Beta-carotene

While some complementary and alternative techniques have been studied scientifically, high-quality data regarding safety, effectiveness, and mechanism of action are limited or controversial for most therapies. Whenever possible, it is recommended that practitioners be licensed by a recognized professional organization that adheres to clearly published standards. In addition, before starting a new technique or engaging a practitioner, it is recommended that patients speak with their primary healthcare provider(s). Potential benefits, risks (including financial costs), and alternatives should be carefully considered. The below monograph is designed to provide historical background and an overview of clinically-oriented research, and neither advocates for or against the use of a particular therapy.

Related Terms:

Background

- The name "carotene" was first coined in the early 19th Century by the scientist Wachenroder after he crystallized this compound from carrot roots. Beta-carotene is a member of the carotenoids, which are highly pigmented (red, orange, yellow), fat-soluble compounds naturally present in many fruits, grains, oil and vegetables (green plants, carrots, sweet potatoes, squash, spinach, apricots, and green peppers). Alpha, beta, and gamma carotene are considered provitamins because they can be converted to active vitamin A.

- The carotenes possess antioxidant properties. Vitamin A serves several biological functions including involvement in the synthesis of certain glycoproteins. Vitamin A deficiency leads to abnormal bone development, disorders of the reproductive system, xerophthalmia (a drying condition of the cornea of the eye), and ultimately death.

- Commercially available beta-carotene is produced synthetically or from palm oil, algae, or fungi. Beta-carotene is converted to retinol, which is essential for vision and is subsequently converted to retinoic acid, which is used for processes involving growth and cell differentiation.

Scientific Evidence

Uses
These uses have been tested in humans or animals. Safety and effectiveness have not always been proven. Some of these conditions are potentially serious, and should be evaluated by a qualified healthcare provider.

Erythropoietic protoporphyria

Erythropoietic protoporphyria is a rare inherited genetic disorder of porphyrin-heme metabolism which has skin and systemic manifestations, including photosensitivity (painful skin sensitivity to sunlight), as well as gallstones and liver

dysfunction. It is usually recognized during childhood. The over-the-counter synthetic beta-carotene product Lumitene is FDA approved for photoprotection in this disease. Antihistamines may also be used to reduce symptoms.

<table>
<thead>
<tr>
<th>Carotenoid deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Although consumption of provitamin A carotenoids (alpha-carotene, beta-carotene, and beta-cryptoxanthin) can prevent vitamin A deficiency, no overt deficiency symptoms have been identified in people consuming low-carotenoid diets if they consume adequate vitamin A. After reviewing the published scientific research, the Food and Nutrition Board of the Institute of Medicine (IOM) concluded that the existing evidence in 2000 was insufficient to establish a recommended dietary allowance (RDA) or adequate intake (AI) for carotenoids.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cataract prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study results of beta-carotene supplementation for cataract prevention are conflicting. Further well-designed clinical trials are needed before a conclusion can be drawn.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemotherapy toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observational research suggests that greater dietary intake of beta-carotene may lower the incidence of adverse effects in children undergoing chemotherapy for lymphoblastic leukemia. However, in theory high-dose antioxidants may interfere with the activity of some chemotherapy drugs or radiation therapy. Therefore, individuals undergoing cancer treatment should speak with their oncologist if they are taking or considering the use of high dose antioxidants. Additional evidence is needed in this area before a clear conclusion can be drawn.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chronic obstructive pulmonary disease (COPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The prevalence of bronchitis and shortness of breath in male smokers with chronic obstructive pulmonary disorder (COPD) seems to be lower in those patients who consume a diet containing high amounts of beta-carotene. However, beta-carotene supplements have not been proven to benefit COPD and may actually increase cancer rates in smokers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cystic fibrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals with cystic fibrosis may be deficient in beta-carotene and vitamin E, and it has been suggested that they may be more susceptible to oxidative damage. Theoretically, these patients may benefit from beta-carotene supplementation. Further research is needed before a conclusion can be drawn.</td>
</tr>
<tr>
<td>Condition</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td><strong>Exercise-induced asthma prevention</strong></td>
</tr>
<tr>
<td><strong>Immune system enhancement</strong></td>
</tr>
<tr>
<td><strong>Macular degeneration</strong></td>
</tr>
<tr>
<td><strong>Oral leukoplakia</strong></td>
</tr>
<tr>
<td><strong>Osteoarthritis</strong></td>
</tr>
<tr>
<td><strong>Polymorphous light eruption (PLE)</strong></td>
</tr>
<tr>
<td><strong>Pregnancy-related complications</strong></td>
</tr>
</tbody>
</table>
before a clear recommendation can be made.

