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Coenzyme Q10: A Natural Energizer © VR

By Yousry Naguib, PhD

Coenzyme Q10 (CoQ10) is found in virtually all cells of the human body including the heart, liver, and skeletal muscles, and in most plant and animal cells. CoQ10 is also found in larger amounts in beef heart, sardines, anchovies, mackerel, salmon, broccoli, spinach, and nuts. CoQ10 is also known as ubiquinone; from "ubiquitous" to signify its widespread distribution in the human body, and "quinone," a chemical structure with a unique ability to be oxidized and reduced.

CoQ10 can be synthesized in the body, and functions as a carrier to transfer electrons across the membrane of mitochondria (the energy generator in the body's cell) to drive the production of adenosine triphosphate (ATP), the fuel that energizes cells in our body. Heart muscle cells have the greatest concentration of mitochondria, 5,000 per cell.

CoQ10 also possesses antioxidant and membrane-stabilizing properties. CoQ10 must first be reduced to ubiquinol to act as an antioxidant, to protect proteins, LDL-cholesterol (bad cholesterol), and mitochondria DNA from oxidative damage. Research has shown that CoQ10 supplementation exerts a sparing effect on vitamin E in healthy subjects, and reduces levels of lipid peroxidation, which is the pivotal step in the cause of atherosclerosis, and thus reduces the risk of cardiovascular diseases.

The membrane stabilizing property of CoQ10 is ascribed to its ability to neutralize free radicals that may cause damage to proteins and lipids of the membranes.

Because of its function in the production of cellular energy, and as an antioxidant, supplemental CoQ10 can prevent and treat a host of health problems including heart disease, cancer, aging, neuro-degenerative diseases, and muscular dystrophy.

In 1974, the Japanese government approved CoQ10 derived from nicotiana (tobacco) for the treatment of chronic heart failure. CoQ10 manufactured from solanesol contains less than one percent cis-isomer of CoQ10, which was shown in an animal study to be safe when administered daily for one

month to Waster rats at dosage of 1 g per kilogram body weight. When CoQ10 was administered in a single dose, orally or intravenously, to mice or rats no sign of toxicities were observed. The LD50 (dose which is lethal to 50% of the animals tested) was estimated to be four grams per kg for oral administration.

The absorption of CoQ10 from the gastrointestinal tract depends on its formulation. In a clinical trial comparing different formulations that included combinations of polysorbate, lecithin, or soybean oil, CoQ10 showed the highest bioavailability with the soybean oil formulation. Preparations of CoQ10 usually contain lipid vehicles, such as vegetable oil, and vitamin E to enhance its absorption in the body.

Cardiovascular Health

CoQ10 plays a key role in oxidative phosphorylation, the ultimate source of heart's energy. In a Swedish study, patients with advanced heart failure were found to have lower plasma CoQ10 levels than subjects with mild degrees of heart failure. The study found that daily supplementation with 100 mg of CoQ10 resulted in improvement of physical activity, and quality of life as compared to the placebo group.

CoQ10 has been shown to benefit patients with cardiovascular diseases, including congestive heart failure (a disease in which the heart does not adequately maintain circulation), cardiomyopathy (heart muscle disease), and angina pectoris (chest pain).

Cardiomyopathy

Researchers at the Langsjoen Clinic in Tyler, TX, showed that treatment of seven patients with hypertrophic cardiomyopathy, with 200 mg CoQ10 daily for three months resulted in a greater strength and easier breathing and 26 percent reduction in the abnormal thickness of their left ventricular wall (the lowest heart chamber that receives blood and pumps it into the arteries). Cardiomyopathy involves an abnormal enlargement of the heart muscle, a condition accompanied by fatigue and difficulty in breathing,

A study in Japan showed that serum CoQ10 levels were lower in non-insulin-dependent diabetes mellitus patients, treated with 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor, and may be associated with diabetic cardiomyopathy which is reversible by CoQ10 supplementation.

Chronic Heart Failure (CHF)

The purported role of CoQ10 in the treatment of CHF, a

condition in which the heart has difficulty pumping out blood due to build-up of fluid around the heart, is ascribed to its ability to increase ATP synthesis, and to enhance myocardial contractility and to prevent lipid peroxidation.

A Danish study found that treatment of patients with CHF with CoQ10 improved heart stroke volume (the volume of blood pumped out of one ventricle of the heart in a single beat), ejection fraction (the blood present in the ventricle after the heart chambers fill with blood, which is then expelled during heart contraction), and cardiac index (the volume of blood pumped in a unit of time, in liters per minute) in 75 percent of the patients, as compared to none in the placebo-group.

Two large, multi-center, open-label studies, involving a total of more than 4000 patients, evaluated the efficacy and safety of CoQ10 as adjuvant therapy in CHF, and found that patients who took CoQ10 experienced clinical improvement in signs and symptoms such as palpitations.

