NovaQ10

Coenzyme Q10

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Summary

Coenzyme Q10 is a fat-soluble compound primarily synthesized by the body and also consumed in the diet.
Coenzyme Q10 is required for mitochondrial ATP synthesis and functions as an antioxidant in cell membranes and lipoproteins.
Endogenous synthesis and dietary intake appear to provide sufficient coenzyme Q10 to prevent deficiency in healthy people, although tissue levels of coenzyme Q10 decline with age.
Oral supplementation of coenzyme Q10 increases plasma, lipoprotein, and blood vessel levels, but it is unclear whether tissue coenzyme Q10 levels are increased, especially in healthy individuals. Coenzyme Q10 supplementation has resulted in clinical and metabolic improvement in some patients with hereditary mitochondrial disorders.
Although coenzyme Q10 supplementation may be a useful adjunct to conventional medical therapy for congestive heart failure, additional research is needed.
Roles for coenzyme Q10 supplementation in cardiovascular diseases, neurodegenerative diseases, cancer, and diabetes require further research.
Coenzyme Q10 supplementation does not appear to improve athletic performance.
Although coenzyme Q10 supplements are relatively safe, they may decrease the anticoagulant efficacy of warfarin.
Although the use of cholesterol-lowering medications known as HMG-CoA reductase inhibitors (statins) decreases circulating levels of coenzyme Q10, it is unclear whether coenzyme Q10 supplementation provides any health benefit to patients taking these drugs.

Introduction

Coenzyme Q10 is a member of the ubiquinone family of compounds. All animals, including humans, can synthesize ubiquinones, hence, coenzyme Q10 cannot be considered a vitamin (1). The name ubiquinone refers to the ubiquitous presence of these compounds in living organisms and their chemical structure, which contains a functional group known as a benzoquinone. Ubiquinones are fat-soluble molecules with anywhere from one to 12 isoprene (5-carbon) units. The ubiquinone found in humans, ubidecaquinone or coenzyme Q10, has a "tail" of ten isoprene units (a total of 50 carbon atoms) attached to its benzoquinone "head" (diagram) (2).

Performance

Athletic performance

Although coenzyme Q10 supplementation has improved exercise tolerance in some individuals with mitochondrial encephalomyopathies (see Deficiency) (19), there is little evidence that it improves athletic performance in healthy individuals. At least seven placebo-controlled trials have examined the effects of 100-150 mg/day of coenzyme Q10 supplementation for three to eight weeks on physical performance in trained and untrained men. Most found no significant differences between groups taking coenzyme Q10 and groups taking placebos with respect to measures of aerobic exercise performance, such as maximal oxygen consumption (VO2 max) and exercise time to exhaustion (85-89). One study found the maximal cycling workload to be slightly (4%) increased after eight weeks of coenzyme Q10 supplementation compared to placebo, although measures of aerobic power were not increased (90). Two studies actually found significantly greater improvement in measures of anaerobic (86) and aerobic (85) exercise performance after supplementation with a placebo compared to coenzyme Q10. Studies on the effect of supplementation on physical performance in women are lacking, but there is little reason to suspect a gender difference in the response to coenzyme Q10 supplementation.

Sources

Biosynthesis

Coenzyme Q10 is synthesized in most human tissues. The biosynthesis of coenzyme Q10 involves three major steps: (1) synthesis of the benzoquinone structure from either tyrosine or phenylalanine, two amino acids; (2) synthesis of the isoprene side chain from acetyl-coenzyme A (CoA) via the mevalonate pathway; and (3) the joining or condensation of these two structures. The enzyme hydroxymethylglutaryl (HMG)-CoA reductase plays a critical role in the regulation of coenzyme Q10 synthesis, as well as the regulation of cholesterol synthesis (1, 6).

The first step in benzoquinone biosynthesis (the conversion of tyrosine to 4-hydroxyphenylpyruvic acid) requires vitamin B6 in the form of pyridoxal 5'-phosphate. Thus, adequate vitamin B6 nutrition is essential for coenzyme Q10 biosynthesis. A pilot study in 29 patients and healthy volunteers found significant positive correlations between blood levels of coenzyme Q10 and measures of vitamin B6 nutritional status (91). However, further research is required to determine the clinical significance of this association.

Food Sources

Based on food frequency studies, the average dietary intake of coenzyme Q10 in Denmark was estimated to be 3-5 mg/day (6, 7). Most people probably have a dietary intake of less than 10 mg/day of coenzyme Q10. Rich sources of dietary coenzyme Q10 include mainly meat, poultry, and fish. Other relatively rich sources include soybean and canola oils, and nuts. Fruits, vegetables, eggs, and dairy products are moderate sources of coenzyme Q10. Approximately 14%-32% of coenzyme Q10 was lost during frying of vegetables and eggs, but the coenzyme Q10 content of these foods did not change when they were boiled. Some relatively rich dietary sources and their coenzyme Q10 content in milligrams (mg) (92-94).

Supplements

Coenzyme Q10 is available without a prescription as a dietary supplement in the U.S. Supplemental doses for adults range from 30-100 mg/day, which is considerably higher than normal dietary coenzyme Q10 intake. Therapeutic doses for adults generally range from 100-300 mg/day, although doses as high as 3,000 mg/day have been used to treat early Parkinson's disease under medical supervision (95). Absorption of coenzyme Q10 decreases with increasing supplemental dose; total intestinal absorption is likely less than 10% in humans. Coenzyme Q10 is fat-soluble and is best absorbed with fat in a meal. Doses higher than 100 mg/day are generally divided into two or three doses throughout the day (7, 96).