; Katoxyn; Lactocol; Osteofos D3; Osteosil Calcium; Ostram D ; Otofluor; Polijodurato; Quixil; Rex; Sedocalcio; Sedopuer F; Silvia Osteo; Tissucol; Tridin; ***Malaysia:*** Adult Citrex Cal-Mag-D3; Bio-Enhanced Calcium Plus; Calcium-Sandoz + Vitamin C; Calcium-Sandoz Forte†; Citracal + D†; Dumocalcin†; Junior Citrex Cal-Mag-D3; Milical; Supa Biocal Vitahealth†; ***Mex.:*** Bedoce-Cal; Beriplast P; C-1000-C; Calciyodina; Calpharma; Caltrec†; Domeboro; Emulsion de Scott; Fluoxytil; Osteocalcio; Posture D; Sandoz Calcium + D; Serracal; Tissucol†; ***Neth.:*** Beriplast P; Calisvit; Quixil; Tissucol; Tissucol Duo; ***Philipp.:*** Caltrate Plus; Glutaphos; Her Soy Plus; Osteo-4; Osteocare; Time-Cee; Ton-A; ***Pol.:*** Ascalcin; Ascalcin Plus; Ascorutical; Beriplast; Calcium C; Sirupus Pini Compositus; Sirupus Tussipini; Sirupus Tussipini D; Wamag; ***Port.:*** Bidiam; Ca-C; Calcigenol; Calcium 600†; Decalcit; Mucal†; Ostram D3†; Osvaren; Osvical; Quixil; Tissucol Duo; ***Rus.:*** Antigrippin-ANVI (Антигриппин-АНВИ); Calcemin (Кальцемин); Calcemin Advance (Кальцемин Адванс); ***S.Afr.:*** Phytopause BSF; Sandoz Calcium-C†; Vitaplus C Plus; ***Singapore:*** BoneCare; Ca-C; Cavit-D3; Citracal + D; Dumocalcin; Flexeze†; Lacto Calcium†; Os-Cal + D; Vita Calmag Zn†; Vitacal; Vitacal + D; ***Spain:*** Alka-Seltzer; Beriplast P Combi; Boldolaxin†; Calcio 20 Complex; Calcio 20 Fuerte; Calcium-Sandoz Forte D; Creacal†; Duplicalcio 150†; Duplicalcio B12; Duplicalcio Hidraz†; Ginejuvent; Ibercal D; Mencalisvit; Metafisol; Osteomerck; Osvical D; Tepox Cal D; Tissucol Duo; Trabex; ***Swed.:*** Macalvit; Relaxit; Tisseel Duo Quick; ***Switz.:*** Beriplast P; C-Calcium; Ca-C†; Calcium D Sauter; Calcivit; Callimon†; Calpred; Decalcit; Demostan N; Famel; Fungex; Ginvapast; Glucocalcium; Phytopharma Calcium; Pidocal†; Stilex; Tissucol; Tissucol Duo S; Vin Tonique de Vial†; ***Thai.:*** Bio-Calcium + D3 + K; Biocalron; Ca-C; Cal-D-Vita; Calcalcin; Calchew; Calcioday-D†; Calcium D; Caltrate Plus; Calvin Plus; Combi-Cal†; Gluco-Calcium; Ostone-B12; Phocium†; ***Turk.:*** Beriplast P; Calcidine; Calcimax D3; Calcium Picken; Calcium-Sandoz C; Caltrate; Folic Plus; Fosfokalsiyum; Fungecyl; Kalsifluor; Nature Made Oyster Shell Calcium; Osteocare; Tisseel VH; ***UK:*** Calcimax; Calcium and Ergocalciferol Tablets; Calcium Clear; Calfovit D3; Caltrate Plus; Crampex; Glykola; Haliborange Calcium Plus Vitamin D; Osteo-Life; Osteocare; Osteopro; Phytolife Plus; S.P.H.P. Salivix; Tisseel; ***USA:*** Artiss; Bayer Womens Aspirin Plus Calcium; Bluboro†; Boropak†; Calcet; Calphosan; Caltrate Plus; Calvite P & D; Citracal + D; Citracal Creamy Bites†; Citracal Plus with Magnesium; Domeboro; Ester-C Plus; GEM 21S; Mag-Cal Mega; Magonate; Oyster Calcium with Vitamin D; Pedi-Boro Soak Paks; Posture-D; PremesisRx; ***Venez.:*** A-D-Vit; Calcibon D; Calcibon D Magnesio; Calcibon D Soya; Calcibon Natal; Calcinor D; Calciofar D; Calciogenol; Calcion D Plus; Calcitrex D3; Calpal D†; Citracal D; Dicalcico†; Gestocal†; Maltocalcine.

