

SELENIUM, NUTRITION AND HEALTH

Named after the Greek moon goddess, Selene, selenium (Se) is one of the essential trace minerals needed by humans. It is a structural component of glutathione peroxidase (GPx), an enzyme that is involved in antioxidant defence mechanism at the cellular level. GPx scavenges free radicals, assists with red blood cell metabolism and has also been shown to prevent chromosome damage in tissue cultures. Selenium is indirectly responsible for keeping the body's supply of vitamin C, glutathione, and vitamin E intact. Although selenium is an essential nutrient, there is very little selenium in our body. Most of it is in the liver, kidneys, and pancreas and, in men, the testes and seminal vesicles.

FUNCTIONS

As part of a nutritional antioxidant system, selenium protects cell membranes from lipid peroxidation, a process that allows free radicals (highly reactive atoms or molecules with unpaired electrons) to combine with electrons from the lipids in cell membranes and results in cell damage. Selenium has other functions. These are as follows:

- Selenium, in the form of another antioxidant, selenocysteine, slows or prevents the biochemical aging process of tissue degeneration and hardening, that is, loss of youthful elasticity. This function is enhanced by vitamin E. This antioxidant effect may also benefit the cardiovascular system. Epidemiological studies have shown an increased incidence of strokes and other cardiovascular problems in many low-selenium areas. However, there is currently insufficient available evidence to recommend selenium supplements for the prevention of coronary heart disease.

- Selenium may have an anti-carcinogenic effect since blood or tissue levels correlate more closely with cancer risk than those of any other substance. Good selenium levels correlate with low cancer rates and conversely, low levels with increased cancer rates. Observational studies indicate that death from cancer, including lung, colorectal, and prostate cancers, is lower among people with higher blood levels or intake of selenium. This protective effect is also thought to be as a result of its role as an antioxidant, or that selenium may prevent or slow tumor growth.
- Selenium appears to help stimulate antibody formation in response to vaccines. This effect is enhanced by vitamin E.
- Selenium may protect us from the toxic effects of heavy metals and other substances. People with adequate selenium intake have fewer adverse effects from cigarette smoking, alcohol, oxidized fats, as well as mercury and cadmium toxicity. Aside from the likely antioxidant influence, the specific mechanism by which selenium affords this protection is not known, though the effect is confirmed by some research.
- Selenium may also aid in protein synthesis, growth and development, and fertility, especially in males because it has been shown to improve sperm production and motility. Thus, selenium may play a role in prevention of male infertility. In addition, it has been suggested, that selenium along with vitamin E, be used for male impotency. Although these uses require further study, it is certainly possible that selenium can increase sexual potency and fertility by improving sperm production and motility and by protecting against oxidative damage in the testes and related organs.
- Selenium supplementation may be helpful in reducing menopausal symptoms.
- In addition to iodine, selenium is a critical mineral for maintaining proper functioning of the thyroid gland. In order for the thyroid to produce the most active form of its hormone (a version of thyroid hormone that is called T3), selenium is not only essential, but it also helps to regulate the amount of hormone that is produced.
- Research has indicated that individuals with rheumatoid arthritis have reduced selenium levels in their blood. In addition, some individuals with arthritis have low selenium intake. The body's immune system naturally makes free radicals that can help destroy invading organisms and damaged tissue, but that can also harm healthy tissue. Selenium, as an antioxidant, may help to relieve symptoms of arthritis by controlling levels of free radicals. Since research is in the early stages, further studies are needed before selenium supplements can be recommended for individuals with arthritis.
- Malabsorption resulting from HIV or AIDS can deplete levels of many nutrients, including selenium. A deficiency of selenium is associated with decreased immune cell count, increased disease progression, and high risk of death among this infected population. HIV disease gradually destroys the immune system, and oxidative stress may contribute to further damage of immune cells. It is thought that selenium, as an antioxidant, helps to protect cells from oxidative stress, thus potentially slowing progression of the disease.

Selenium status has therefore been suggested to be a significant predictor of survival for persons infected with HIV. Although there is insufficient evidence to routinely recommend selenium supplements for HIV-positive individuals, physicians may prescribe such supplements as part of an overall treatment plan.

