

Coenzyme Q-10

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WHAT IS IT KNOWN AS?

While the compound is commonly known as coenzyme Q-10, it is sometimes abbreviated as CoQ10 or Co-Q₁₀. Its scientific name is ubiquinone, ubidecarenone or mitoquinone.

HOW DOES IT WORK?

Although coenzyme Q-10 has a structure similar to vitamins E and K, it is not classified as a vitamin. It is an important component within the mitochondria, which are the main source of cell energy. At the cellular level, coenzyme Q-10 contributes to the production of adenosine triphosphate (ATP), a key component of oxidative metabolism (1-3). Without coenzyme Q-10, energy stores may become depleted, thereby decreasing the effectiveness of organs such as the heart.

Coenzyme Q-10 also acts as an important antioxidant and membrane stabilizer, eliminating those chemicals from the body that could damage cell walls (1). In fact, the compound has been shown to protect against oxidation of LDL (low-density lipoprotein), or "bad cholesterol", which is related to the formation of plaque inside the arteries of the heart (4). Coenzyme Q-10 is also involved in processes that move energy and minerals around and between heart muscle cells.

Coenzyme Q-10 is found naturally throughout the body, and at high concentrations in organs such as the pancreas, liver, kidney and heart. Produced inside the tissues of these organs, it is fat soluble and acts like a vitamin (1). The quantity of

Coenzyme Q-10 protects:

- The body's energy stores maintaining the heart's effectiveness
- Against oxidation of "bad cholesterol" which is related to plaque formation within coronary arteries

coenzyme Q-10 found inside the body is significantly less than is felt to represent a therapeutic dosage. When administered orally, coenzyme Q-10 reaches its maximum concentration within the blood in five to 10 hours and remains at relatively high levels for up to 34 hours.

Patients with certain diseases, including congestive heart failure (CHF), have low levels of coenzyme Q-10, with the lowest levels found in those with the most severe symptoms. In addition, patients who benefit most from a coenzyme Q-10 supplement have the lowest natural levels of coenzyme Q-10 (1, 5-7). Supplementation appears to raise these levels in the serum (8).

In addition, coenzyme Q-10:

- prevents oxidative stress, which seems to be the beneficial mechanism at work in treating congestive heart failure.
- is associated with increased ATP synthesis, membrane protection and the reduction of free radicals in the treatment of angina (chest pain) (1).
- may protect against heart toxicity associated with the chemotherapy drug doxorubicin (Adriamycin). While no mechanism has been established for this effect, the cor-

Coenzyme Q-10 has been used in heart disease to treat:

- congestive heart failure
- chest pain (angina)
- high blood pressure (hypertension)
- mitral valve prolapse (a condition characterized by blood flow back into the heart's upper chamber)

and to prevent:

- heart toxicity associated with doxorubicin (Adriamycin) chemotherapy (9).

Coenzyme Q-10 has also demonstrated benefits in patients undergoing coronary artery bypass surgery (10).

rection of coenzyme Q-10 deficiencies and the scavenging of free radicals has been suggested (1).

HAS IT BEEN STUDIED IN HEART DISEASE?

Congestive Heart Failure

Clinical trials suggest that coenzyme Q-10 can significantly improve the quality of life and decrease hospitalization rates for patients with mild to severe congestive heart failure. The signs and symptoms associated with the condition's symptoms such as shortness of breath, lower extremity edema (accumulation of fluids in the legs), an enlarged liver and insomnia are reduced as well (11-13). However, coenzyme Q-10 does not appear to

improve the strength of the heart's contraction (which is measured as the ejection fraction) or the exercise tolerance in congestive heart failure patients (8,12,14,15).

Angina

Coenzyme Q-10 has been shown to improve the symptoms of chest pain, (angina pectoris), and to improve exercise tolerance in patients with chronic stable angina (16). In a placebo-controlled study of 12 patients, there was a trend toward reduced angina and decreased use of the drug nitroglycerin in patients taking coenzyme Q-10. In treated patients, there was a significant increase in exercise capacity, with less

evidence of inadequate blood flow to the heart muscle during exercise. The researchers concluded that coenzyme Q-10 was a "safe and promising treatment for angina pectoris."

High Blood Pressure

Coenzyme Q-10 may play a role in high blood pressure (hypertension) by decreasing the body's chemical response to a rise in diastolic blood pressure (blood pressure when the heart is relaxed) (3,17). Several studies have identified a potential benefit for coenzyme Q-10 in the treatment of high blood pressure. The largest study - of 109 patients - found that patients taking coenzyme Q-10 had a substantially reduced need for medications to lower blood pressure. In fact, 51% of patients were able to discontinue between one and three medications, contributing to a substantial cost savings. Patients also exhibited a marked improvement in their quality of life, with fewer symptoms potentially related to an improvement in cardiac performance - or perhaps due to fewer side effects from medication.