*Used as an adjunct in:* ***Swed.:*** Deltison.

# Magnesium

Magnesio; Magnésium; Magnez.

Mg = 24.305.

**Description.** Magnesium is a cation given as various magnesium-containing salts.

**Incompatibility.** Magnesium salts have been reported to be incompatible with a wide range of drugs.

## Magnesium Acetate

Magnesii acetas tetrahydricus; Magnesio, acetato de; Magnésium (acétate de) tétrahydraté; Magnesiumacetattetrahydrat; Magnesiumasetaattitetrahydraatti; Magnézium acetáttetrahidrát; Magnezu octan; Magnio acetatas tetrahidratas; Octan hořečnatý tetrahydrát.

$C_4H_6MgO_4,4H_2O$ = 214.5.

*CAS — 142-72-3 (anhydrous magnesium acetate); 16674-78-5 (magnesium acetate tetrahydrate).*

**Pharmacopoeias.** In *Eur.* (see p.vii).
**Ph. Eur. 6.2** (Magnesium Acetate Tetrahydrate). Colourless crystals or a white or almost white, crystalline powder. Freely soluble in water and in alcohol. A 5% solution in water has a pH of 7.5 to 8.5.

**Equivalence.** Each g of magnesium acetate (tetrahydrate) represents about 4.7 mmol of magnesium and the equivalent of bicarbonate. Magnesium acetate (tetrahydrate) 8.83 g is equivalent to about 1 g of magnesium.

## Magnesium Ascorbate

Magnesio, ascorbato de.

$(C_6H_7O_6)_2Mg$ = 374.5.
*CAS — 15431-40-0.*

**Equivalence.** Each g of magnesium ascorbate (anhydrous) represents about 2.7 mmol of magnesium. Magnesium ascorbate (anhydrous) 15.4 g is equivalent to about 1 g of magnesium.

## Magnesium Aspartate

Bázisos magnézium-aszpartát-dihidrát; Magnesii aspartas dihydricus; Magnesii Hydrogenoaspartas Dihydricus; Magnesio, aspartato de; Magnésium (aspartate de) dihydraté; Magnesium Aspartate Dihydrate; Magnesiumaspartaattidihydraatti; Magnesiumaspartatdihydrat; Magnesium-hydrogen-aspartát dihydrát; Magnio aspartatas dihidratas. Magnesium aminosuccinate dihydrate; Magnesium di[(*S*)-2-aminohydrogenobutane-1,4-dioate].

$C_8H_{12}MgN_2O_8,2H_2O$ = 324.5.
*CAS — 18962-61-3 (anhydrous magnesium aspartate); 2068-80-6 (anhydrous magnesium aspartate or magnesium aspartate dihydrate); 7018-07-7 (magnesium aspartate tetrahydrate);.*
*ATC — A12CC05.*
*ATC Vet — QA12CC05.*

**Pharmacopoeias.** *Eur.* (see p.vii) includes the dihydrate form of the (*S*)-aspartate. *Ger.* includes the tetrahydrate form of the racemic aspartate.
**Ph. Eur. 6.2** (Magnesium Aspartate Dihydrate; Magnesium Aspartate BP 2008). A white or almost white, crystalline powder or colourless crystals. Freely soluble in water. A 2.5% solution in water has a pH of 6.0 to 8.0.

**Equivalence.** Each g of magnesium aspartate (dihydrate) represents about 3.1 mmol of magnesium. Magnesium aspartate (dihydrate) 13.4 g is equivalent to about 1 g of magnesium.

