



# Vitamin A

## Snapshot Monograph



### Vitamin A

#### Most Frequent Reported Uses:

- Antioxidant
- Epithelial skin health, acne, wounds
- Gastrointestinal epithelial barrier health; celiac disease, Crohn's disease
- Ocular health
- Bones and teeth
- Immune balance; infections
- Pancreatic Disorders
- Fat Malabsorption

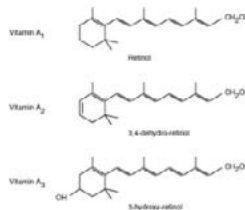
#### Nutrient name(s):

Vitamin A

Retinol

Retinyl palmitate

Mixed carotenoids



Vitamin A was the first fat-soluble vitamin to be isolated. Vitamin A is made in the body from retinoids, which occur in animal foodstuff and carotenoids (including beta-carotene, lutein, lycopene, zeaxanthin. Retinoids with vitamin A activity occur in nature in three different forms: a) the alcohol, retinol, b) the aldehyde, retinal or retinaldehyde, and c) the acid, retinoic acid. Beta-carotene, which is also called pro-vitamin A, is found exclusively in plant (fruit and vegetable) sources. Beta-carotene consists of two molecules of vitamin A linked head to head (A-A). Enzymes in the intestinal tract split beta-carotene into two molecules of vitamin A whenever the body needs it.

Vitamin A requires fats as well as minerals in order to be properly absorbed from the digestive tract. Substantial amounts of vitamin A are stored in the liver, and therefore, it does not need to be supplied in the diet on a daily basis.

Vitamin A must be obtained from the diet via food like green and yellow vegetables, dairy products, fruits and organ meats. In the body, vitamin A can be found as retinol, retinal and retinoic acid. Because all of these forms are toxic at high concentrations, they are bound to proteins in the extracellular fluids and inside cells. Vitamin A is stored primarily as long chain fatty esters and as provitamin carotenoids in the liver, kidney and adipose tissue

## FUNCTIONS:

- **Antioxidant Support** - the antioxidant activity of vitamin A and carotenoids is conferred by the hydrophobic chain of polyene units that can quench singlet oxygen, neutralize thiyl radicals and combine with and stabilize peroxy radicals. Because of the structures, vitamin A and carotenoids can autoxidize when O<sub>2</sub> tension increases, and thus are most effective antioxidants at low oxygen tensions that are typical of physiological levels found in tissues.
  - o Evidence has reported vitamin A, carotenoids and provitamin A carotenoids can be effective antioxidants for reducing the risk of developing ocular conditions, cardiovascular diseases and cancer.
- **Cancer support** – Retinol and vitamin A derivatives influence cell differentiation, proliferation, and apoptosis. Whether dietary β-carotene and vitamin A intake protects against lung cancer risk is not clear.
  - o Epidemiological studies have suggested an inverse correlation between cancer development and dietary consumption of vitamin A.
  - o However, evidence from 18 studies suggested that higher category of dietary β-carotene intake could reduce lung cancer risk. The associations were also significant in American and Asian populations.
  - o A meta-analysis of five studies showed no association between serum retinol and liver cancer.
  - o A systematic review of studies from 1955 to July 2017 reported no association between the intake and serum level of α-carotene and β-cryptoxanthin and the risk of liver cancer.
  - o The relationship between serum vitamin A levels or vitamin A supplementation and cancer risk is unclear.
- **Ocular health** - Required for night vision. Vitamin A combines with the protein opsin to form the photosensitive pigments rhodopsin and iodopsin in the rods and cones of the eyes, which are necessary for night vision. It is also essential for the lubricant from tear glands that prevent drying of the cornea.
  - Vitamin A supplements are reported to decrease oxidative stress associated with Age-related macular degeneration (AMD).
  - The 2001 Age-Related Eye Disease Study (AREDS), a large randomized clinical trial, reported that individuals at high risk of developing advanced AMD reduced their risk of developing advanced AMD by 25% by taking a daily supplement containing beta-carotene (15 mg), vitamin E (180 mg [400 IU] dl-alpha-tocopheryl acetate), vitamin C (500 mg), zinc (80 mg), and copper (2 mg) for 5 years compared to participants taking a placebo.
  - However, a 2013 follow-up AREDS2 study confirmed the value of this supplement in reducing the progression of AMD over a median follow-up period of 5 years but that beta-carotene was not a required ingredient; the original AREDS formulation without beta-carotene provided the same protective effect against developing advanced AMD.
- **Epithelial Tissue** - Plays an important role in maintaining the integrity of epithelial tissue, which are the mucous membrane-secreting cells that line all the glands, and organs of the body. Many studies show that adequate intake of vitamin A is associated with reduced risk to various epithelial-cell cancers (mouth, skin, lungs, bladder, breast, stomach, cervix, etc.)
- **Immune System** - Helps maintain healthy epithelial cells (surface cells of many glands, organs, and skin); helps to facilitate effective barriers to infections.
  - Vitamin A and retinoids reported to lead to compositional changes in microbiota
  - Improves Lactobacillus sp.
  - Partial reason for immune support
  - Response to viruses mediated by INF-beta upregulation
  - The World Health Organization recommends high oral doses (60,000 mcg RAE [200,000 IU]) of vitamin A for two days for children over age 1 with measles who live in areas with a high prevalence of vitamin A deficiency.
- **Growth and Bone Development** - Essential for the growth of bone and soft tissue. It is also necessary for the formation of tooth enamel in the development of teeth. A 2011 meta-analysis reported that vitamin A supplementation was associated with large reductions in mortality, morbidity, and vision problems in children under 5 years of age.

