

# CoQ10: A literature review

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**Abstract:** CoQ10 is quite possibly the most powerful antioxidant known to scientists, clinicians and researchers alike. It is rich in applications that offer an outstanding array of potential human therapeutic benefit. Some of the more prominent conditions that respond to CoQ10's use, include hypertension, migraine headaches, coronary artery disease and even Parkinson's disease. The purpose of this review is to illustrate the clinically significant findings in a plethora of prominent studies on Coenzyme Q10.

**Keywords:** CoQ10, Ubiquinol, Ubiquinone, Antioxidant, Hypertension, Migraines, Coronary Artery Disease

## INTRODUCTION:

Coenzyme Q10 is a naturally occurring substance required by every cell of the body with particularly high concentrations in the heart, kidney, brain and liver.<sup>1,2</sup> CoQ10, also known as ubiquinone, is a necessary component of cell respiration and ATP production. Its role is quite profound, given that 95% of all energy used in the body is produced by the mitochondria.<sup>3</sup> Ubiquinone is a fat soluble substance used to form ubiquinol, the fully reduced form of ubiquinone and potent antioxidant. Food sources include fish and meats, although the available concentrations are quite low.<sup>4</sup> The more bioactive anti-oxidant form, ubiquinol, is thought to be more important for older individuals, anyone who may be experiencing greater levels of oxidative stress, or individuals who appear not to respond to regular CoQ10 supplementation. CoQ10 is the third most commonly sold dietary supplement in the United States after omega-3 fatty acids and multivitamins.<sup>5</sup> This paper will discuss some of the important roles and clinical applications for the use of CoQ10 in nutritional medicine.

## HISTORY AND INITIAL APPLICATIONS:

In 1957, Professor Frederick Crane and colleagues discovered CoQ10 from beef heart mitochondria at the University of Wisconsin-Madison Enzyme Institute.<sup>6</sup> R.A. Morton, from the United Kingdom, isolated the compound in rat liver just after Dr. Crane's discovery. It was Morton who named the compound ubiquinone, meaning ubiquitous quinone or one that "exists everywhere."<sup>3,7</sup> Scientists at Merck synthesized CoQ10 in 1958. In 1962, Peter D. Mitchell, PhD from University of Edinburgh determined how CoQ10 produces energy at the cellular level and in 1978 he was awarded the Nobel Prize for chemistry based on his discovery.<sup>7</sup>

## ARE THERE ESTABLISHED SAFE INTAKE LEVELS?

The safety of escalated doses of CoQ10 has been evaluated in a randomized, placebo-controlled trial in patients with

early Parkinson's disease.<sup>8</sup> A total of 80 patients received doses of 300 mg to 1200 mg per day of CoQ10 for up to 16 months, and there was no difference in the incidence of drug-related toxicities between the placebo and treatment arms.<sup>9</sup> The observed safe level (OSL) is intake up to 1,200 mg/day. However, the usual dose is 100-200 mg/day in deficiency states and other disease states.<sup>5</sup> The Institute of Medicine at the National Academy of Sciences has not established a Dietary Reference Intake, or DRI, nor Tolerable Upper Intake Level (UL) for CoQ10.<sup>4</sup>

## FOOD SOURCES:

- Fish
- Calf's Liver (and other organ meats)
- Germ portion of whole grains

\*\*Research is not currently available to classify food sources of coenzyme Q according to the Quality Rating System used for other nutrients.<sup>4</sup>

## FUNCTIONS:

A diet high in coenzyme Q10 intake levels can help in the prevention of cardiovascular diseases (arrhythmia, angina, heart attack, mitral valve prolapse, high blood pressure, coronary artery disease, atherosclerosis and congestive heart failure). CoQ10 helps to restore the power of Vitamin E, improve overall cellular energy levels and helps to provide assistance with blood sugar stability.<sup>4</sup> CoQ10 regulates glucose levels throughout a lessening of oxidative stress.<sup>10</sup> CoQ10 levels decrease with age and may be low in people with cancer, diabetes, various heart conditions, HIV/AIDS, muscular dystrophies, Parkinson's disease and certain other genetic disorders. Some prescription drugs, statins in particular, may also lower CoQ10 levels.<sup>1</sup>

## OTHER NUTRIENTS THAT ARE COFACTORS:

The same chemical pathways that make Vitamin E, K and folic acid also make coenzyme Q10. While it appears that the human body cannot make the fat-soluble nutrients (vitamin E and vitamin K) or folic acid, the body can make

CoQ10.<sup>4</sup> In a study conducted by Lee et al, it was observed, that the level of Vitamin E was significantly higher in the group that was given 300 mg/day of CoQ10 and was positively correlated with the level of coenzyme Q10 after 12 weeks of supplementation. CoQ10 not only protects vitamin E against superoxide-driven oxidation but also regenerates vitamin E during anti-oxidation processes.<sup>11,12</sup>

