tate Injection; Potassium Bicarbonate and Potassium Chloride Effervescent Tablets for Oral Solution; Potassium Bicarbonate and Potassium Chloride for Effervescent Oral Solution; Potassium Chloride Extended-release Capsules; Potassium Chloride Extended-release Tablets; Potassium Chloride for Injection Concentrate; Potassium Chloride for Oral Solution; Potassium Chloride in Dextrose and Sodium Chloride Injection; Potassium Chloride in Dextrose Injection; Potassium Chloride in Lactated Ringer's and Dextrose Injection; Potassium Chloride in Sodium Chloride Injection; Potassium Chloride Oral Solution; Potassium Chloride, Potassium Bicarbonate, and Potassium Citrate Effervescent Tablets for Oral Solution; Potassium Gluconate and Potassium Chloride for Oral Solution; Potassium Gluconate and Potassium Chloride Oral Solution; Potassium Gluconate and Potassium Citrate Oral Solution; Potassium Gluconate Elixir; Potassium Gluconate Tablets; Potassium Gluconate, Potassium Citrate, and Ammonium Chloride Oral Solution; Trikates Oral Solution.

**Proprietary Preparations** (details are given in Part 3)
***Arg.:*** Co-Salt; Control K; Gluco-K; Kaon; Orakit; QBE Elixir†; ***Austral.:*** Celloids PC 73; Celloids PS 29; Chlorvescent; Duro-K; KSR†; Slow-K; Span-K; ***Austria:*** KCl-retard; Micro-Kalium; ***Belg.:*** Chloropotassuril; Kali-Steropˆ†; Kalium Durettes†; Steropotassium; Ultra-K; ***Braz.:*** Clotassio; Decorfen; ***Canad.:*** Apo-K; K-10; K-Dur; K-Lor†; K-Lyte/Cl; Kaon†; Micro-K; Potassium-Rougier†; Proflavanol C; Roychlor†; Slow-K; ***Chile:*** Kaion Retard; Sal Dietetica; Slow-K; Yonka; ***Cz.:*** Kaldyum; Kalnormin; Spofalyt-Kalium†; ***Denm.:*** Kaleorid; ***Fin.:*** Durekal; Kalinorm; Kalisol; Kalisteril†; ***Fr.:*** Diffu-K; Kaleorid; Nati-K; ***Ger.:*** Kalinor-retard P; Kalium-Duriles†; Kalium†; KCl-retard; Rekawan; ***Gr.:*** Sopa-K; ***Hong Kong:*** Addi-K†; Apo-K; Kalium†; KSR; Slow-K; Span-K; ***Hung.:*** Kaldyum; Kalium Durules; Kalium-R; ***India:*** Diucontin-K; Keylyte; Potklor; ***Irl.:*** Kay-Cee-L; Slow-K; ***Israel:*** Slow-K; ***Ital.:*** K-Flebo; Kadalex; Lento-Kalium; ***Malaysia:*** Apo-K; Beacon K; KSR†; Slow-K; ***Mex.:*** Ceposil; Clor-K-Zaf; Corpotasin GK; Corpotasin LP; K-Dur; Kaliolite; Kaselé†; Kelefusin; Potasoral; ***Neth.:*** Kalium Durettes†; Slow-K; ***Norw.:*** Kaleorid; ***NZ:*** Chlorvescent; K-SR†; Slow-K; Span-K; ***Philipp.:*** Ion-O-Trate; Kalium; ***Pol.:*** Kaldyum; Kalimat; Kalipoz; ***S.Afr.:*** Micro-K; Plenish-K; Sandoz K; Slow-K; Swiss-Kal SR†; ***Singapore:*** Addi-K†; Apo-K; KSR†; ***Spain:*** AP Inyect Cloruro Potasico; Boi K; Boi K Aspartico; Boi K Gluconato; Potasion; Potasion Solucion; ***Swed.:*** Kaleorid†; Kalitabs; Kalium Duretter†; Kalium Retard; ***Switz.:*** Kaliglutol; Plus Kalium retard; ***Thai.:*** Addi-K; Enpott; Kaliject; Potassride; ***Turk.:*** Kadaleks; ***UK:*** Kay-Cee-L; Slow-K; ***USA:*** Cena-K; Gen-K; K + 10; K + 8†; K-Dur; K-G Elixir; K-Lease†; K-Lor; K-Lyte/Cl; K-Norm†; K-Tab; Kaon; Kaon-Cl; Kay Ciel; Klor-Con; Klorvess; Klotrix; Micro-K; Potasalan; Rum-K†; Slow-K†; Ten-K; ***Venez.:*** Kaon†; Konat†.