**UV-induced erythema prevention/sunburn**

A combination of antioxidants may help protect the skin against irradiation. Long-term supplementation with beta-carotene may reduce UV-induced erythema, and appears to modestly reduce the risk of sunburn in individuals who are sensitive to sun exposure. However, beta-carotene is unlikely to have much effect on sunburn risk in most people.  

**Abdominal aortic aneurysm (AAA) prevention**

Long-term supplementation with alpha-tocopherol or beta-carotene has been shown not to have a protective or preventive effect in male smokers with large AAAs.

**Alzheimer's disease**

Intake of dietary or supplemental beta-carotene has been shown not to have any effect on Alzheimer's disease risk.

**Angioplasty**

There is some concern that when antioxidant vitamins, including beta-carotene, are used together they might have harmful effects in patients after angioplasty. Additional research is needed to determine the effect of beta-carotene specifically. Supplements containing these vitamins should be avoided immediately before and following angioplasty without the recommendation of a qualified healthcare professional.

**Birthmark/mole (dysplastic nevi) prevention**

Beta-carotene has been shown not to reduce the development of new moles in patients with numerous atypical moles.

**Cancer**

While diets high in fruits and vegetables rich in beta-carotene have been shown to potentially reduce the incidence of certain cancers, results from randomized controlled trials with oral supplements do not support this claim.

There is some concern that beta-carotene metabolites with pharmacological activity can accumulate and potentially have cancer causing (carcinogenic) effects. A higher, statistically significant incidence of lung cancer in male smokers who took beta-carotene supplements has been discovered. Beta-
carotene/vitamin A supplements may have an adverse effect on the incidence of lung cancer and on the risk of death in smokers and asbestos exposed people or in those who ingest significant amounts of alcohol. In addition, high-dose antioxidants theoretically may interfere with the activity of some chemotherapy drugs or radiation therapy. Therefore, individuals undergoing cancer treatment should speak with their oncologist if they are taking or considering the use of high dose antioxidants.

Beta-carotene in the amounts normally found in food does not appear to have this adverse effect.

### Cardiovascular disease

Although several studies suggest that diets high in fruits and vegetables containing beta-carotene appear to reduce the risk of cardiovascular disease, most randomized controlled trials with oral supplements of beta-carotene have not supported these claims.

A Science Advisory from the American Heart Association states that the evidence does not justify use of antioxidants such as beta-carotene for reducing the risk of cardiovascular disease.

### Helicobacter pylori bacteria eradication

Infection with *Helicobacter pylori* bacteria in the gut can lead to gastric ulcers. Dietary supplementation with beta-carotene has not been found to be effective for this indication.

### Mortality reduction

Patients given beta-carotene supplements show no reduction in relative mortality rates from all causes based on most available data.

### Postoperative tissue injury prevention

Study results conclude that peri-operative supplementation with antioxidant micronutrients has limited effects on strength and physical function following major elective surgery.

### Stroke

Taking all-trans beta-carotene (synthetic beta-carotene) orally has been reported to have no effect on the overall incidence of stroke in male smokers. Additionally, there is some evidence that beta-carotene actually increases the risk of intracerebral hemorrhage by 62% in patients who also drink alcohol.
The below uses are based on tradition, scientific theories, or limited research. They often have not been thoroughly tested in humans, and safety and effectiveness have not always been proven. Some of these conditions are potentially serious, and should be evaluated by a qualified healthcare provider. There may be other proposed uses that are not listed below.