Coronary Artery Bypass Surgery

It has been suggested that coenzyme Q-10 may be beneficial to patients at the time of coronary artery bypass surgery. In a controlled trial

of 40 patients, those who received coenzyme Q-10 had less heart muscle injury with surgery, as well as fewer irregular heart rhythms, during postoperative recovery.(10) While this isolated study hardly establishes its role in cardiac surgery, it does indicate a potential benefit for coenzyme Q-10, and demonstrates the need for additional research.

Mitral Valve Prolapse

A less studied use for coenzyme Q-10 includes treating the symptoms associated with mitral valve prolapse, a condition wherein blood flows back into the upper chamber of the heart. At this point there is insufficient data to draw any meaningful conclusions.

Study Results with coenzyme Q-10:

- ***Congestive heart failure patients had an improved quality of life***
- ***Angina patients had a significant increase in exercise capacity***
- ***51% of high blood pressure patients were able to discontinue between one and three medications***

IS IT FOR ME?

Congestive Heart Failure

While studies utilizing coenzyme Q-10 in patients with congestive heart failure have not shown an improvement in patient survival, the strength of the heart's contraction or a patient's exercise tolerance, the only randomized study undertaken found an improvement in quality of life in those patients who received the compound (8). Therefore, for patients who have congestive heart failure, coenzyme Q-10 may be a useful supplement to traditional drug therapy. ACE inhibitors, digoxin (Lanoxin), beta blockers and diuretics remain the cornerstones of drug treatment for this condition and should never be substituted for a supplement such as coenzyme Q-10. Coenzyme Q-10 should serve as a complement to traditional medications.

Angina

Coenzyme Q-10 may decrease chest pain in patients with coronary artery disease. It may also improve exercise tolerance in this group of patients. As the available data is quite limited, patients with chest pain should never take coenzyme Q-10 in place of traditional

medications. But as with other conditions where coenzyme Q-10 appears to be beneficial, it should be considered as a supplement to proven medical therapy.

High Blood Pressure

High blood pressure, the most common cause of stroke, remains a major risk factor for heart disease as well. For a patient with high blood pressure, the desired systolic blood pressure (blood pressure measured during heart contraction) should be less than 140 mm Hg, and diastolic blood pressure should be less than 90 mm Hg. In order to achieve these goals, many patients require several medications, and all medications have potential side effects. Therefore, traditional drug therapy for high blood pressure may be supplemented with coenzyme Q-10 in hopes of limiting the number and dosage of medications required, but it should never be utilized by itself for this purpose, nor substituted for proven therapies. Limited research has been performed in this area, and more information is required in order to better understand the role of coenzyme Q-10 in treating high blood pressure.

IS IT SAFE?

Coenzyme Q-10 is generally considered safe when used

in quantities lower than 300 mg per day. There have been no reports of significant toxicity with this dosage in studies lasting up to one year.(1,3,11,14,15) However, in dosages exceeding 300 mg per day, coenzyme Q-10 may adversely affect the liver (see laboratory interactions). In rare instances coenzyme Q-10 has been reported to cause gastric distress (0.39%), loss of appetite (0.23%), nausea (0.16%) and diarrhea (0.12%).(1-3)

ARE THERE ANY REPORTED INTERACTIONS WITH HERBS, SUPPLEMENTS OR DRUGS?

Herb and supplement interactions:

Drug interactions: Insulin

requirements may be reduced in people with diabetes and therefore may require more frequent glucose monitoring and alterations in insulin dosing (3).

Warfarin (Coumadin) effectiveness may be reduced when used together with coenzyme Q-10. Vitamin K-like properties have been attributed to coenzyme Q-10, possibly resulting in an increase in blood clotting. In fact, four patients have experienced decreased effectiveness from warfarin while taking coenzyme Q-10 (18,19). Increased monitoring with more frequent laboratory

testing is thus appropriate in patients taking warfarin together with coenzyme Q-10.

Coenzyme Q-10 used together with **antihypertensive** medications (medications to reduce blood pressure) may lead to further reductions in blood pressure. Thus caution is warranted when coenzyme Q-10 is administered while taking any such drug (17). **"Statin"** cholesterol-lowering medications such as **cerivastatin (Baycol), fluvastatin (Lescol), lovastatin (Mevacor), pravastatin (Pravachol), simvastatin (Zocor) and atorvastatin (Lipitor)** may all reduce coenzyme Q-10 levels; however, the clinical significance of this finding has not been established (20).

Oral hypoglycemic drugs used for glucose control in people with adult onset diabetes - drugs such as **glyburide (Micronase), acetohexamide (Dymelor) and tolazamide (Tolinase)** - have been found to reduce coenzyme Q-10 levels. However, **chlorpropamide (Diabinese), glipizide (Glucotrol), and tolbutamide (Orinase)** have not been found to reduce coenzyme Q-10 serum levels. There is no data

concerning **glimepiride (Amaryl)**.

ARE THERE ANY INTERACTIONS WITH LABORATORY TESTS?