Each g of magnesium aspartate (tetrahydrate) represents about 2.8 mmol of magnesium. Magnesium aspartate (tetrahydrate) 14.8 g is equivalent to about 1 g of magnesium.

## Magnesium Chloride

Chlorid hořečnatý; Chlorure de Magnésium Cristallisé; Cloreto de Magnésio; E511; Magnesii chloridum; Magnesio, cloruro de; Magnesium Chloratum; Magnésium, chlorure de; Magnesiumklorid; Magnesiumkloridi; Magnézium-klorid; Magnezu chlorek; Magnio chloridas.

$MgCl_2,xH_2O$ = 95.21 (anhydrous); 203.3 (hexahydrate).
*CAS — 7786-30-3 (anhydrous magnesium chloride); 7791-18-6 (magnesium chloride hexahydrate).*
*ATC — A12CC01; B05XA11.*
*ATC Vet — QA12CC01; QB05XA11.*

**Pharmacopoeias.** *Eur.* (see p.vii), *US*, and *Viet*. include the hexahydrate.
*Eur.* also includes magnesium chloride 4.5-hydrate.
**Ph. Eur. 6.2** (Magnesium Chloride Hexahydrate; Magnesii Chloridum Hexahydricum). Colourless, hygroscopic crystals. Very soluble in water; freely soluble in alcohol. Store in airtight containers.
**Ph. Eur. 6.2** (Magnesium Chloride 4.5-Hydrate; Magnesii Chloridum 4.5-Hydricum; Partially Hydrated Magnesium Chloride BP 2008). A white or almost white, hygroscopic, granular powder. Very soluble in water; freely soluble in alcohol. Store in airtight containers.
**USP 31** (Magnesium Chloride). Colourless, odourless, deliquescent flakes or crystals, which lose water when heated to 100° and lose hydrochloric acid when heated to 110°. Very soluble in water; freely soluble in alcohol. pH of a 5% solution in water is between 4.5 and 7.0. Store in airtight containers.

**Equivalence.** Each g of magnesium chloride (hexahydrate) represents about 4.9 mmol of magnesium and 9.8 mmol of chloride. Magnesium chloride (hexahydrate) 8.36 g is equivalent to about 1 g of magnesium.

## Magnesium Gluceptate

Magnesio, glucoheptonato de; Magnesium Glucoheptonate.

$C_{14}H_{26}MgO_{16}$ = 474.7.

**Equivalence.** Each g of magnesium gluceptate (anhydrous) represents about 2.1 mmol of magnesium. Magnesium gluceptate (anhydrous) 19.5 g is equivalent to about 1 g of magnesium.

## Magnesium Gluconate

Magnesii gluconas; Magnesio, gluconato de; Magnésium, gluconate de. Magnesium D-gluconate hydrate.

$C_{12}H_{22}MgO_{14}(+xH_2O)$ = 414.6 (anhydrous).
*CAS — 3632-91-5 (anhydrous magnesium gluconate); 59625-89-7 (magnesium gluconate dihydrate).*
*ATC — A12CC03.*
*ATC Vet — QA12CC03.*

**Pharmacopoeias.** In *Eur.* (see p.vii), which allows either anhydrous or hydrated forms, and in *US*, which allows either anhydrous or the dihydrate.
**Ph. Eur. 6.2** (Magnesium Gluconate). A white or almost white, amorphous, hygroscopic, crystalline or granular powder. Freely soluble in water; slightly soluble in alcohol; very slightly soluble in dichloromethane. Store in airtight containers.
**USP 31** (Magnesium Gluconate). Colourless crystals or a white powder or granules. Is odourless. Freely soluble in water; very slightly soluble in alcohol; insoluble in ether. pH of a 5% solution in water is between 6.0 and 7.8.

**Equivalence.** Each g of magnesium gluconate (anhydrous) represents about 2.4 mmol of magnesium. Magnesium gluconate (anhydrous) 17.1 g is equivalent to about 1 g of magnesium.

