CoEnzyme Q$_{10}$ – The “Energizing” Supplement

Overview of Coenzyme Q$_{10}$
Coenzyme Q10 (CoQ10) is produced by the human body and is necessary for the basic functioning of cells. CoQ10 levels are reported to decrease with age and to be low in patients with some chronic diseases such as heart conditions, muscular dystrophies, Parkinson’s disease, cancer, diabetes, and HIV/AIDS. Some prescription drugs may also lower CoQ10 levels.$^1$

Coenzyme Q$_{10}$ is one of the most important nutrients in the human body. It is a fat-soluble vitamin-like compound that is also known as ubiquinone, from the word ubiquitous, meaning “everywhere.” Coenzyme Q or ubiquinone compounds are synthesized in the cells of all living organisms including plants, animals and humans. There are ten coenzymes Q compounds that occur throughout nature, but only coenzyme Q$_{10}$ is synthesized in humans.

This oil-soluble vitamin-like substance is present in most eukaryotic cells, primarily in the mitochondria. It is a component of the electron transport chain and participates in aerobic cellular respiration, generating energy in the form of ATP. Ninety-five percent of the human body’s energy is generated this way.$^2,3$ Therefore, those organs with the highest energy requirements—such as the heart and the liver—have the highest CoQ$_{10}$ concentrations.$^4,5,6$

Biochemical role
CoQ$_{10}$ is found in the membranes of many organelles. Since its primary function in cells is in generating energy, the highest concentration is found on the inner membrane of the mitochondrion. Some other organelles that contain CoQ$_{10}$ include endoplasmic reticulum, peroxisomes, lysosomes, and vesicles.

Supplementation
Because of its ability to transfer electrons and therefore act as an antioxidant, Coenzyme Q is used as a dietary supplement. According to the Mayo Clinic$^7$ “CoQ$_{10}$ has been used, recommended, or studied for numerous conditions.

Mitochondrial disorders
Supplementation of Coenzyme Q$_{10}$ is a treatment for some of the very rare and serious mitochondrial disorders and other metabolic disorders, where patients are not capable of producing enough coenzyme Q$_{10}$ because of their disorder. Coenzyme Q$_{10}$ is then prescribed by a physician.$^8$

Heart failure
There is some clinical evidence$^9$ that supplementation with Coenzyme Q10 is beneficial treatment of patients with congestive heart failure.

Migraine headaches
Supplementation of Coenzyme Q$_{10}$ has been found to have a beneficial effect on the condition of some sufferers of migraine headaches. So far, three studies have been done, of which two were small, did not have a placebo group, were not randomized, and were open-label,$^10$ and one was a double-blind, randomized, placebo-controlled trial, which found statistically significant results despite its small sample size of 42 patients.$^{11}$ Dosages were 150 to 300 mg/day.

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Cancer

It is also being investigated as a treatment for cancer, and as relief from cancer treatment side-effects.12

Cardiac arrest

Another recent study shows a survival benefit after cardiac arrest if coenzyme Q_{10} is administered in addition to commencing active cooling of the body to 90–93 degrees Fahrenheit (32–34 degrees Celsius)13

Blood pressure

There are several reports concerning the effect of CoQ_{10} on blood pressure in human studies.14 In a recent meta-analysis of the clinical trials of CoQ_{10} for hypertension, a research group led by Professor Frank Rosenfeldt (Director, Cardiac Surgical Research Unit, Alfred Hospital, Melbourne, Australia) reviewed all published trials of Coenzyme Q_{10} for hypertension, and assessed overall efficacy, consistency of therapeutic action, and side-effect incidence. Meta-analysis was performed in 12 clinical trials (362 patients) comprising three randomized controlled trials, one crossover study, and eight open-label studies. The research group concluded that coenzyme Q_{10} has the potential in hypertensive patients to lower systolic blood pressure by up to 17 mm Hg and diastolic blood pressure by up to 10 mm Hg without significant side-effects.15

Biosynthesis

The benzoquinone portion of Coenzyme Q_{10} is synthesized from tyrosine, whereas the isoprene sidechain is synthesized from acetyl-CoA through the mevalonate pathway. The mevalonate pathway is also used for the first steps of cholesterol biosynthesis.

