

# Selenium

## Physiological Functions

Selenium is a component of glutathione peroxidases which are primarily responsible for reducing peroxide free radicals that include lipid peroxide formation in cell membranes. Reduction of peroxides formed by oxidation of membrane phospholipids breaks the auto-oxidative chain reaction that damages cell membranes. Selenium-dependent antioxidant protection of cell membrane phospholipids is synergistic with vitamin E. Selenium also has a role in prostaglandin synthesis by protecting the oxidative state of lipid intermediates formed during cyclooxygenase reactions which determines the balance of the endproducts and whether proaggregatory, proinflammatory or antiaggregatory, antiinflammatory responses will dominate.

## Factors Affecting Availability

Food sources provide selenium in either the inorganic forms selenite or selenate or in an organic form where it displaces sulfur in methionine or cysteine. Soil selenium content determines the amount of selenium concentrated in plant sources which can vary as much as 200-fold between crops grown in different regions. Since produce and grain products consumed in the US are obtained from various regions, the average selenium intake from plant sources is similar between different geographical areas. Processing of grains decreases the selenium content of the grain products. Meat and poultry are more reliable selenium sources because livestock feed is supplemented with selenium.

## Deficiency

Clinical selenium deficiency is rarely observed in humans. Marginal intakes may reduce activities of selenium-dependent peroxidases. Changes in these enzyme activities have been associated with development of Keshan Disease (cardiomyopathy) and Kashin-Beck Disease (chondrodystrophy) in children in selenium-deficient regions of China.

Selenium deficiency can also develop in malnourished patients dependent on enteral or parenteral nutrition for long periods of time. Muscle pain, weakness, and tenderness have been reported by these patients. Selenium supplementation can correct this type of deficiency.

## Toxicity

Excessive amounts of selenium (> 750 mcg/day) can cause nausea, vomiting, diarrhea, loss of hair and nails, tenderness and swelling of the fingers, fatigue, irritability, skin lesions, tooth damage and nervous system disturbances.

Supplementation that provides > 3 times the DRI is more likely to cause toxicity than what is consumed from dietary sources. Organic selenium supplements (selenomethionine and selenocysteine) are better absorbed than inorganic forms. Symptoms of selenium toxicity include dermatitis, loose hair, brittle nails, and peripheral neuropathy.

- ❖ *The upper limit of safety for selenium established by the Food and Nutrition Board of the Institute of Medicine is 400 micrograms daily for adults. See table below for more age- and gender specific guidelines.*

<b>Selenium Tolerable Upper Intake Levels</b>	
Life Stage	Selenium (mcg/day)
Infants	
0-6 mo	45
7-12 mo	60
Children	
1-3 y	90
4-8 y	150
Males, Females	
9-13 y	280
14-18 y	400
19-70 y	400
70 y	400
Pregnancy	
≤ 18 y	400
19-50 y	400
Lactation	
≤ 18 y	400
19-50 y	400

## Dietary Requirements

The Daily Reference Intakes (DRI) for selenium are shown in the table below.

<b>Selenium Requirements</b> Daily Reference Intakes	
<b>Life Stage</b>	<b>Selenium</b> (mcg/day)
<b>Infants</b>	
0 – 6 months	15
7 – 12 months	20
<b>Children</b>	
1 – 3 years	20
4 – 8 years	30
<b>Males</b>	
9 – 13 years	40
14 – 18 years	55
19 – 30 years	55
31 – 50 years	55
51 – 70 years	55
> 70 years	55
<b>Females</b>	
9 – 13 years	40
14 – 18 years	55
19 – 30 years	55
31 – 50 years	55
51 – 70 years	55
> 70 years	55
<b>Pregnancy</b>	
< 18 years	60
19 – 30 years	60
31 – 50 years	60
<b>Lactation</b>	
< 18 years	70
19 – 30 years	70
31 – 50 years	70

### **Dietary Sources**

Selenium is commonly found in Brazil nuts, seafood, kidney, liver, meat, poultry, whole grain pasta, sunflower seeds, oatmeal, soynuts, other nuts, eggs and low-fat dairy products. The list below provides the selenium content of selected foods.

<b>Selenium Content of Food</b>	
<b>Food</b>	<b>Selenium (mcg)</b>
Brazil nuts, 1/4 cup	1036

Oysters, 3.5 oz	115
Chicken liver 3.5 oz	71
Raw oyster, 3.5 oz	70
Steamed clams, 3.5 oz	64
Beef liver, 3.5 oz	57
Sardines, 3.5 oz	46
Crab, 3.5 oz	40
Whole wheat pasta, 1 cup	36
White pasta, 1 cup	30
Wheat germ, toasted, _ cup	28
Molasses, blackstrap, 2 T.	25
Sunflower seeds, 1/4 cup	26
Cooked oatmeal, 1 cup	19
Soynuts, 1/2 cup	17
Freshwater fish, 3.5 oz	15
Egg, boiled, one	13
Tofu, 1/2 cup	11