

Vitamin E

Physiological Functions

Vitamin E (tocopherol) is a fat-soluble vitamin which functions solely as a membrane-bound antioxidant that prevents cell membrane damage by inhibiting peroxidation of membrane phospholipids and disrupting free radical chain reactions induced by formation of lipid peroxides. Vitamin E also increases the bioavailability of vitamin A by inhibiting its intestinal oxidation.

As the only membrane-bound lipid-soluble antioxidant, Vitamin E plays a key role in preventing cellular injury from oxidative stress associated with premature aging, cataracts, uncontrolled diabetes, cardiovascular disease, inflammation, and infection. For example, the vitamin E content of LDL protects the cholesterol component from oxidation, thereby inhibiting the initiation of plaque formation in the arteries. In the immune system, vitamin E preserves immune cell activities by protecting the membranes of these cells.

Vitamin E occurs in food as tocopherols or tocotrienols. Alpha-tocopherol has the highest bioactivity. Vitamin E occurs naturally as d-alpha-tocopherol. The synthetic version is the dl-isomer which has 25% less bioactivity than the d-isomer.

Factors Affecting Availability

Since vitamin E is a fat-soluble vitamin, its bioavailability depends on fat intake for stimulation of bile acids required for micelle formation. Vitamin E along with selenium, copper, and manganese are integral components of the *cellular antioxidant defense system*, thus deficiency in any one of these minerals can increase demand for the vitamin.

In food, milling of whole grains which involves removing the outer husk and the germ, and bleaching of flour eliminates or destroys most of the vitamin E content. Although the vitamin E is heat-stable, the high temperatures used in frying can destroy the vitamin.

Whole grains and dark green leafy vegetables are rich sources of vitamin E. Regular consumption of processed grain products may contribute to a marginal vitamin E intake. Additionally, very low-fat intakes (<15% total energy) also decrease vitamin E availability.

Deficiency

At the cellular level, vitamin E deficiency promotes increased lipid peroxidation, making cells more vulnerable to oxidative injury. Clinical manifestations of chronic vitamin E deficiency are rare and are usually seen only when fat malabsorption is present (e.g., cystic fibrosis). In these cases, loss of deep tendon reflexes, muscle weakness,

problems with balance, visual impairment and decreased vibratory perceptions are observed.

Toxicity

No known toxicity to vitamin E has been observed. High intakes of vitamin E (100 times the recommended level) may decrease availability or interfere with utilization of other fat-soluble vitamins (vitamin A, D and K). In experimentally-induced vitamin E toxicity, impaired bone mineralization, decreased storage of vitamin A in the liver, and prolonged clotting times have been observed.

- ❖ *The upper safety limit for vitamin E intake established by the Food and Nutrition Board of the Institute of Medicine is 1,000 mg daily (as α -tocopherol in food or supplemental form) for adults.*

Vitamin E Tolerable Upper Intake Levels	
Life Stage	Vitamin E (mg)
Infants	
0-6 mo	N/A
7-12 mo	N/A
Children	
1-3 y	200
4-8 y	300
Males, Females	
9-13 y	600
14-18 y	800
19-70 y	1000
≥70 y	1000
Pregnancy	
≤ 18 y	800
19-50 y	1000
Lactation	
≤ 18 y	800
19-50 y	1000

Requirements

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

Vitamin E Requirements Daily Reference Intakes	
Life Stage	Vitamin E (mg)
Infants	
0-6 mo	4
7-12 mo	6

Children	
1-3 y	6
4-8 y	7
Males	
9-13 y	11
14-18 y	15
19-30 y	15
31-50 y	15
51-70 y	15
≥70 y	15
Females	
9-13 y	11
14-18 y	15
19-30 y	15
31-50 y	15
51-70 y	15
≥70	15
Pregnancy	
≤18 y	15
19-30 y	15
31-50 y	15
Lactation	
≤18 y	19
19-30 y	19
31-50 y	19

Dietary Sources

Vitamin E is primarily found in foods of plant origin. Wheat germ is the richest source of the vitamin. Vegetable oils and whole grains are additional rich sources of this nutrient. Nuts, peanut butter, salad dressings and vegetable oils are also good sources of vitamin E.

Vitamin E requirements are measured in milligrams (mg). However, vitamin E content is measured in International Units (IU) on food labels. To convert IU to mg, one IU of vitamin E is equivalent to 0.67 mg.

Vitamin E Rich Foods	
FOOD	Vitamin E (mg)
Wheat germ oil, 1 Tbl	26
Wheat germ, 2 Tbl	2.6
Sunflower seeds, ¼ cup	17.0
Sunflower oil, 1 Tbl	7.0
Peanut butter, 2 Tbl	3.3
Peanuts, ¼ cup	2.5
Peanut oil, 1 Tbl	1.7
Almond oil, 1Tbl	5.0
Almonds, ¼ cup	2.2
Mango, one, fresh	2.3

Corn oil, 1 Tbl	2.9
Canola oil, 1 Tbl	2.9
Avocado, whole	2.8
Olive oil, 1 T	1.7
Mayonnaise, 1 T	1.7
Margarine, 1 T	1.6
Swiss chard, ½ cup cooked	1.7
Papaya cubes, 1 cup, cubed	1.6
Mustard greens, ½ cup cooked	1.4
Catfish, 3.5 oz cooked	1.3
Pinto beans, ½ cup cooked	1.1
Grapes, 1 cup fresh	1.1