**Multi-ingredient:** ***Arg.:*** Dialitica II; Potasio C; Water Pill c Potasio†; ***Austral.:*** Aspartatol; Cardioplegia A; Cardioplegia Concentrate; Digestaid; Duo Celloids PCCP; Duo Celloids PCIP; Duo Celloids PCMP; Duo Celloids PSMP; Duo Celloids PSPC; Duo Celloids SPPC; Duo Celloids SPPS; Duo Celloids SSPC; Extralife Uri-Care; Iron Compound†; K-Mag†; Kali Mag†; Mag-Oro; Potasi; Silicic Complex†; ***Austria:*** Centramin; Corozell; Elozell; Elozell spezial; Gladixol; Maycardin K; Trommcardin; ***Braz.:*** Albicon; Furosemide Composto; Hidrion; ***Canad.:*** Uracyst Test Kit; ***Chile:*** Sal Lite; Sal Liviana En Sodio; ***Cz.:*** Acidigen†; Avinl H†; Cardilan; Solutio Thomas cum Procaino; Tromcardin; ***Denm.:*** Burinex med kaliumklorid; Centyl med Kaliumklorid; ***Fin.:*** Miral; ***Fr.:*** Decramp; Rhinodoron; ***Ger.:*** Ardeycordal N†; Bascardial†; Cardio-Kreislauf-Longoral; Chinosol; Cordesin; Galacordin; Kalium-Magnesium†; Magium K; Movicard; Rhinodoron; Septacord; Tromcardin; Trophicard; ***Gr.:*** Cardioplegia; ***Hong Kong:*** Cardioplegia; ***Hung.:*** Acidigen†; Aspacardin†; Panangin; Tromcardin; ***India:*** Cotaryl; ***Indon.:*** Cardioplegia; Totilac; ***Irl.:*** Burinex K†; Centyl K; Diumide-K Continus; Low Centyl K; ***Israel:*** Lyteers; ***Ital.:*** Briovitase; Polase; Pomag; Potassion; Potassium MG†; ***Malaysia:*** Burinex K†; Cardioplegia; Pot-Citra; ***Mex.:*** Corpotasin CL; Forcremol; Kaposalt; ***Norw.:*** Burinex K; Centyl med Kaliumklorid; ***Philipp.:*** Diumide-K; ***Pol.:*** Aspargin; Magne-Balans Plus; Magnokal; Sal Ems Artificiale; Sal Ems Factitium; ***Port.:*** Miostenil; Polase; Safrux; ***Rus.:*** Panangin (Панангин); Triresid K (Трирезид К); ***S.Afr.:*** Burinex K; Kloref; Lenurex-K; Urirex-K; ***Singapore:*** Burinex K; Cardioplegia; ***Spain:*** Acetuber; Glucopotasico; Leberetic; Potasico; Salcedol; Suero Potassico Bieffe ME†; ***Swed.:*** Centyl K; Salures-K; ***Thai.:*** Cardioplegia; ***Turk.:*** Kadeks; Sensodyne-F; ***UK:*** Burinex K†; Centyl K; Kloref; Lasikal; Neo-NaClex-K; Sando-K; Sensodyne-F; ***USA:*** Chlor-3; K-Lyte/Cl; Klorvess; Slo-Salt-K†; Temp Tab; Tri-K; Twin-K†.

# Sodium

Natrium; Sód; Sodio.

Na = 22.98976928.

**Description.** Sodium chloride is the principal sodium salt used as a source of sodium ions. Sodium salts used chiefly as sources of bicarbonate ions, such as the acetate, bicarbonate, citrate, and lactate, are covered under Bicarbonate, p.1673. Phosphate salts of sodium are covered under Phosphate, p.1682.

## Sodium Chloride

Chlorid sodný; Chlorure de Sodium; Cloreto de Sódio; Natrii chloridum; Natrio chloridas; Natriumklorid; Nátrium-klorid; Natriumkloridi; Salt; Sodio, cloruro de; Sodium, chlorure de; Sodu chlorek; Sodyum Klorür.