- Acute respiratory infections, anemia, angina pectoris, asbestosis, benign breast disease, bone marrow transplantation, bronchial asthma (exercise-induced bronchoconstriction symptoms in young athletes), bronchopulmonary dysplasia in premature infants, chronic atrophic gastritis, chronic myeloid leukemia, diabetes, Graves' disease, high cholesterol, HIV, improving lung function, iron deficiency prevention, low birth weight (prevention), multiple myeloma, nasal polyposis, nutrition supplementation (during alcohol rehabilitation), sepsis, Streptococcal infections (group A), supratentorial glioblastoma, weight loss (HIV, post-partum).

**Dosing**

The below doses are based on scientific research, publications, traditional use, or expert opinion. Many herbs and supplements have not been thoroughly tested, and safety and effectiveness may not be proven. Brands may be made differently, with variable ingredients, even within the same brand. The below doses may not apply to all products. You should read product labels, and discuss doses with a qualified healthcare provider before starting therapy.

**General:**

- **Formulations:** Beta-carotene supplements are available in both oil matrix gelatin capsules and water-miscible forms. Some clinical trials have used water-miscible beta-carotene (10%) beadlets. The water miscible form seems to produce a significantly higher response in plasma beta-carotene (approximately 47% to 50%) than oil matrix gelatin capsules. Oral dosage is available in capsules (U.S. and Canada), tablets (U.S. and Canada), and chewable tablets (Canada).

- **Dietary intake:** Consuming 5 servings of fruit and vegetables daily provides 6-8 milligrams of beta-carotene. Beta-carotene requires some dietary fat for absorption, but supplemental beta-carotene is similarly absorbed when taken with high-fat or low-fat meals. 1,800 micrograms of beta-carotene has been reported to maintain adequate vitamin A levels.

- **Consensus recommendations:** The American Heart Association recommends obtaining antioxidants, including beta-carotene, from a diet high in fruits, vegetables and whole grains rather than through supplements, until more information is available from randomized clinical trials. Similar statements have been released by the American Cancer Society, the World Cancer Research Institute in association with the American Institute for Cancer Research, and the World Health Organization’s International Agency for Research on Cancer. The Institute of Medicine has reviewed beta-carotene, but has not make recommendations for daily intake, citing lack of sufficient evidence. Routine use of beta-carotene supplements is not considered necessary in the general population.

**Adults (18 years and older):**
15-180 milligrams taken by mouth of supplemental beta-carotene has been studied for various indications.

**Children (younger than 18 years):**

- There is insufficient available data to recommend high-dose oral (by mouth) supplementation in children.

---

**SAFETY**

The U.S. Food and Drug Administration does not strictly regulate herbs and supplements. There is no guarantee of strength, purity or safety of products, and effects may vary. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy. Consult a healthcare provider immediately if you experience side effects.

**Allergies**

- People who are sensitive to beta-carotene, vitamin A or any other ingredients in beta-carotene products should avoid supplemental use.

**Side Effects and Warnings**

- Supplemental beta-carotene in children should be limited to specific medical indications. There is insufficient reliable information available about the safety of large doses of beta-carotene in pregnant or breastfeeding women.
- Supplemental beta-carotene may increase the risk of lung cancer, prostate cancer, intracerebral hemorrhage, and cardiovascular and total mortality in people who smoke cigarettes or have a history of high-level exposure to asbestos. Beta-carotene from foods does not seem to have this effect.
- In people who smoke, beta-carotene may increase cardiovascular mortality. In men who smoke and have had a prior myocardial infarction (MI), the risk of fatal coronary heart disease increases by as much as 43% with low doses of beta-carotene. There is some evidence that beta-carotene in combination with selenium, vitamin C and vitamin E might lower high-density lipoprotein 2 (HDL2) cholesterol levels. HDL levels are protective so this is considered to be a negative effect. Dizziness, reversible yellowing of palms, hands, or soles of feet and to a lesser extent the face (called carotenoderma) can occur with high doses of beta-carotene. Loose stools, diarrhea, unusual bleeding or bruising and joint pain have been reported.