Acute Myocardial Infarction (AMI)

AMI is a heart attack due to a sudden, acute deprivation of circulating blood to the heart muscle (myocardium). It is caused by clogging of the artery (infarction), which is initiated by the build up of cholesterol on the inner wall of the blood vessels that distribute blood to the heart muscle.

In a randomized, double-blind, placebo-controlled trial, researchers found that CoQ10, given along with other antioxidants to patients with AMI, increased vitamins A, C, and E and beta-carotene levels in their plasma, which were lower at the onset of AMI. The study suggested that CoQ10 could provide protective effects in patients with AMI if administered within three days of the onset of symptoms.

Angina

The ability of CoQ10 supplementation to protect the ischemic myocardium and reduce or delay signs and symptoms of angina is suggested by six small randomized, double-blind, placebo-controlled studies involving patients with stable angina pectoris. These studies found that CoQ10 at dosages of 60 to 100 mg per day significantly prolonged exercise duration, and delayed the onset of stable angina pectoris when compared with placebo.

Hypertension

As in patients with CHF, a significant deficiency of CoQ10 was detected in patients with hypertension. A pilot study showed that CoQ10 supplementation at dosages that ranged from 30 to 360 mg/day to patients with hypertension led to an increase

in CoQ10 levels and statistically significant decreases in systolic and diastolic blood pressure.

Effect of HMG-CoA Reductase Inhibitors on CoQ10

Both cholesterol and CoQ10 share a common biosynthetic pathway, which involves the formation of mevalonate compound with the aid of 3-hydroxy-methylglutaryl coenzyme A (HMG-CoA) reductase. Inhibition of HMG-CoA reductase by statin drugs at the mevalonate level will inevitably decrease the levels of both cholesterol and CoQ10. Several studies revealed a possible dose-related and significant decrease in CoQ10 serum levels as a result of HMG-CoA reductase inhibitor treatment (e.g., simvastatin, pravastatin, lovastatin) alone.

In a double-blind, randomized clinical trial hypercholesterolemic patients received either Lovastatin or Pravastatin over a period of 18 weeks. At the end of the study period, the total serum level of CoQ10 declined by about 25 percent in the Lovastatin and Pravastatin groups.

Similar results were also reported in another study which demonstrated that Simvastatin lowers both cholesterol and CoQ10 in plasma, and that CoQ10 supplementation prevents plasma CoQ10 decrease, without affecting the cholesterol lowering effect of Simvastatin.

In addition, simultaneous administration of CoQ10 with statins can result in a statistically significant increase in CoQ10 blood levels without opposing the lipid-lowering effect of an HMG-CoA reductase inhibitor.

Other Benefits of CoQ10

- **Sports and Exercise:** In a double-blind crossover study on 25 top-level cross-country skiers, CoQ10 supplementation of 90 mg daily, improved the performance and recovery time in 94% of the athletes as compared to only 33% in the placebo group.
- **Brain Wellness:** CoQ10 may be beneficial in treating brain degenerative disorders such as Parkinson's disease. Feeding 12-month-old rats with CoQ10 resulted in significant increases in brain mitochondria concentrations of CoQ10, indicating that CoQ10 can exert neuroprotective effects that might be useful in the treatment of neurodegenerative disease.
- **Immune System:** William Lee, PhD, reported that daily dosage of 60 mg of CoQ10 for three to 12 weeks to patients with cardiovascular problems, cancer, and diabetes significantly increased the levels of the antibody

immunoglobulin G.

- **Diabetes:** Suzuki et al found that CoQ10 prevented progressive hearing loss and improved blood lactate after exercise in the diabetes mellitus patients.
- **Breast Cancer:** A study involving 200 women hospitalized for the biopsy and/or removal of a breast tumor found that CoQ10 was deficient in both carcinomas (80 patients) and non-malignant lesions (120 patients). The study suggested that CoQ10 could be helpful in breast cancer patients, and to avert tumor development by free radicals.
- **Male Fertility:** Researchers in Israel reported that CoQ10 provides energy and protects sperm cells from oxidative damage. The study found that 60 mg CoQ10 supplementation for 103 days to 17 patients with low fertilization rates doubled both the sperm's motility rate (power to move toward the egg) and their fertilization rate.

Research also showed that seminal fluid contains high levels of CoQ10, which correlates directly with sperm count and motility rates. Patients with a varicose enlargement of the veins of the spermatic cord were found to have low CoQ10 levels, as well as low sperm count and motility rates. The study concluded that CoQ10 is essential in the protection of the spermatozoa against oxidative free-radical damage.

Summary

Typical dose is 50 to 150 mg per day. For chronic heart failure, it is recommended to take 100 to 300 mg a day, preferably in divided doses. According to the results of bioavailability studies, oil-based (e.g., soybean oil) CoQ10 contained in a soft gel capsule is absorbed much more efficiently than powdered-based forms.

The most common adverse effects are gastrointestinal in nature and can include nausea, diarrhea, heartburn, and appetite suppression. **VR**

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