Beta-Carotene

AT A GLANCE

Introduction

Beta-carotene is a member of the carotenoid family, which are highly coloured (red, orange, yellow), fat-soluble pigments naturally present in many fruits, grains, oils, vegetables and in every leave where they are covered by chlorophyll. When temperature decreases in autumn, chlorophyll is destroyed and the beautiful carotenoids colours appear.

Among the naturally occurring carotenoids that can be converted to vitamin A in the human body, so-called 'provitamin A carotenoids', beta-carotene is the most abundant and most efficient one found in foods.

Health Functions

A sufficient intake of beta-carotene is important as it functions as

• a safe source of vitamin A, helping the body to reach the vitamin A levels that are essential for normal growth and development, good vision and eye health, a strong immune system, and healthy skin.

• an antioxidant, contributing to protecting the body against the damaging effects of free radicals and reactive oxygen species, which can potentially increase the risk of developing certain diseases, including cardiovascular diseases, chronic inflammation and cancer.

• an agent for sun protection of the skin

Disease Risk Reduction

Lung cancer

Studies indicate that increased intake of vegetables and fruits rich in beta-carotene may decrease the risk of lung cancer. It is not clear if these effects can be attributed to beta-carotene alone as the role of other carotenoids or vitamins from vegetables and fruits and associated dietary or life style patterns have not been adequately explored in the studies (see also Principles – The contradictory science of micronutrients). Some preliminary data suggest that beta-cryptoxanthin protects the lung rather than beta-carotene.

Heart disease

A number of studies have associated high blood levels of dietary beta-carotene and other carotenoids, such as lycopene, with a lower risk of developing diseases that involve the heart or blood vessels (e.g., heart attack and atherosclerosis).

Skin health

There is evidence that beta-carotene, alone and in combination with other carotenoids or antioxidant vitamins can protect the skin from sun damage. Oral supplementation of beta-carotene

has been used successfully as sun protection in combination with sunscreens in the prevention of sunburn.

Age-related eye disorders

The results of population studies suggest that diets rich in beta-carotene and other carotenoids (lutein and zeaxanthin) may help to slow the development of age-related macular degeneration (deterioration of the macula, the part of the retina that is responsible for central vision) and cataracts (clouding in the lens of the eye) causing vision loss if left untreated. Whereas the beneficial effect of lutein and zeaxanthin supplementation on age-related macular degeneration has been proven in various intervention studies, the positive effect of beta-carotene intake on cataract was shown in a meta-analysis including 22 human studies.

Immune function

In a number of studies, supplementation with beta-carotene and other carotenoids was found to enhance certain immune responses potentially preventing infections.

Other Applications

Please note:

Any dietary or drug treatment with high-dosed micronutrients needs medical supervision.

Sun sensitivity

Studies suggest that high doses of beta-carotene may decrease sensitivity to the sun. People with 'erythropoietic protoporphyria', a rare genetic condition that causes painful sun sensitivity, are often treated with high dose beta-carotene to reduce sun sensitivity.

Intake Recommendations

European and U.S. health authorities have decided that the existing evidence is insufficient to establish intake recommendations for beta-carotene.

Until now, dietary intake of beta-carotene, which can be converted to vitamin A, has been expressed as part of the intake recommendations for vitamin A.

Apart from its 'provitamin A function', data continue to accumulate supporting a role for beta-carotene as important micronutrient in its own right.

However, consumption of foods rich in beta-carotene is being recommended by scientific and government organizations in Europe and the U.S.; the recommended intakes range from 2 to 6 mg beta-carotene per day for adults.

Supply Situation

The estimated average amount of total beta-carotene presently consumed in Europe and the U.S. is below the recommended intake.

Deficiency

In populations that consume low amounts of vitamin A, which is only found in animal products such as liver, a sufficient intake of beta-carotene, as provitamin A carotenoid, is essential in preventing vitamin A deficiency. This is true for vegetarians and vegans as they do not all consume preformed vitamin A. For pregnant and lactating women it is also advised to supplement beta-carotene as this is the safest sources of vitamin A.

Above average intake of beta-carotene may improve health (see Health Benefits).

Sources

The best sources of beta-carotene are yellow/orange vegetables (e.g., carrots, sweet potatoes, pumpkins, and winter squash) and fruits (e.g., apricots, cantaloupes, papayas, mangoes, carambolas, nectarines, peaches) and dark green leafy vegetables (e.g., spinach, broccoli, endive, kale, chicory, escarole, watercress and beet leaves).

The proportion of beta-carotene that can be absorbed, transported and utilized by the body once it has been consumed ('bioavailability'), is influenced by a number of factors, among them the vitamin A status and genetic predisposition of the subject. Beta-carotene from dietary supplements is better absorbed than beta-carotene from foods. In addition chopping, mechanical homogenisation and cooking enhances bioavailability of beta-carotene, and the presence of fat in the digestive tract is required for the absorption of beta-carotene.

Safety

High doses of beta-carotene (up to 180 mg/day) used for the treatment of skin disorders have shown no adverse or toxic effects.

Excessive intakes of beta-carotene may cause a yellowish tone of the skin, mainly on the palms of the hands and soles of the feet. The yellow colour disappears when carotenoid consumption is reduced or stopped.

Beta-carotene is considered a safe source of vitamin A: while the ingestion of high amounts of preformed vitamin A (retinol) for months or years can be toxic (see Vitamin A / Safety), the body will convert only as much vitamin A from beta-carotene as it needs without a risk of intoxication.

Lung cancer risk

Two clinical studies indicated that long-term high-dose beta-carotene supplementation (20 or 30 mg/day over several years) in heavy smokers and former asbestos workers increased the risk of lung cancer and death. The reasons for these findings. were investigated for many years and researcher think that the beta-carotene or metabolites thereof interfere with the retinoid signalling in the lung. The prooxidative environment in lung epithelia is another factor that increases degradation of beta-carotene and the formation of unwanted metabolites.

Other clinical studies, such as the Linxian study in China (15mg/d) or the Physicians' Health Study in the USA (25mg/d) did not confirm these observations; in latter two studies however, the plasma

concentration of beta-carotene was much lower, in the range that is reached by high consumers of fruit and vegetables.

The consequence of these results is that supplemental beta-carotene in doses over15 mg/day is not recommended for use in current smokers.

Tolerable upper intake level

In 2012 the EFSA panel on food additives and nutrient sources added to food released a scientific opinion on the safety of beta-carotene use in heavy smokers. The Panel concluded that exposure to β-carotene from its use as food additive and as food supplement at a level below 15 mg/day do not give rise to concerns about adverse health effects in the general population, including heavy smokers (62).
EU member states have independently assessed the safety of beta-carotene and came to a different conclusion. The UK health authorities set the safe upper level for the general population at 7mg/day and the Norwegian VKM set an upper level of 4mg/d for beta-carotene use as food supplement (65).

Drug interactions

Please note:

Because of the potential for interactions, dietary supplements should not be taken with medication without first talking to an experienced healthcare provider.

Authored by Dr Peter Engel in 2010, reviewed and revised by Dr. Adrian Wyss on 03.10.17 .