PRECAUTIONS

There are reports of high doses of silicon intake, usually in the form of the antacid magnesium trisilicate, causing siliceous renal calculi. Those who form renal calculi should be cautious about the use of supplemental silicon.

ADVERSE REACTIONS

High doses of silicon have been reported to form siliceous renal calculi.

INTERACTIONS

Silicon may inhibit aluminum absorption.

OVERDOSAGE

No reports of overdosage.

DOSAGE AND ADMINISTRATION

There is not sufficient data to set dietary reference intakes (DRIs), including tolerable upper intake levels (UL), for silicon.

Silicon is available in multivitamin preparations, usually in the form of silicon dioxide or magnesium trisilicate, typically at doses of about 2 milligrams. Supplemental silicon is also available as orthosilicic acid. The stems of the herb horsetail (*Equisetum arvense*) are rich in silicon dioxide. *Equisetum* is also used as a homeopathic remedy. Silicon may be found in colloidal or liquid minerals.

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Sodium Alginates and other Phyco-Polysaccharides

DESCRIPTION

The algal plants or seaweeds are classified into four principal groups: the green algae or *Chlorophyceae*, the blue-green algae or *Cyanophyceae*, the brown algae or *Phaeophyceae*, and the red algae or *Rodophyceae*. The study of algae is called phycology. The brown and red algae are important commercially because of their polysaccharide content. These phyco-polysaccharides have broad applications in foods, pharmaceuticals and cosmetics, and as nutritional supplements. Agar and carrageenan are extracted from various types of red seaweeds, and algin is derived from brown seaweeds.

Agar is comprised of two major polysaccharides, neutral agarose and charged agaropectin. Both of these polysaccharides are composed of linear chains of alternating beta-D-galactose and 3,6-anhydro-alpha-L-galactose residues. These polysaccharides are resistant to digestion by intestinal digestive enzymes. Agar is also known as agar-agar. Agar is marketed in flakes and powder form and is commonly used to replace gelatin in various recipes. Agar is sometimes used to promote bowel regularity.

Carrageenans are polysaccharides also derived from certain red seaweeds. They are polysulfated, straight-chain galactans comprised of residues of D-galactose and 3,6-anhydro-D-galactose. The principal carrageenans are called kappa-carrageenan, lambda-carrageenan and iota carrageenan. Carrageenans are also resistant to digestion by intestinal digestive enzymes. Carrageenans have been reported to lower cholesterol levels in animals and also to have antiviral activity against some membrane-containing viruses in culture.

Algin is a polysaccharide derived from the brown seaweeds or *Phaeophyceae*. Algin is present in these organisms as a mixed salt (sodium, potassium, calcium, magnesium) of alginic acid. Alginic acid is a high molecular polymer comprised of two types of uronic acid residues, beta-D-mannuronic acid and its C_5 epimer alpha-L-guluronic acid. The uronic acids are simple monosaccharides in which the primary hydroxyl group at C_6 has been oxidized to the corresponding carboxylic acid. For example, D-mannuronic acid is derived from D-mannose.

Algin is principally extracted from the giant kelp *Macrocystis pyrifera*. Its derivatives have wide application in the food industry (gelling, water-holding, emulsifying and stabilizing properties), in the cosmetic industry, and in medicine and dentistry (dental impressions). Calcium alginate, the calcium salt of alginic acid, is used as a wound dressing for the treatment of exudative wounds. Sailors have been treating their wounds with seaweed for hundreds of years. Sodium alginate, the sodium salt of alginic acid, is present in some antacid products and is effective for the treatment of gastroesophageal reflux disease or GERD. Sodium alginate reacts with gastric acid to form a viscous gel called the alginate raft. The alginate raft floats on top of the gastric contents and acts as a barrier to acid and food reflux.

Sodium alginate binds tightly to such substances as strontium, calcium, barium, cadmium and radium. Cows have been fed sodium alginate, which binds to radioactive strontium 90, causing it to pass out of the body without any of it getting absorbed. Sodium alginate has also been used to treat ouch-ouch or Itai-Itai-Byo disease. This disease has been found in Japan and is believed to be due to poisoning by cadmium-containing water used to irrigate rice. Painful joints are the major symptom of ouch-ouch disease.

Sodium alginate may be considered a soluble fiber. And, similar to other soluble fibers like pectin and psyllium, sodium alginate may have hypocholesterolemic and glycemic-regulatory activities.

ACTIONS AND PHARMACOLOGY

ACTIONS

Sodium alginate may have hypocholesterolemic and glycemic-regulatory activities. It may also have detoxification activity.

MECHANISM OF ACTION

Sodium alginate has been found to lower cholesterol in animal studies. It is speculated that this may be due to alginate-stimulated increase of fecal bile acid excretion.

Sodium alginate has also been demonstrated to lower glucose levels in diabetic animals. The mechanism of this activity is unknown.