NaCl = 58.44.

*CAS — 7647-14-5.*

*ATC — A12CA01; B05CB01; B05XA03.*

*ATC Vet — QA12CA01; QB05CB01; QB05XA03.*

NOTE. An aqueous solution of sodium chloride 0.9% is often known as physiological saline.

SALINE is a code approved by the BP 2008 for use on single unit doses of eye drops containing sodium chloride 0.9% where the individual container may be too small to bear all the appropriate labelling information. HECL is a similar code approved for hyetellose and sodium chloride eye drops.

**Pharmacopoeias.** In *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, *US*, and *Viet.*

**Ph. Eur. 6.2** (Sodium Chloride). A white or almost white, crystalline powder or colourless crystals or white or almost white pearls. Freely soluble in water; practically insoluble in dehydrated alcohol.

**USP 31** (Sodium Chloride). Colourless cubic crystals or white crystalline powder. Soluble 1 in 2.8 of water, 1 in 2.7 of boiling water, and 1 in 10 of glycerol; slightly soluble in alcohol.

**Equivalence.** Each g of sodium chloride represents about 17.1 mmol of sodium and of chloride. Sodium chloride 2.54 g is equivalent to about 1 g of sodium.

**Storage.** Solutions of some sodium salts, including sodium chloride, when stored, may cause separation of solid particles from glass containers and solutions containing such particles must not be used.

## Adverse Effects

Adverse effects of sodium salts are attributable to electrolyte imbalances from excess sodium; there may also be effects due to the specific anion.

Retention of excess sodium in the body usually occurs when there is defective renal sodium excretion. This leads to the accumulation of extracellular fluid to maintain normal plasma osmolality, which may result in pulmonary and peripheral oedema and their consequent effects.

Hypernatraemia (a rise in plasma osmolality) is usually associated with inadequate water intake, or excessive water losses (see p.1670). It rarely occurs after therapeutic doses of sodium chloride, but has occurred with the use of hypertonic saline for induction of emesis or for gastric lavage and after errors in the formulation of infant feeds. Hypernatraemia may also occur after inappropriate intravenous use of hypertonic saline.

The most serious effect of hypernatraemia is dehydration of the brain which causes somnolence and confusion progressing to convulsions, coma, respiratory failure, and death. Other symptoms include thirst, reduced salivation and lachrymation, fever, sweating, tachycardia, hypertension or hypotension, headache, dizziness, restlessness, irritability, weakness, and muscular twitching and rigidity.

Gastrointestinal effects associated with acute oral ingestion of hypertonic solutions or excessive amounts of sodium chloride include nausea, vomiting, diarrhoea, and abdominal cramps.

Excessive use of chloride salts may cause a loss of bicarbonate with an acidifying effect.

Intra-amniotic injection of hypertonic solutions of sodium chloride, which has been used for termination of pregnancy, has been associated with serious adverse effects including disseminated intravascular coagulation, renal necrosis, cervical and uterine lesions, haemorrhage, pulmonary embolism, pneumonia, and death.

◊ General references.


1. Moder KG, Hurley DL. Fatal hypernatremia from exogenous salt intake: report of a case and review of the literature. *Mayo Clin Proc* 1990; **65:** 1587–94. Correction. *ibid.* 1991; **66:** 439.
2. Martos Sánchez I, *et al.* Hipernatremia grave por administración accidental de sal común. *An Esp Pediatr* 2000; **53:** 495–8.
3. Adeleye O, *et al.* Hypernatremia in the elderly. *J Natl Med Assoc* 2002; **94:** 701–5.
4. Coulthard MG, Haycock GB. Distinguishing between salt poisoning and hypernatraemic dehydration in children. *BMJ* 2003; **326:** 157–60. Correction. *ibid.*; 497.


## Treatment of Adverse Effects

In patients with mild sodium excess, drinking water and restricting sodium intake is sufficient. However, in the event of recent acute oral overdose of sodium chloride, gastric lavage should be carried out along with general symptomatic and supportive treatment. Serum-sodium concentrations should be measured, and if severe hypernatraemia is present this should be treated (see p.1670).