## DOSAGE:

### DRI\*

Women: 2,333 IU daily (700 mcg RAE) retinol activity equivalents

Men: 3,000 IU daily (900 mcg RAE) retinol activity equivalents

### ODA\*\*

5,000 - 25,000 IU daily (1,500 mcg - 7,500 mcg RAE) retinol activity equivalents

\* The Dietary Reference Intakes (DRI) are the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine, 1997-2001. They replace previous RDAs, and may be the basis for eventually updating the RDIs.

\*\*The Optimum Daily Allowance (ODA) represents a reference level beyond the RDI, and is often many times higher than the RDI to prevent diseases such as aging or cancer. These numbers are based on clinical use.

RDAs for vitamin A are given as retinol activity equivalents (RAE) to account for the different bioactivities of retinol and provitamin A carotenoids, all of which are converted by the body into retinol (see Table 1). One mcg RAE is equivalent to 1 mcg retinol, 2 mcg supplemental beta-carotene, 12 mcg dietary beta-carotene, or 24 mcg dietary alpha-carotene or beta-cryptoxanthin.

**Table 1: Recommended Dietary Allowances (RDAs) for Vitamin A [5]**

Age	Male	Female	Pregnancy	Lactation
0-6 months*	400 mcg RAE	400 mcg RAE		
7-12 months*	500 mcg RAE	500 mcg RAE		
1-3 years	300 mcg RAE	300 mcg RAE		
4-8 years	400 mcg RAE	400 mcg RAE		
9-13 years	600 mcg RAE	600 mcg RAE		
14-18 years	900 mcg RAE	700 mcg RAE	750 mcg RAE	1,200 mcg RAE
19-50 years	900 mcg RAE	700 mcg RAE	770 mcg RAE	1,300 mcg RAE
51+ years	900 mcg RAE	700 mcg RAE		

\*Adequate Intake (AI), equivalent to the mean intake of vitamin A in healthy, breastfed infants.

Vitamin A is listed on the new Nutrition Facts and Supplement Facts labels in mcg RAE. The U.S. Food and Drug Administration (FDA) required manufacturers to use these new labels starting in January 2020.

- 1 IU retinol = 0.3 mcg RAE
  - 1 IU supplemental beta-carotene = 0.3 mcg RAE
  - 1 IU dietary beta-carotene = 0.05 mcg RAE
  - 1 IU dietary alpha-carotene or beta-cryptoxanthin = 0.025 mcg RAE
- Food Sources: Good food sources of vitamin A include liver, kidney, butter, egg yolk, whole milk and cream, and fortified skim milk. Good food sources of beta-carotene (pro-vitamin A) include yellow and dark leafy green vegetables (carrots, collards, spinach, sweet potatoes, squash) and yellow fruit (apricots, peaches, cantaloupe). Cod liver oil and halibut fish oil contain high levels of vitamin A.
  - Retinol and carotenoid levels are generally measured in plasma, therefore plasma retinol levels are useful for assessing vitamin A inadequacy. However, their value for assessing marginal vitamin A status is limited because retinol and carotenoid levels do not decline until vitamin A levels in the liver are almost depleted.