## Magnesium Glycerophosphate

Glycerofosforečnan hořečnatý; Magnesii glycerophosphas; Magnesio, glicerofosfato de; Magnesium Glycerinophosphate; Magnésium, glycérophosphate de; Magnesiumglycerofosfat; Magnesiumglyserofosfaatti; Magnézium-glicerofoszfát; Magnio glicerofosfatas.

$C_3H_7MgO_6P(+xH_2O)$ = 194.4 (anhydrous).
*CAS — 927-20-8 (anhydrous magnesium glycerophosphate).*

**Pharmacopoeias.** In *Eur.* (see p.vii).
**Ph. Eur. 6.2** (Magnesium Glycerophosphate). A mixture, in variable proportions, of magnesium (*R,S*)-2,3-dihydroxypropyl phosphate and magnesium 2-hydroxy-1-(hydroxymethyl)ethyl phosphate. It may be hydrated. A white or almost white, hygroscopic powder. Practically insoluble in alcohol; dissolves in dilute solutions of acids. Store in airtight containers.

**Equivalence.** Each g of magnesium glycerophosphate (anhydrous) represents about 5.1 mmol of magnesium. Magnesium glycerophosphate (anhydrous) 8 g is equivalent to about 1 g of magnesium.

## Magnesium Lactate

Magnesii lactas; Magnesio, lactato de; Magnésium, lactate de; Magnesiumlaktaatti; Magnesiumlaktat; Magnesium-laktát; Magnezu mleczan. Magnesium 2-hydroxypropionate.

$C_6H_{10}MgO_6$ = 202.4.
*CAS — 18917-93-6.*
*ATC — A12CC06.*
*ATC Vet — QA12CC06.*

**Pharmacopoeias.** *Eur.* (see p.vii) includes the dihydrate.
**Ph. Eur. 6.2** (Magnesium Lactate Dihydrate; Magnesii Lactas Dihydricus). A white or almost white, crystalline or granular powder. Slightly soluble in water; soluble in boiling water; practically insoluble in alcohol. A 5% solution in water has a pH of 6.5 to 8.5.

**Equivalence.** Each g of magnesium lactate (anhydrous) represents about 4.9 mmol of magnesium. Magnesium lactate (anhydrous) 8.33 g is equivalent to about 1 g of magnesium.

## Magnesium Phosphate

Magnesio, fosfato de; Tribasic Magnesium Phosphate; Trimagnesium Phosphate.

$Mg_3(PO_4)_2,5H_2O$ = 352.9.
*CAS — 7757-87-1 (anhydrous magnesium phosphate); 10233-87-1 (magnesium phosphate pentahydrate).*
*ATC — B05XA10.*
*ATC Vet — QB05XA10.*

**Pharmacopoeias.** In *US*.
*Ger.* includes Magnesium Hydrogen Phosphate Trihydrate ($MgHPO_4,3H_2O$ = 174.3).
**USP 31** (Magnesium Phosphate). A white, odourless, powder. Almost insoluble in water; readily soluble in dilute mineral acids.

**Equivalence.** Each g of magnesium phosphate (pentahydrate) represents about 8.5 mmol of magnesium and 5.7 mmol of phosphate. Magnesium phosphate (pentahydrate) 4.84 g is equivalent to about 1 g of magnesium.

## Magnesium Pidolate *(pINNM)*

Magnesii pidolas; Magnésium, pidolate de; Magnesium Pyroglutamate; Magnesiumpidolaatti; Magnesiumpidolat; Magnesium-pidolát; Magnézium-pidolát; Magnio pidolatas; Pidolate de Magnesium; Pidolato de magnesio. Magnesium 5-oxopyrrolidine-2-carboxylate.

Магния Пидолат

$(C_5H_6NO_3)_2Mg$ = 280.5.
*CAS — 62003-27-4.*
*ATC — A12CC08.*
*ATC Vet — QA12CC08.*

**Pharmacopoeias.** In *Eur.* (see p.vii).
**Ph. Eur. 6.2** (Magnesium Pidolate). An amorphous, white or almost white, hygroscopic powder. Very soluble in water; practically insoluble in dichloromethane; soluble in methyl alcohol. A 10% solution in water has a pH of 5.5 to 7.0. Store in airtight containers.