## Precautions

Sodium salts should be used with caution in patients with hypertension, heart failure, peripheral or pulmonary oedema, renal impairment, pre-eclampsia, or other conditions associated with sodium retention.

When sodium supplements are given orally, adequate water intake should be maintained. Sustained-release tablets should not be given to patients with gastrointestinal disorders associated with strictures or diverticula because of the risk of obstruction.

Sodium chloride solutions should *not* be used to induce emesis; this practice is dangerous and deaths from resulting hypernatraemia have been reported.

## Pharmacokinetics

Sodium chloride is well absorbed from the gastrointestinal tract. Excess sodium is mainly excreted by the kidney, and small amounts are lost in the faeces and sweat.

## Human Requirements

The body contains about 4 mol (92 g) of sodium of which about one-third is found in the skeleton and about half is present in the extracellular fluid.

The body can adapt to a wide range of intakes by adjustment of renal excretion through physical and hormonal factors. Loss through the skin is significant only if excessive sweating occurs. Sodium requirements may be increased with exercise or exposure to high ambient temperatures in the short term, until the body adjusts.

Sodium is widely available in foods and is also added as salt during processing, cooking, and at the table. Dietary deficiency of sodium is therefore extremely rare and more concern has been expressed that current intakes are excessive. Restriction of sodium intake, by limiting the amount of culinary salt consumed, may be a useful aid in the management of some patients with hypertension (p.1171).

**UK and US recommended dietary intake.** In the UK dietary reference values (DRV—see Human Requirements, p.1925)[1] have been published for sodium. The reference nutrient intake (RNI) for adults is 1.6 g of sodium (70 mmol) daily, which is about 4 g of sodium chloride. In the USA, it has been recommended that daily intakes of sodium be limited to 2.4 g (6 g of sodium chloride) or less.[2] Dietary intake is often in excess of these recommendations, and may be a factor in essential hypertension,[3] and osteoporosis.[4]


1. DoH. Dietary reference values for food energy and nutrients for the United Kingdom: report of the panel on dietary reference values of the committee on medical aspects of food policy. *Report on health and social subjects 41*. London: HMSO, 1991.
2. Subcommittee on the tenth edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences, National Research Council. *Recommended dietary allowances*. 10th ed. Washington, DC: National Academy Press, 1989. Also available at: http://www.nap.edu/openbook.php?isbn=0309046335 (accessed 21/07/08)
3. Midgley JP, *et al.* Effect of reduced dietary sodium on blood pressure: a meta-analysis of randomized controlled trials. *JAMA* 1996; **275:** 1590–7.
4. Devine A, *et al.* A longitudinal study of the effect of sodium and calcium intakes on regional bone density in postmenopausal women. *Am J Clin Nutr* 1995; **62:** 740–5.


## Uses and Administration

Sodium chloride is used in the management of deficiencies of sodium and chloride ions in salt-losing conditions (see Hyponatraemia, p.1670). Sodium chloride solutions are used as a source of sodium chloride and water for hydration.

A 0.9% solution in water is iso-osmotic, and thus in most cases isotonic with serum and lachrymal secretions. Doses may be expressed in terms of mEq or mmol of sodium, mass (mg) of sodium, or mass of sodium salt. For comparative purposes, see Table 4, below.

A typical oral replacement dose of sodium chloride in **chronic salt-losing conditions** is about 2.4 to 4.8 g (about 40 to 80 mmol of sodium) daily as a modified-release preparation, accompanied by a suitable fluid intake; doses of up to 12 g daily may be necessary in

**Table 4.** Some sodium salts and their sodium content.

| | Sodium content per g | | |
|---|---|---|---|
| Sodium salt | mg | mmol | mEq |
| Sodium acetate (anhydrous) | 280 | 12.2 | 12.2 |
| Sodium acetate (trihydrate) | 169 | 7.3 | 7.3 |
| Sodium acid citrate | 175 | 7.6 | 7.6 |
| Sodium bicarbonate | 274 | 11.9 | 11.9 |
| Sodium chloride | 394 | 17.1 | 17.1 |
| Sodium citrate (anhydrous) | 267 | 11.6 | 11.6 |
| Sodium citrate (dihydrate) | 235 | 10.2 | 10.2 |
| Sodium lactate | 205 | 8.9 | 8.9 |