Sodium alginate binds tightly to such substances as strontium, cadmium, radium and barium. It also binds to lead, but not as well. Sodium alginate's binding to these substances reduces their absorption.

PHARMACOKINETICS

There is little on the pharmacokinetics of sodium alginate in humans. It appears to be resistant to digestion by the digestive enzymes and is probably fermented, in part, by colonic bacteria to the short-chain fatty acids acetate, propionate and butyrate.

INDICATIONS AND USAGE

Sodium alginate may have some usefulness as a lipid-lowering agent, but the evidence for this possible indication is preliminary. Similarly, there is preliminary evidence that it may be of benefit in diabetes. It has demonstrated detoxifying effects and may be helpful in some with gastroesophageal reflux disease. Seaweed, rich in iodine, is used in many parts of the world to prevent and treat goiter. Carrageenans found in some red seaweeds have demonstrated some antiviral activity. Agar is used by some for regulating bowels. Calcium alginate has been used for wound healing, and sodium alginate has been effective in treating ouch-ouch disease. Some other polysaccharide components of seaweed have exhibited immunomodulating and anticarcinogenic effects in the laboratory. Folk remedy uses of seaweed products have included fever, eczema, gallstone and liver disease, gout, menstrual problems, hypertension, kidney disease and scabies. There is no credible research to support these folk uses.

RESEARCH SUMMARY

There are some preliminary animal studies in which sodium alginate and agar have been shown to reduce cholesterol levels. In one of these studies, sodium alginate enhanced cholesterol excretion into feces. It also inhibited blood glucose and insulin levels from rising 30 minutes after glucose administration. In another animal study, both algin and agar had favorable cholesterol effects but did not affect triglycerides. There are also preliminary reports that carrageenans derived from red seaweeds have some experimental cholesterol-lowering properties.

In a small human trial, consumption of 175 mg/kg/day of sodium alginate for seven days followed by consumption of 200 mg/kg/day for an additional 16 days resulted in no significant effects on hematological indices, plasma biochemistry and urinalysis parameters, blood glucose and plasma insulin concentrations, and breath hydrogen concentrations. No allergic responses were noted. There were only five subjects in this study—all with normal health at the outset.

Alginates have been used for heartburn and acid reflux for decades. Numerous *in vitro* and *in vivo* studies have demonstrated that alginate-based rafts effectively provide physical barriers to acidic gastric contents and can thus significantly reduce reflux episodes. Alginates are present in some over-the-counter antacids.

Calcium alginate is often used as a dressing for exudative wounds. It is an effective absorbable hemostatic and is often used to pack sinuses, bleeding wounds of various types and burns. Sodium alginate is also used for this purpose. In one study, the use of calcium alginate hemostatic swabs was

credited with significantly reducing blood loss in various surgeries and with significantly reducing duration of operations. Calcium alginate was shown to be four times as absorbent per unit weight as gauze.

The alginates have been shown to bind tightly to strontium, barium, cadmium and radium so that these toxins pass out of the body with little or no absorption. It also binds with lead, but not as completely. Ouch-ouch disease, characterized by painful joints and believed to be caused by oral cadmium exposure, has been successfully treated with alginates in Japan. Reduction in the absorption of strontium has been noted in children given an alginate derivative. Retention of radioactive barium has been reduced in rats fed sodium alginate derivatives. In one human trial, 10 grams of sodium alginate ameliorated acute radiation effects due to exposure to radiation doses of 50 to 3,000 rads.

Calcium alginate has shown antiviral activity in some *in vitro* and animal studies. It is sufficiently effective that diagnostic laboratories caution against the use of calcium alginate swabs in some diagnostic sampling, owing to calcium alginate's toxicity to herpes viruses and chlamydia, among other infective agents.

The carrageenans, sulfated polysaccharides derived from red seaweeds like Irish moss, have inhibited both HSV1 and HSV2 *in vitro*. They also inhibit some other viruses, including HIV. The natural alginates, on the other hand, do not show antiherpetic or anti-HIV activity.

In one animal study, preparations from various edible seaweeds significantly reduced the incidence of chemically induced cancers, compared with controls that were unsupplemented with these preparations. In another animal study, an extract of the brown alga hijiki recently showed immunoenhancing activity. The polysaccharide fraction of the extract, more than the nonpolysaccharide fraction, had immune-enhancing effects on the proliferative response of spleen cells. This response was associated with B-cell, but not T-cell, populations. More research is needed.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

Sodium alginate is contraindicated in those who are hypersensitive to any component of a sodium alginate-containing product.

PRECAUTIONS

Pregnant women and nursing mothers should avoid supplementation with sodium alginate unless it is recommended by their physicians.

ADVERSE REACTIONS

Gastrointestinal symptoms such as flatulence may occur with sodium alginate supplements.

