
Coenzyme Q₁₀ (*Ubiquinone*)

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General Features

CoQ₁₀ is an essential component of the electron transfer system in the mitochondria. More specifically, it functions to shuttle hydrogen electrons from NAD to cytochrome b, facilitating the release of energy required to recouple ADP with inorganic phosphate in the synthesis of ATP. As such, CoQ₁₀ is an integral part of the bioenergetic system that enables cells to produce adequate amounts of ATP through aerobic pathways. ATP is the primary fuel required to power the body's metabolic reactions, maintain optimal function of cells and sustain life. A deficit in ATP synthesis can compromise any number of energy-dependent cellular functions and hasten the onset of dysfunction and if severe enough, cell death.

Although the body can synthesize CoQ₁₀, deficiency states of CoQ₁₀ tend to exist and are associated with various health conditions. Moreover, supplementation studies with CoQ₁₀ have been shown to effectively treat and sometimes reverse a number of these conditions.

There is evidence that a decline in CoQ₁₀ synthesis occurs with aging, predisposing individuals to a number of CoQ₁₀ deficiency-related disorders and diseases.

Professor F.L. Crane and his colleagues at the University of Wisconsin first discovered CoQ₁₀ in 1957. Since then, Dr. Karl Folkers at the University of Texas (Austin) is most responsible for the ongoing research on CoQ₁₀.¹⁻⁴

Coenzyme Q₁₀ is also a fat soluble antioxidant, which has been shown to reduce oxidation of LDL-cholesterol and the mitochondrial DNA.^{5,6} CoQ₁₀ supplementation has been shown to modulate immune system function, enhancing levels of immunoglobulin G (IgG), in the serum of patients provided with 60 mg CoQ₁₀ per day.⁷

The average person may consume about 5 mg per day of CoQ₁₀ from foods, with the main sources being meat, fish, soybeans and some vegetable oils. Clinical Coenzyme Q₁₀ studies have involved daily supplemental intake levels ranging from 60 mg to 300 mg per day; far greater than food alone can provide.⁸

Supplementation Studies and Clinical Applications

1. Cardiovascular Disease

Biopsy results from heart tissue in patients with various cardiovascular diseases (especially congestive heart failure) show a deficiency in CoQ₁₀ in 50 to 75 percent of cases. Low blood levels of CoQ₁₀ are also a consistent finding in the majority of these patients.⁹⁻¹²

Supplementation studies with patients suffering from various cardiomyopathies (i.e. ischemic cardiomyopathy, dilated cardiomyopathy, heart valve disorders) and congestive heart failure have demonstrated significant improvement in heart function (according to the New York Heart Association functional scale) in a high percentage of cases.

Many patients in these studies have been able to reduce the number of cardiac drugs required (1-3 medications reduced in 43 percent of CoQ₁₀ supplemented patients in one study of 424 patients, over an eight year period).

Heart function parameters monitored have included left ventricular wall thickness, mitral valve inflow slope, and fractional shortening.^{13,14,15}

- a. Congestive Heart Failure - Several controlled studies using Coenzyme Q₁₀ supplementation in patients with congestive heart failure have demonstrated significant improvement in cardiac ejection fraction, reduced shortness of breath, and increased muscle strength. Other studies have demonstrated increased stroke volume and cardiac index, improved survival and improved quality of life, in general. Of great significance is the fact that when patients discontinue CoQ₁₀ supplementation, cardiac function deteriorates. Thus, CoQ₁₀ needs to be a lifelong intervention in these cases.^{16,17,18}
- b. Angina - A small study has shown that CoQ₁₀ supplementation can reduce angina episodes and nitroglycerine use and improve treadmill exercise tolerance. Larger trials are required to substantiate this data.¹⁹
- c. Hypertension - Several studies have provided evidence that CoQ₁₀ supplementation can lower systolic and diastolic blood pressure (i.e. systolic 164-146, diastolic 98-86) in hypertensive patients. Improved blood cholesterol levels also occurred in one study, with a rise in HDL and a reduction in total cholesterol from 229.9 mg/dl to 213.3 mg/dl.¹⁸⁻²²