**Pregnancy and Breastfeeding**

- FDA Pregnancy Risk Factor C.
- Insufficient data are available on larger oral doses of beta-carotene in pregnant and breastfeeding woman.

---

**INTERACTIONS**

Most herbs and supplements have not been thoroughly tested for interactions with other herbs, supplements, drugs, or foods. The interactions listed below are based on reports in scientific publications, laboratory experiments, or traditional use. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy.

**Interactions with Drugs**
Preliminary studies in animals indicate that beta-carotene supplementation, when combined with heavy alcohol consumption, may increase liver toxicity and promote cancer.

Cigarette smoking decreases serum concentrations of beta-carotene and other carotenoids, and depletes body stores of beta-carotene. However, oral beta-carotene supplementation should not be recommended in smokers because supplemental beta-carotene in certain doses is associated with a significantly higher risk of lung and prostate cancer in smokers. Smokers and people with a history of asbestos exposure should avoid taking beta-carotene supplements.

Cholestyramine (Questran®) and colestipol (Colestid®) can reduce absorption of fat-soluble vitamins, including beta-carotene. Serum levels of beta-carotene can be reduced, but this is probably only in proportion to the lowering of cholesterol (on which beta-carotene is transported). Supplements are not usually necessary.

Colchicine can cause disruption of intestinal mucosal function, resulting in malabsorption of beta-carotene.

Taking beta-carotene in combination with selenium, vitamin C, and vitamin E appears to decrease the effectiveness of the combination of simvastatin (Zocor®) and niacin. Theoretically, beta-carotene could reduce the effectiveness of other HMG-CoA reductase inhibitors ("statins") such as atorvastatin (Lipitor®), fluvastatin (Lescol®), lovastatin (Mevacor®), and pravastatin (Pravachol®).

Mineral oil reduces absorption of fat-soluble vitamins, including beta-carotene.

Orlistat (Xenical®) can decrease absorption of beta-carotene and other fat-soluble vitamins. It is recommended that patients take a multivitamin supplement, and separate the dosing time by at least two hours from orlistat.

Loss of stomach acid can reduce absorption of a single dose of beta-carotene. Example proton pump inhibitors (PPIs) include esomeprazole (Nexium®), lansoprazole (Prevacid®), omeprazole (Prilosec®, Losec®), rabeprazole (Aciphex®), and pantoprazole (Protonix®, Pantoloc®).

Interactions with Herbs and Dietary Supplements

Consumption of a natural carotenoid mixture has been shown to lower the increase in oxidative stress induced by the fish oil. This carotenoid mixture may also enhance the plasma triglyceride-lowering effect of the fish oil.

Iron supplementation in infants with marginal vitamin A status has led to lower plasma vitamin A concentrations and greater vitamin A liver stores. Some researchers recommend that iron supplementation in infants should be accompanied by measures to improve vitamin A status.

Beta-carotene supplementation has been shown to lower serum lutein concentrations. Lutein from food sources does not seem to result in the decrease in beta-carotene concentrations that accompanies administration of lutein supplements.

Plant sterols have been shown to reduce beta-carotene bioavailability in some studies and not to have a significant effect in others. The effects on cholesterol levels are also unproven.

Supplementation of beta-carotene may decrease the vitamin E concentration in tissues.
This information is based on a systematic review of scientific literature edited and peer-reviewed by contributors to the Natural Standard Research Collaboration (www.naturalstandard.com).

Natural Standard developed the above evidence-based information based on a thorough systematic review of the available scientific articles. For comprehensive information about alternative and complementary therapies on the professional level, go to www.naturalstandard.com. Selected references are listed below.

The information in this monograph is intended for informational purposes only, and is meant to help users better understand health concerns. Information is based on review of scientific research data, historical practice patterns, and clinical experience. This information should not be interpreted as specific medical advice. Users should consult with a qualified healthcare provider for specific questions regarding therapies, diagnosis and/or health conditions, prior to making therapeutic decisions.