**Equivalence.** Each g of magnesium pidolate (anhydrous) represents about 3.6 mmol of magnesium. Magnesium pidolate (anhydrous) 11.5 g is equivalent to about 1 g of magnesium.

## Magnesium Sulfate

518; Epsom Salts; Magnesii sulfas; Magnesio, sulfato de; Magnésium, sulfate de; Magnesium Sulphate; Magnesiumsulfaatti; Magnesiumsulfat; Magnézium-szulfát; Magnezu siarczan; Magnio sulfatas; Sal Amarum; Sel Anglais; Sel de Sedlitz; Síran hořečnatý.

$MgSO_4,xH_2O$ = 120.4 (anhydrous); 246.5 (heptahydrate).
*CAS — 7487-88-9 (anhydrous magnesium sulfate); 10034-99-8 (magnesium sulfate heptahydrate).*
*ATC — A06AD04; A12CC02; B05XA05; D11AX05; V04CC02.*
*ATC Vet — QA06AD04; QA12CC02; QB05XA05; QD11AX05; QV04CC02.*

**Pharmacopoeias.** *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, and *Viet.* include the heptahydrate.
*US* allows the dried form, the monohydrate, or the heptahydrate form.
The dried form is included in *Br.*
**Ph. Eur. 6.2** (Magnesium Sulphate Heptahydrate; Magnesii Sulfas Heptahydricus). A white or almost white, crystalline powder or brilliant, colourless crystals. Freely soluble in water; very soluble in boiling water; practically insoluble in alcohol.
The BP 2008 gives Epsom Salts as an approved synonym.
**BP 2008** (Dried Magnesium Sulphate). A white odourless or almost odourless powder, prepared by drying magnesium sulfate (heptahydrate) at 100° until it has lost about 25% of its weight; it contains 62 to 70% of $MgSO_4$. Freely soluble in water; more rapidly soluble in hot water.
The BP gives Dried Epsom Salts as an approved synonym.
**USP 31** (Magnesium Sulfate). It is the dried form, monohydrate, or the heptahydrate. Small, colourless crystals, usually needle-like. It effloresces in warm dry air. Soluble 1 in 0.8 of water and 1 in 0.5 of boiling water; freely but slowly soluble 1 in 1 of glycerol; sparingly soluble in alcohol. pH of a 5% solution in water is between 5.0 and 9.2.

**Equivalence.** Each g of magnesium sulfate (heptahydrate) represents about 4.1 mmol of magnesium. Magnesium sulfate (heptahydrate) 10.1 g is equivalent to about 1 g of magnesium.

## Adverse Effects

Excessive parenteral doses of magnesium salts lead to the development of hypermagnesaemia, important signs of which are respiratory depression and loss of deep tendon reflexes, both due to neuromuscular blockade. Other symptoms of hypermagnesaemia may include nausea, vomiting, flushing of the skin, thirst, hypotension due to peripheral vasodilatation, drowsiness, confusion, slurred speech, double vision, muscle weakness, bradycardia, coma, and cardiac arrest.

Hypermagnesaemia is uncommon after oral magnesium salts except in the presence of renal impairment. Ingestion of magnesium salts may cause gastrointestinal irritation and watery diarrhoea.

**Effects on the gastrointestinal tract.** There are isolated reports of paralytic ileus in patients receiving magnesium salts.[1,2] Delayed intestinal transit has also been reported in a neonate who received an intramuscular overdose of magnesium.[3] See also Pregnancy, under Precautions, below.


1. Hill WC, *et al*. Maternal paralytic ileus as a complication of magnesium sulfate tocolysis. *Am J Perinatol* 1985; **2:** 47–8.
2. Golzarian J, *et al*. Hypermagnesemia-induced paralytic ileus. *Dig Dis Sci* 1994; **39:** 1138–42.
3. Narchi H. Neonatal hypermagnesemia: more causes and more symptoms. *Arch Pediatr Adolesc Med* 2001; **155:** 1074.