2. Periodontal Disease

Several intervention trials involving patients with periodontal disease have revealed that CoQ₁₀ supplementation can be useful in reversing the condition to various degrees.^{23,24}

3. Aerobic Exercise Performance

A study of 25 cross-country skiers has provided preliminary evidence that CoQ₁₀ supplementation may improve exercise performance in endurance athletes.²⁵

Sedentary individuals have also demonstrated improvement with work capacity, oxygen consumption, fat burning and oxygen transport after beginning an exercise program. The group supplemented with CoQ₁₀ demonstrated greater improvement in these aerobic parameters compared to the placebo group, in a 4-8 week trial period.²⁶

Dosage Ranges

1. Cardiovascular Conditions: typical dosage is 50-60 mg, three times per day. Large doses (up to 300 mg) may be needed in severe heart disease. Some studies use a dosage of 2 mg CoQ₁₀ for each kilogram of body weight.
2. Periodontal Disease: 50 mg per day has been used in clinical trials
3. Exercise Performance Studies: 60 mg per day²⁷

Toxicity and Contraindications

Coenzyme Q₁₀ is well tolerated, and no serious adverse effects have been reported with long-term use.²⁷

Drug-Nutrient Interactions

1. Warfarin

CoQ₁₀ supplementation has been shown to antagonize the anti-coagulant effects of warfarin, requiring dose adjustment.

2. Beta-Blockers and HMG

CoA Reductase (statin) drugs for cholesterol lowering are known to inhibit the endogenous synthesis of CoQ₁₀. CoQ₁₀ supplementation can compensate for this inhibition effect and is indicated as a concurrent therapy when these drugs are in use (100 mg of CoQ₁₀ per day is recommended in these cases).

3. Psychotropic Drugs

Coenzyme Q₁₀ supplementation has been shown to reduce the cardiac side effects of phenothiazines and tricyclic antidepressant drugs.

4. Chemotherapy

Q₁₀ supplementation can mitigate the cardiac side effects and cardiotoxicity of the chemotherapy drug known as adriamycin (100 mg per day of CoQ₁₀ supplementation). Even children with lymphoblastic leukemia or non-Hodgkin lymphoma realized this benefit compared with the placebo group.²⁸⁻³⁴

5. Anticoagulants

As noted above, there are reported cases of CoQ₁₀ countering the action of warfarin. Thus, the physician prescribing warfarin may need to adjust the warfarin dose if CoQ₁₀ is to be used and therefore must be consulted.^{34,35}

The following drugs may reduce the body's levels of CoQ₁₀:

1. Orlistat: reduces CoQ₁₀ absorption.³⁶
2. Beta blockers: decreases CoQ₁₀ synthesis.³⁷
3. Biguanides: decreases CoQ₁₀ synthesis.³⁸
4. Clondine: decreases CoQ₁₀ synthesis.³⁹
5. Gemfibrozil: (cholesterol-lowering drug).⁴⁰
6. Haloperidol: decreases CoQ₁₀ synthesis.⁴¹
7. HMG-CoA Reductase inhibitors: decreases CoQ₁₀ synthesis.⁴²
8. Hydralazine: decreases CoQ₁₀ synthesis.³⁷
9. Methyropa: decreases CoQ₁₀ synthesis.³⁹
10. Phenothiazines: decreases CoQ₁₀ synthesis.⁴¹
11. Sulfonylureas: some of these drugs decrease CoQ₁₀ synthesis (acetohexamide, glyburide, tolazamide).³⁸
12. Thiazide Diuretics: decrease CoQ₁₀ synthesis.³⁹
13. Tricyclic Antidepressants: decrease CoQ₁₀ synthesis.⁴¹

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