Inhibition by statins and beta blockers

Coenzyme Q_{10} shares a common biosynthetic pathway with cholesterol. The synthesis of an intermediary precursor of Coenzyme Q_{10}, mevalonate, is inhibited by some beta blockers, blood pressure-lowering medication,16 and statins, a class of cholesterol-lowering drugs.17 Statins can reduce serum levels of coenzyme Q_{10} by up to 40%.18 Some research suggests the logical option of supplementation with coenzyme Q_{10} as a routine adjunct to any treatment that may reduce endogenous production of coenzyme Q_{10} based on a balance of likely benefit against very small risk.19,20

Studies & Abstracts

HMG-CoA Reductase Inhibitors & Coenzyme Q_{10} Depletion


Inhibition of 3-hydroxy-3-methylglutaryl-coenzyme A reductase may inhibit the biosynthesis of coenzyme Q_{10} an enzyme which is important for cardiac function. This article reports on three protocols which were designed to determine whether lovastatin inhibited the biosynthesis of coenzyme Q_{10}. Data from the three protocols demonstrated that lovastatin does indeed lower levels of CoQ_{10}. An increase in cardiac disease from lovastatin, particularly in patients with class IV cardiomyopathy was proposed. Oral administration of CoQ_{10} increased blood levels of CoQ_{10} and improved cardiac function in most patients. The authors also speculate that some cases of lovastatin-induced liver dysfunction may be attributed to a deficiency of CoQ_{10}. 


In a randomized, double-blind trial, 45 hypercholesterolemic patients were treated with increasing dosages of either lovastatin (20-80 mg/day) or pravastatin (10-40 mg/day). Serum levels of coenzyme Q₁₀ and cholesterol were measured over 18 weeks of treatment. A significant, dose-related decrease in the serum level of coenzyme Q₁₀ was found in both the pravastatin and lovastatin groups at the end of the study. The decrease after lovastatin therapy was more pronounced. The authors note that HMG-CoA reductase inhibitors are generally safe and effective over a limited time, but patients should be monitored for possible adverse consequences of coenzyme Q₁₀ reductions during long-term therapy.

**Effects of Coenzyme Q₁₀ Depletion**

Although we get a limited amount of coenzyme Q₁₀ (Co Q₁₀) from dietary sources, the majority of CoQ₁₀ in humans is manufactured by our own cells. The biosynthesis of coenzyme Q₁₀ is a 17-step process that requires riboflavin, niacinamide, pantothenic acid, pyridoxine, cabalamin, folic acid, vitamin C, and numerous other trace elements. Consequently, there are many ways the complex synthesis of coenzyme Q₁₀ can be interrupted. It is probable that many people with health problems are suffering from a coenzyme Q₁₀ deficiency due to inadequate dietary intake of the necessary nutrients and/or ingestion of one or more drugs that interrupt the synthesis of coenzyme Q₁₀.

**Symptoms of coenzyme Q₁₀ deficiency includes:**

- Congestive heart failure
- High blood pressure
- Angina
- Mitral valve prolapse
- Stroke
- Cardiac arrhythmias
- Cardiomyopathy
- Lack of energy
- Gingivitis
- Generalized weakening of the immune system

Since coenzyme Q₁₀ is intimately involved in the production of energy, a deficiency of CoQ₁₀ first affects the heart and cardiovascular system because the heart is the most energy demanding muscle in the human body. The results of some studies suggest that congestive heart failure is primarily a coenzyme Q₁₀ deficiency disease.

**Biological Function & Effect of Coenzyme Q₁₀**

- **Energy**: Coenzyme Q₁₀ plays critical roles in the production of energy within the mitochondria. It is a coenzyme for numerous enzymes that are involved in the production of triphosphate (ATP), which is the high-energy fuel for all living cells.
- **Antioxidant**: Coenzyme Q₁₀ is also an important antioxidant. Because it is fat-soluble, it is able to reside in the mitochondrial cell membranes where it provides protection against free radical damage.
- **Cardiovascular disease**: Co Q₁₀ is reportedly useful in all kinds of cardiovascular disease. Co Q₁₀ has been found to be effective for periodontal disease.
- **Protective**: Coenzyme Q₁₀ also helps to protect against the toxic side effects of drugs such as Adriamycin®, beta-blockers, and drugs used for psychiatric disorders.

**Side Effects & Toxicity** of CoQ₁₀. Coenzyme Q₁₀ appears to be very safe. No studies have reported toxicity or adverse side effects.
RDA No RDA has been set for coenzyme Q10. Normal supplement dosage range from 30-100 mg.

Dietary Sources Coenzyme Q compounds exist in the cells of all plants and animals. However, the level of coenzyme Q10 that we obtain from the diet is believed to be inadequate to meet the needs for optimal health and wellness.

Forms: Capsule, powder-filled; softgel; Spray, liposomal; Tablet, powder-based

References
17. ^ The Synthesis of Cholesterol