INTERACTIONS

NUTRITIONAL SUPPLEMENTS

Sodium alginate may decrease the absorption of the carotenoids beta-carotene, lycopene and lutein if used concomitantly. It may also decrease the absorption of such minerals as calcium, zinc, manganese, chromium and magnesium if used concomitantly.

FOODS

Sodium alginate may reduce the absorption of food carotenoids, such as beta-carotene, lycopene and lutein and such minerals in foods as calcium, magnesium, zinc, manganese and chromium.

DOSAGE AND ADMINISTRATION

Sodium alginate supplements can be found in the marketplace, but there are no typical doses. Various algaes and seaweeds are available as supplements as well. Among algae or seaweeds often used as foods and supplements are hijiki, kombu, wakame and arame. These are all brown seaweeds or algae. The red seaweeds and some of their constituents are also widely used. These include nori, agar or agar-agar, dulse and Irish moss. There are no typical doses.

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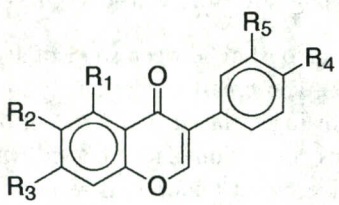
Soy Isoflavones

DESCRIPTION

Soy isoflavones are phytoestrogens (plant estrogens) found in soybeans. Phytoestrogens are plant-derived nonsteroidal compounds that possess estrogen-like biological activity. Soy isoflavones have both weak estrogenic and weak anti-estrogenic effects. They have been found to bind to estrogen receptors-alpha (ER-alpha) and beta (ER-beta). They appear to bind better to ER-beta than to ER-alpha.

Soy isoflavones comprise three main isoflavones and their glycosylated forms. The three main isoflavones are the aglycones genistein, daidzein and glycitein. They can be represented by the following structural formulas:



Soy isoflavones

	R_1	R_2	R_3	R_4
Daidzein	H	H	OH	OH
Genistein	OH	H	OH	OH
Glycitein	H	OCH3	OH	OH

The glycosylated forms of genistein are genistin, 6″-O-malonylgenistin and 6″-O-acetylgenistin; those of daidzein are daidzin, 6″-O-malonyldaidzin and 6″-O-acetyldaidzin, and those of glycitein are glycitin, 6″-O-malonylglycitin and 6″-O-acetylglycitin. The malonyl glycosides of genistein are the major forms of the soy isoflavones that are found in soybeans. Fermented soy foods, such as tempeh and miso, are rich in the soy isoflavone aglycones. The most abundant of the soy isoflavones in soybeans are the genistein glycosides (about 50%), followed by the daidzein glycosides (about 40%). The least abundant of the soy isoflavones in soybeans are the glycitein glycosides (about 5 to 10%). Soy protein derived from soybeans contains about 2 mg of genistin and daidzin per gram of protein. In soy germ, the order is different. Glycitein glycosides comprise about 40% of soy germ, daidzein glycosides about 50% and genistein glycosides about 10%.

Soy isoflavones, when marketed as nutritional supplements, are mainly present as the isoflavone glycosides genistin, daidzin and glycitin.

See also Daidzein, Equol, Genistein and Glycitein.

ACTIONS AND PHARMACOLOGY

ACTIONS

Soy isoflavones may have estrogenic, antiestrogenic and nonestrogenic activities. Soy isoflavones may also have antioxidant, anticarcinogenic, anti-atherogenic, vasoprotective and anti-osteoporotic activities. Soy isoflavones might also have activity for the treatment of menopausal hot flashes.

MECHANISM OF ACTION

Soy isoflavones have weak estrogenic activity. The order of activity in *in vivo* assays is glycitein greater than genistein greater than daidzein. They bind to estrogen receptors-alpha and beta. They appear to bind better to estrogen receptor-beta than to estrogen receptor-alpha.

The most studied of the soy isoflavones is genistein. Genistein has been found to have a number of antioxidant activities. It is a scavenger of reactive oxygen species and inhibits lipid peroxidation. It also inhibits superoxide anion generation by the enzyme xanthine oxidase. In addition, genistein, in animal experiments, has been found to increase the activities of the antioxidant enzymes superoxide dismutase, glutathionine peroxidase, catalase and glutathione reductase. Daidzein and glycitein also appear to have reactive oxygen scavenging activity. However, these isoflavones have not been studied as much as genistein has.

Regarding possible anticarcinogenic activity, again genistein has been the most studied of the soy isoflavones. Several mechanisms have been proposed for genistein's possible anticarcinogenic activity. These include upregulation of apoptosis, inhibition of angiogenesis, inhibition of DNA topoisomerase II and inhibition of protein tyrosine kinases. Genistein's weak estrogenic activity may be involved in its putative activity against prostate cancer. Other possible anti-prostate cancer mechanisms include inhibition of NF (nucle-