Potassium

TRADE NAMES

Potassium is available generically from numerous manufacturers as an OTC product. Branded products include: Potassium Fortified (Rexall Consumer), Potassium "99' (McGuff), Glu-K (Western Research Labs), K-99 (Bio-Tech Pharmacal), K-Glucon (Wesley Pharmacal).

DESCRIPTION

Potassium is an essential macromineral in human nutrition with a wide range of biochemical and physiological roles. Among other things, it is important in the transmission of nerve impulses, the contraction of cardiac, skeletal and smooth muscle, the production of energy, the synthesis of nucleic acids, the maintenance of intracellular tonicity and the maintenance of normal blood pressure. In 1928, it was first suggested that high potassium intake could exert an anti-hypertensive effect. Accumulating evidence suggests that diets high in potassium may be protective not only against hypertension, but also strokes and cardiovascular disease and possibly other degenerative diseases, as well.

Potassium is a metallic element with atomic number 19 and an average atomic weight of 39.09 daltons. Its symbol is K. It is an alkali metal and belongs to the same group as lithium, sodium, rubidium, cesium and francium. The only non-alkali element that it shares some similarities with is thallium. The thallous cation is similar in size to the potassium cation, which is the basis of the use of thallium for myocardial perfusion imaging. The thallous cation is considered a potassium cation analogue. Potassium exists physiologically in its univalent cationic state. It is the principal intracellular cation with an intracellular concentration of about 145 milliequivalents or millimoles per liter. This is 30 to 40 times greater than its extracellular concentration, which is normally 3.5 to 5.0 milliequivalents or millimoles per liter. About 98% of the body's potassium is in intracellular fluid.

The major cause of potassium deficiency is excessive losses of potassium through the alimentary tract or through the kidneys. Potassium depletion typically occurs as a consequence of prolonged use of oral diuretics, from severe diarrhea and from primary or secondary hyperaldosteronism, diabetic ketoacidosis or in those on long-term total parenteral nutrition who have received inadequate potassium. Signs and symptoms of potassium deficiency include hypokalemia, metabolic alkalosis, anorexia, weakness, fatigue, listlessness and cardiac dysrhythmias. Prominent U-waves are seen in the electrocardiograms of those with hypokalemia.

The intake of potassium in the American diet ranges from about 1,560 to 4,680 milligrams (40 to 120 milliequivalents or millimoles) daily. The potassium intake of vegetarians is at the high end. Foods that are rich in potassium are fresh vegetables and fruits. A medium-size banana supplies 630 milligrams of potassium or about 75 milligrams per inch; a medium orange, 365 milligrams; half a cantaloupe, 885 milligrams; half an avocado, 385 milligrams; raw spinach, 780 milligrams per three to four ounces; raw cabbage, 230 milligrams a cup; raw celery, 300 milligrams a cup. Some vegetable juices supply up to 800 milligrams per serving. A dietary intake of about 3.5 grams of potassium is considered to be a desirable intake of potassium for adults.
ACTIONS AND PHARMACOLOGY

ACTIONS

Supplementary potassium is used to treat potassium depletion states, e.g., from prolonged use of diuretics. It is also used to prevent potassium depletion in those on diuretics. Potassium may also have antihypertensive and cerebrovascular- and cardiovascular-protective activities.

MECHANISM OF ACTION

Potassium chloride, in the form of potassium-rich foods or potassium chloride supplements, is used in the management of potassium-deficiency associated with metabolic alkalosis. The fundamental cause of the deficiency is also treated whenever possible. Potassium deficiency may also be associated with metabolic acidosis, e.g., in those with renal tubular acidosis. In those cases, potassium salts other than potassium chloride are used, including potassium citrate, potassium acetate or potassium carbonate.

Potassium supplementation has been demonstrated to bring about small but significant reductions in blood pressure in those with mild to moderate hypertension. The mechanism of this effect is unclear. Possible mechanisms for this antihypertensive effect include a decrease in plasma renin activity, effects on resistance vessels related either to a high potassium concentration or to a decrease in the number of angiotensin II receptors and natriuresis (potassium inhibits sodium reabsorption in the proximal tubules).

The mechanism by which increased potassium intake may prevent stroke is not known. Possible mechanisms include potassium's hypotensive effect, inhibition of free radical formation, prevention of vascular smooth muscle proliferation and prevention of arterial thrombosis. In in vitro and in animal studies, elevation of extracellular potassium concentration within the physiological range has been shown to inhibit free radical formation from macrophages and endothelial cells, as well as to inhibit proliferation and thymidine incorporation of vascular smooth muscle cells and to reduce platelet sensitivity to thrombin and other agonists. High potassium diets have also been shown to reduce oxidative stress on the endothelium of high sodium chloride-fed stroke-prone spontaneously hypertensive rats independent of blood pressure changes.

PHARMACOKINETICS

The efficiency of absorption of supplementary potassium from the gastrointestinal tract is high. Greater than 90% of an ingested dose of potassium is absorbed. The efficiency of absorption of dietary potassium is similar. Potassium is delivered to the liver via the portal circulation and the rest of the body via the systemic circulation. Insulin and catecholamines promote potassium transport into cells. Potassium is lost from the body in the urine and, to a lesser degree, in gastrointestinal secretions.

INDICATIONS AND USAGE

Potassium may be useful in the prevention and treatment of hypertension in some, notably African Americans. Epidemiological studies have suggested that high dietary intake of potassium may protect many populations against stroke. More recent analyses suggest that this protection may be restricted to black men and hypertensive men. There is experimental data indicating that high potassium intake may have a number of cardioprotective effects. There is no credible evidence that supplemental potassium has anticarcinogenic effects or that it can enhance athletic performance other than, possibly, in those who are potassium deficient.