## **SYMPTOMS OF DEFICIENCY:**

- Both provitamin A and preformed vitamin A must be metabolized intracellularly to retinal and retinoic acid the active forms of vitamin A, to support the vitamin's important biological functions
- Most of the body's vitamin A is stored in the liver in the form of retinyl esters
- Vitamin A deficiency can be caused by inadequate dietary intake or metabolic dysfunction that interferes with absorption, storage or transport of the vitamin.
- Deficiency of vitamin A is associated with the development and promotion of epithelial cell cancers in various glands and organs in the body.
- Vision problems: Night blindness (nyctalopia) is the classic vision problem resulting from vitamin A deficiency. Xerophthalmia (a drying and hardening of the epithelial cell membranes in the eye) can also develop. This condition causes blindness in hundreds of thousands of infants and children yearly world wide, but seldom occurs in the United States.
- Long-term vitamin A deficiency causes a condition known as follicular hyperkeratosis in which the skin becomes dry, scaly, and rough. Small hard bumps develop on the skin because hair follicles plug up with a hard protein called keratin.
- Vitamin A deficiency in infants and children hinders growth and development. Bone deformities and dental problems often occur.
- Individuals at risk for vitamin A deficiency include:
  - Premature infants
  - Infants and children in developing Countries
  - Pregnant and lactating women in developing Countries
  - Individuals with cystic fibrosis
- The following drugs can cause a depletion of vitamin A, which may increase an individual's need for vitamin A:
  - Cholestyramine
  - Colchicine
  - Colestipol
  - Mineral oil
  - Neomycin
  - Corticosteroids

## **SIDE EFFECTS AND WARNINGS:**

- Since vitamin A is fat soluble, excesses can accumulate in fatty tissues to toxic levels. Signs of vitamin A toxicity include dry itchy skin, brittle nails, hair loss, bone pain, gingivitis, headaches, muscle and joint pains, anorexia, fatigue, diarrhea, increased infections, enlarged liver and abnormal liver function. Symptoms are reversible when vitamin A is discontinued.
- Hypervitaminosis A has been reported in adults taking in excess of 50,000 IU daily for several years, and in a case of taking a water-soluble synthetic vitamin A at 18,500 to 60,000 IU for several months.
- Doses greater than 10,000 IU of Vitamin A have caused birth defects, especially during the first 7 weeks of pregnancy. Women who could potentially become pregnant should limit their daily vitamin A levels to less than 10,000 IU daily.
- Use with caution in those with pre-existing hepatic conditions or in those who drink alcohol excessively.
- Use of beta-carotene has been associated with an increased risk of lung cancer in those who smoke or who have been exposed to asbestos (Goralczyk et al, Nutr Cancer, 2009).
  - o One study of 29,000 male smokers reported an 18% increase in lung cancer in the group receiving 20 mg of beta-carotene a day for 5 to 8 years.
  - o Another study of 18,000 people reported 28% more lung cancers in people with a history of smoking and/or asbestos exposure. These individuals took 30 mg of beta-carotene in addition to 25,000 Units of retinol (a form of vitamin A) a day for 4 years.
  - o However, one study of 22,000 male physicians, some of them smokers or former smokers, took 50 mg of beta-carotene every other day for 12 years and reported no increase in lung cancer.
  - o If the patient smokes cigarettes or has a history of smoking or asbestos exposure, recommend to not take large amounts of beta-carotene supplements for long periods of time.

## VITAMIN A PATIENT SNAPSHOT

### Uses:

- Vitamin A is an important antioxidant vitamin for your body.
- Vitamin A supports a healthy immune system
- Vitamin A helps prevent night blindness, promotes healthy growth and development
- Vitamin A is needed for healthy skin.

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### Special Concerns:

- If you are taking prescription or non-prescription medications, have a pre-existing medical condition, or are pregnant and/or breastfeeding, talk with your healthcare provider before taking any dietary supplement.
- Doses greater than 10,000 IU of Vitamin A have caused birth defects, especially during the first 7 weeks of pregnancy. Women who could potentially become pregnant should limit their daily vitamin A levels to less than 10,000 IU daily.
- Do not take if there is an allergy to any component of this dietary supplement.
- If you smoke tobacco and/or have a history of cancer, talk to your healthcare provider before taking Vitamin A supplements.
- The following medications may deplete vitamin A from the body. When taking these medications, it is best to supplement your diet with vitamin A:
  - o Cholestyramine (Questran)
  - o Colchicine
  - o Colestipol (Colestid)
  - o Mineral oil
  - o Neomycin
  - o Corticosteroids (prednisone, methylprednisolone)

**DISCLAIMER:** Statements made are for educational purposes and have not been evaluated by the US Food and Drug Administration. They are not intended to diagnose, treat, cure, or prevent any disease. If you have a medical condition or disease, please talk to your doctor prior to using the recommendations given.

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