Liver tests such as **SGOT and LDH** concentrations can elevate in patients taking coenzyme Q-10 in excess of 300 mg per day.

WHERE CAN IT BE FOUND NATURALLY?

Common dietary sources for coenzyme Q-10 include certain types of fish and shellfish, beef, pork and lamb.

The compound is also found in vegetables such as broccoli and spinach, and in vegetable oils. However, the quantities in these sources are low. Therapeutic doses require dietary supplementation.

WHAT IS THE MOST APPROPRIATE DOSAGE?

Dosage varies, depending on the condition being treated:

- Congestive heart failure: the most common dosage is 100 mg per day, divided into two or three doses.
- Angina: 50 mg three times per day has been recommended (16).
- High blood pressure: although no specific dose has been identified, 200 to 300 mg in two or three divided doses is most likely appropriate.
- Patients about to undergo

coronary artery bypass surgery: the suggested dosage is 50 mg three times a day beginning 7 days prior to surgery.

- Patients taking doxorubicin (Adriamycin): a dosage of 50 mg once a day has been associated with decreased toxicity of the heart muscle (3).

REFERENCES

1. Greenberg S, Fishman WH. "Coenzyme Q10: A New Drug for Cardiovascular Disease." *J Clin Pharmacol* 1990;30:596-608
2. The Review of Natural Products by Facts and Comparisons. St. Louis, MO: Wolters Kluwer Co., 1999.
3. Micromedex Healthcare Series. Englewood, CO: MICROMEDIX Inc.
4. Zamora R et al. Comparative antioxidant effectiveness of dietary beta carotene, vitamin E, selenium and co-enzyme Q10 in rat erythrocytes and plasma. *J Nutr* 1991;121:50
5. Gaby AR. Coenzyme Q10. In: Pizzorno JE, Murray MT, eds. Textbook of Natural Medicine. 2nd Ed. New York: Churchill Livingstone, 1999;663
6. Folkers K, et al, eds. Biomedical and Clinical Aspects of Coenzyme Q10, Vol. 1-4. Amsterdam: Elsevier Science Publishers; Vol. 1, 1977; Vol. 2, 1980; Vol.

3, 1982; Vol. 4 1984

7. Mortensen SA,. Coenzyme Q10: Clinical benefits with biochemical correlates suggesting a scientific breakthrough in the management of chronic heart failure. *Int J. Tissue React* 1990;12:155-162
8. Khatta M, Alexander BS, Krichten CM, et al. The effect of coenzyme Q10 in patients with congestive heart failure. *Ann Intern Med* 2000;132(8):636-640
9. Lininger SW. The Natural Pharmacy. 1st ed. Rocklin, CA: Prima Publishing; 1998
10. Chello M, Mastroberto P, Romano R, et al. Protection by coenzyme Q10 from myocardial reperfusion injury during coronary artery bypass grafting. *Annals of Thoracic Surgery* 1994;58:1427-1432
11. Morisco C, Trimarco B, Condorelli M. Effect of coenzyme Q10 therapy in patients with congestive heart failure: A long-term multicenter randomized study. *Clin Invest* 1993;71(Suppl. 8):S134-136
12. Hofman-Bang C, et al. Coenzyme Q10 as an adjunctive treatment of congestive heart failure. *J Card Fail* 1995;1:101-107

13. Baggio E, Gandini R, Plaunche AC, et al. Italian multi-center study on the safety and efficacy of coenzyme Q10 as adjunctive therapy in heart failure. CoQ10 Drug Surveillance Investigators. *Mol Aspects Med* 1994;(15 Suppl):S287-29
14. Watson PS, Scalia GM, Galbraith A, et al. Lack of effect of coenzyme Q on left ventricular function in patients with congestive heart failure. *J Am Coll Cardiol* 1999;33:1549-1552
15. Permanetter B, Rossy W, Klein G, et al. Ubiquinone (coenzyme Q10) in the long-term treatment of idiopathic dilated cardiomyopathy. *Eur Heart J* 1992;13:1528-1533
16. Kamikawa T, Kobayashi A, Yamashita T, et al. "Effects of coenzyme Q10 on exercise tolerance in chronic stable angina pectoris." *Am J Cardiol* 1985;56(4):247-251
17. Langsjoen P, Willis R, Folkers K. Treatment of essential hypertension with coenzyme Q10. *Mol Aspects Med* 1994;15 Suppl:S265-272
18. Spigset O. "Reduced effect of warfarin caused by ubiquinone." *Lancet* 1994;334:1372-1373
19. Heck AM, DeWitt BA, Lukes AL. Potential interactions between alternative therapies and warfarin. *Am J Health Syst Pharm* 2000;57:1221-7
20. Mortensen SA, Leth A, Agner E, et al. Dose-related decrease of serum coenzyme Q10 during treatment with HMG-CoA reductase inhibitors. *Mol Aspects Med*, 1997;18(Suppl):S137-S144