- Selenium may also play a role in the prevention and/or treatment of health conditions such as:

- Acne
- Asthma
- Cervical dysplasia
- Colorectal cancer
- Oesophageal cancer
- Kashin-Beck's disease
- Keshan's disease
- Multiplesclerosis
- Ovarian cysts
- Parkinson's disease
- Psoriasis
- Sudden infant death syndrome (SIDS)
- Stomach cancer

FOOD SOURCES OF SELENIUM

Selenium is widely available from many foods and mother's milk usually has several times more selenium than cow's milk. Brewer's yeast and wheat germ usually contain high concentrations of selenium. Animal foods such as liver, butter, most fish, and lamb have adequate amounts. Many vegetables, whole grains, nuts and molasses are fairly good sources. Brazil nuts have high amounts; barley, oats, whole wheat, and brown rice are also good sources; and shellfish such as scallops, lobster, shrimp, clams, crab, and oysters are rich in selenium. Garlic and onions, mushroom, broccoli and tomatoes, may be good sources depending on the selenium content of the soil. Selenium may also be present in some drinking water, and it is sometimes added where it is deficient.

In some foods, where a greater percent of selenium is found in water-soluble form and contact with water is great, high losses of selenium can occur. Wheat is very susceptible to selenium loss during processing. In 60% extraction wheat flour – the kind that is used to make over 90% of all breads, baked goods, and pastas sold in the U.S.A., almost 75% of the original selenium is lost. In the case of animal foods, loss of selenium from cooking appears minimal.

The selenium content of 100 grams of the following groups of foods is as follows:

- Baked products including breads, cookies, crackers, bagels, etc. – 1.0 to 48.0 µg
- Breakfast cereals – 3.5 to 123.1µg
- Cereals (for cooking) – 3.1 to 34.0µg
- Cereal grains and Pasta – 2.3 to 79.2 µg
- Legumes – 0.8 to 19.1 µg
- Nuts and Seeds – 4.0 to 2960.0µg
- Vegetables – 0.2 to 14.2 µg

• Fruits and fruit juices	– 0.1 to 1.1 µg
• Fish and Shellfish	– 12.6 to 80.4 µg
• Poultry	– 21.7 to 70.9 µg
• Meat and Meat products (beef, lamb, veal, pork)	– 8.0 to 148.8 µg
• Sausages and Luncheon meats	– 11.3 to 58.0 µg
• Dairy products	– 0.6 to 27.3 µg
• Eggs	– 17.6 to 45.2 µg
• Fats and Oils	– 0.2 to 2.1 µg
• Alcoholic and non alcoholic beverages (hot and cold)	– 0.0 to 12.6 µg

SELENIUM REQUIREMENTS

The current table of Recommended Dietary Allowances (RDA) for the Caribbean does not include amounts for selenium however the text includes some recommendations:

- 10-13 µg/day for infants (0-12 months)
- 15-30 µg/day for children (1-10 years)
- 45 µg/day for children (11-14 years)
- 55 µg/day for adolescents (14-18 years), males and females
- 60 µg/day during pregnancy
- 70 µg/day during lactation

A high intake of foods that contain large amounts of saturated fatty acids may increase requirements for selenium because of its antioxidant activity.

DEFICIENCY OF SELENIUM

Dietary deficiency is the most common cause of selenium deficiency. Globally, selenium deficiency is rare although it has been identified in high-risk areas of Africa, Russia, New Zealand, and China because of the low levels in the soil thus affecting the levels in food. Additionally, infants fed cow's milk instead of breastmilk, and the elderly are also at risk. Among the latter group this is related to reduced consumption of selenium-containing fresh and whole foods.

Selenium deficiency has also been reported in malnourished persons receiving long-term total parenteral nutrition (TPN), that is being fed intravenously with absorbable nutrients in a liquid form. However improvements have resulted in reduction of these occurrences because preparations should now include adequate amounts of selenium. It should also be noted that severe gastrointestinal disorders may decrease the absorption of selenium, resulting in selenium depletion or deficiency. Both iron deficiency and copper

deficiency appear to increase the risk of selenium deficiency. There is evidence that selenium deficiency does not usually cause illness by itself but makes the body more susceptible to illnesses caused by other nutritional, biochemical or infectious stresses.

WHAT ABOUT TOO MUCH SELENIUM?

The occurrence of selenium toxicity is extremely rare. The levels of selenium necessary to trigger these toxicity symptoms aren't usually obtained from food, since selenium-rich foods contain about 30-50 micrograms(μg) per serving. The few reported cases have been associated with industrial accidents and a manufacturing error that led to an excessively high dose of selenium in a supplement.

Blood levels greater than $100\mu\text{g/dL}$ can result in a condition called selenosis. Symptoms include gastrointestinal upsets, hair loss, white blotchy nails, garlic breath odor, fatigue, irritability and mild nerve damage. Other problems may include loss of nails, and teeth, as well as skin inflammation, nausea, and fatigue. Some subtle symptoms that have been experienced include a garlic odor, metallic taste or dizziness. Acute selenium poisoning can lead to fever, anorexia, gastrointestinal symptoms, liver and kidney impairment, and even death if the levels are high enough.

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