### CURRENT RESEARCH TRENDS:

A Study in Denmark based on food frequency revealed that the average dietary intake of CoQ10 is approximately 3 to 5 mg daily.<sup>7</sup> Due to the fact that this compound is synthesized by the body, no established dietary requirements for CoQ10 have been set. In another study, up to 95% less damage to cell membranes has been demonstrated following supplementation with coenzyme Q10.<sup>4</sup> According to the Mayo Clinic website, promising uses for CoQ10 include: treating eye disease, chest pain caused by exercise, asthma, chronic fatigue, high cholesterol and even the amelioration of chemotherapy side effects in children.<sup>1</sup> In addition to the uses above, current dosing values are available for as many as 40 specific medical conditions on the Mayo Clinic website. These dosages range in size from 22-40 milligrams and are delivered through the following routes: by mouth, in oil preparation (corn, etc.), powdered form, ointment (containing ubiquinone), 1% cream, and even intravenous injection.<sup>1</sup> The length of time recommended for use varies from as short as 4 weeks to as long as 5 years for some of the conditions like muscular dystrophy. Cardio-protective properties of CoQ10 include its role as an antioxidant, vasodilator and membrane stabilizer in addition to its ability to decrease blood viscosity, pro-inflammatory cytokines, endothelial dysfunction, insulin resistance and to promote proper diastolic and systolic function of the myocardium.<sup>13</sup>

### CLINICAL APPLICATIONS AND USES:

- **Hypertension** – The effectiveness of CoQ10 is perhaps most poignantly illustrated in research studies regarding its usefulness in effectively lowering both systolic and diastolic blood pressures. This can and does occur when CoQ10 is used in conjunction with antihypertensive pharmaceutical interventions or when used singularly. Combining CoQ10 with other antihypertensive agents may permit decrease of antihypertensive dose as it can enhance the effects of antihypertensive medications.<sup>14</sup> A meta-analysis from 2007, concluded that CoQ10 in hypertensive patients can lower systolic blood pressure by up to 17 mm Hg and diastolic blood pressure by up to 10 mm of Hg without significant

side effects.<sup>14</sup> Dose of CoQ10 used in these studies ranges from 120-200 mg given twice daily.<sup>5</sup> In cases of isolated systolic hypertension, taking 60 mg of CoQ10 twice daily, has been shown to lower systolic blood pressure by about 26% after 12 weeks of therapy in some people.<sup>5</sup>

- **Migraine prevention** – Oral CoQ10 helps in preventing migraine headache (prophylaxis).<sup>15</sup> It can decrease the frequency of headaches by about 30%. However, CoQ10 does not seem to be effective in treating migraine once it has developed. Dose is 100 mg given three times daily. It has been used effectively in prophylaxis of migraine (300 mg/day) in combination with magnesium citrate 500 mg/day and riboflavin 400 mg/day.<sup>16</sup>
- **Parkinson's Disease** – It has been suggested that CoQ10 might protect brain cells from damage by free radicals.<sup>5</sup> In a 16-month trial of CoQ10, especially at 1,200 mg/day dose, a significant reduction in disability occurred compared to those who took placebo. A randomized, double-blind, placebo controlled multicenter study of 80 patients observed that 1,200 mg/day of Coenzyme Q10 was associated with up to 44% less functional decline in patients with Parkinson's disease, including activities of daily living.<sup>9</sup> Oral CoQ10 may slow the decline in people with early Parkinson's disease, but not in people with mid-stage Parkinson's disease.<sup>9,17</sup>
- **Coronary Artery Disease** – In an intervention study conducted on 43 subjects, who were all identified by cardiac catheterization as having at least 50% stenosis of one major coronary artery; a placebo group was formed, a second group was given 60 mg/d and another group given 150 mg/d of Q10 supplementation for 12 weeks.<sup>18</sup> Results show that the plasma CoQ10 levels significantly increased in the 150 mg/d group; more so than in the other two groups (placebo and 60 mg/d). Subjects in the CoQ10-150 group also had a significant correlation with lower levels of low-density lipoprotein levels.<sup>18</sup> The authors of the study concluded that CoQ10 supplementation at a dose of 150 mg/day can decrease oxidative stress and increase antioxidant enzyme activity in patients with CAD and they hypothesize that a higher dose of coenzyme Q10 supplements (> 150 mg/day) might promote rapid and sustainable anti-oxidation in patients with coronary artery disease.<sup>18</sup>

### CONCLUSION:

Since the discovery of the chemical structure in 1957 there

have been nearly 5,000 research studies on coenzyme Q10.<sup>4</sup> While considerable research efforts have been put forth in the examination of this molecule, if we are going to change the landscape in acceptable use for CoQ10, more large, double-blind, placebo controlled research studies will certainly need to be conducted. This will be the only way to put CoQ10 on the map with current pharmaceutical options for treatment of conditions like hypercholesterolemia, hypertension, Parkinson's disease, migraines, periodontitis and many others. Researchers are working hard to uncover the scientific data to support proper dosages for each of the conditions studied. The pairing up of CoQ10 with other beneficial and synergistic nutrients could be another key to unlocking its full potential in standard nutritional medicine.

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