RESEARCH SUMMARY

Epidemiological studies have shown an inverse relationship between potassium
intake and blood pressure. A major meta-analysis designed to assess the effects of potassium supplements on blood pressure examined data from 33 randomized, controlled trials involving 2,609 subjects. The researchers concluded that low potassium intake may be an important contributor to hypertension and that increased potassium intake can both prevent and treat hypertension, particularly in those who cannot or will not reduce their sodium intake.

The study found that potassium supplementation resulted in a significant reduction in mean systolic blood pressure of 3.11 mmHg and a significant reduction in mean diastolic blood pressure of 3.42 mmHg. Greater reductions were also seen in black Americans, compared with Caucasians. Better results were reported in hypertensives than in normotensives, but effects in the latter were sufficient to suggest that supplemental potassium may help significantly prevent hypertension.

Studies have shown that diets high in potassium, magnesium and fiber reduce the risk of strokes. Other studies have reported an inverse relationship between potassium intake and stroke. One of these studies found that, among men with the highest potassium intakes, risk of any type of stroke was 38% lower than among those with the lowest potassium intakes. Potassium supplementation has specifically been inversely associated with the risk of stroke, especially among hypertensive men.

In perhaps the best analysis to date, increased potassium intake was significantly associated with decreased risk of stroke mortality — but only among black men and hypertensive men. Research is ongoing.

There are an abundance of in vitro and animal data suggesting that high potassium intake may protect against cardiovascular disease. Various studies have reported that potassium reduces vascular and plasma lipids, macrophage adherence to the vascular wall and endothelial permeability in hypertensive animals. Other animal studies have demonstrated that potassium can reduce atherosclerotic cholesterol ester deposition in the aorta. Research continues.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

Potassium supplements are contraindicated in those with hyperkalemia.

Potassium supplements are also contraindicated in those with hypersensitivity to any component of a potassium-containing supplement.

PRECAUTIONS

The use of potassium supplements in those with potassium deficiency requires medical supervision.

Pregnant women and nursing mothers should avoid potassium supplements unless they are prescribed by their physicians.

ADVERSE REACTIONS

The most common adverse reactions of potassium supplements are gastrointestinal ones and include nausea, vomiting, abdominal discomfort, flatulence and diarrhea. Taking potassium supplements with meals may reduce these adverse reactions. Rashes are occasionally reported. The most serious adverse reaction is hyperkalemia. Hyperkalemia is rare in those with normal renal function.

INTERACTIONS

DRUGS
Angiotensin Converting Enzyme (ACE) inhibitors (benazepril, captopril, enalapril, fosinopril, lisinopril, moexipril, perindopril, quinapril, ramipril, trandolapril): ACE inhibitors will produce some potassium retention by inhibiting aldosterone production. Potassium supplements should be given to those receiving ACE inhibitors only with close monitoring.

Potassium sparing diuretics (amiloride, triamterene, spironolactone): The concomitant administration of a potassium-sparing diuretic and a potassium supplement can produce severe hyperkalemia.

OVERDOSAGE

The use of oral potassium supplements in those with normal renal function very rarely causes serious hyperkalemia. However, overdoses with oral potassium supplements in those with normal renal function have been reported. For example, a 46 year-old woman ingested 31 grams of potassium chloride in a suicide attempt and developed severe hyperkalemia associated with life-threatening arrhythmias. The woman died two weeks later as a result of cerebral anoxia during cardiopulmonary arrest. Oral doses greater than 18 grams of potassium taken at one time may lead to severe hyperkalemia in those with normal renal function.

DOSAGE AND ADMINISTRATION

The use of potassium supplements in those with potassium deficiency requires medical supervision.

There are several potassium supplemental forms available, including potassium chloride, potassium citrate, potassium gluconate, potassium bicarbonate, potassium aspartate and potassium orotate.

Multivitamin, multimineral supplements do not contain more than 99 milligrams of potassium per serving. One milliequivalent or millimole is equal to 39.09 milligrams.

High-potassium (up to 800 milligrams per serving), low-sodium vegetable juices are available. Some soft drinks are rich in potassium. Some soft drinks contain potassium gluconate which has a less bitter taste than some other potassium supplements. Salt substitutes are high in potassium.

Potassium-rich foods and drinks are the best ways to increase potassium intake.

HOW SUPPLIED

Potassium acetate is available in the following forms and strengths for Rx use:

Injection — 2 meq/mL, 4 meq/mL

Potassium chloride is available in the following forms and strengths for OTC use:

Tablets — 75 mg, 95 mg, 99 mg, 180 mg

Potassium chloride is available in the following forms and strengths for Rx use:

Injection — 2 meq/mL, 10 meq/50 mL, 20 meq/50 mL, 10 meq/100 mL, 20 meq/100 mL, 30 meq/100 mL, 40 meq/100 mL

Liquid — 20 meq/15 mL, 40 meq/15 mL

Powder for Reconstitution — 20 meq, 25 meq

Tablet, Extended Release — 8 meq, 10 meq, 20 meq
Potassium gluconate is available in the following forms and strengths:

*Tablets* — 486 mg, 500 mg, 550 mg, 595 mg, 610 mg, 620 mg

**LITERATURE**


Sugimoto T, Tobian L, Ganguli MC. High potassium diets protect against


