This article will review some of the vital cellular functions and health/wellness applications for coenzyme Q10 (CoQ10), and address safety issues, as well as the difference between reduced (ubiquinone) and oxidized (ubiquinol) states of CoQ10, and the most effectively absorbed delivery forms.

**Vital Cellular Functions**

CoQ10 is best known for two functions. One is its role in the conversion of glucose and fatty acids to ATP (within the mitochondria of cells), the form of energy used to power most body functions.1 The other is its role as a powerful antioxidant in cells, inhibiting lipid peroxidation in cell membranes, DNA and low-density lipoproteins (LDL).2 Various studies have shown that supplementation with 100 mg of CoQ10 daily is capable of significantly reducing oxidative damage.3-5

[Note: CoQ10’s levels in skin decline with age6, which may also make skin more susceptible to oxidative damage.]

**Cardiovascular Disorders**

**Angina**

In a review of the scientific literature, CoQ10 was shown to be used orally to treat various cardiovascular disorders including angina.7 In one study, patients with acute myocardial infarction experienced a significant reduction in angina, arrhythmias (abnormal heartbeat) and poor heart function when supplemented with 120 mg of CoQ10 daily.8 In another study, 150 mg of CoQ10 given to angina patients not only increased their blood levels of CoQ10, but also increased their ability to exercise longer. These results lead the researchers to conclude, “This study suggests that CoQ10 is a safe and promising treatment for angina pectoris.”9 [Note: Those with acute angina should only exercise in accordance to a physician-approved program.]

**Congestive Heart Failure**

A few researchers have said that in many cases, a lack of CoQ10 is the cause of congestive heart failure (CHF). Whether this is ultimately proven to be true, research certainly supports the use of this supplement by patients with CHF. A meta-analysis of eight controlled clinical trials of 100 to 200 mg/day CoQ10 treatment of CHF revealed a significant improvement in several important cardiac parameters.10 Other research on CHF patients using CoQ10 has shown similar benefits, including the improvement of quality of life and survival.11,12

**High Blood Pressure**

Research indicates that CoQ10 affects blood vessels in a way that should cause a decrease in blood pressure.13 In fact, this has been substantiated in a number of studies where CoQ10 significantly lowered blood pressure in people with hypertension.14-17 All of these studies used at least 50 mg of CoQ10 taken twice daily. One should expect about 10 weeks of supplementation to pass before looking for results. CoQ10 also has been used successfully to treat diabetics with high blood pressure. In double-blind research, 200 mg and 120 mg were used.18,19

**Parkinson’s Disease**

In a multicenter, randomized, parallel-group, placebo-controlled, double-blind, dosage-ranging trial, 80 subjects with early Parkinson’s disease where randomly assigned to placebo or CoQ10 at dosages of 300, 600 or 1,200 mg daily for 16 months. The subjects underwent evaluation with the Unified Parkinson Disease Rating Scale (UPDRS), the change in which served as the primary response variable in the total score from baseline to the last visit. The results were that all doses of CoQ10 slowed functional decline in people with early Parkinson’s disease, although this effect appears to be dose dependent. In addition, the difference between the 1,200 mg and placebo groups were statistically significant.20 Other research demonstrated that CoQ10 slows function decline in Parkinson’s.21,22

**Diabetes**

Research has shown that some diabetic patients who use diet to control their
blood sugar may have a deficiency of CoQ10, which may be further exacerbated by certain commonly used anti-diabetic drugs. Such a CoQ10 deficiency in the pancreas could impair aspects of energy metabolism, and the biosynthesis of insulin. Other research has demonstrated that CoQ10 levels are lower in diabetic patients, which can cause diabetic cardiomyopathy. That same research, however, also showed that the diabetic cardiomyopathy can also be reversed by CoQ10 supplementation. Further, research has also demonstrated that CoQ10 exhibits an effective antiarrhythmic (i.e., prevents abnormal heart beat) in patients with diabetes. And CoQ10 has also shown efficacy in treating maternally inherited diabetes mellitus and deafness (MIDD), preventing progressive hearing loss and improving blood sugar metabolites after exercise.

**Physical Performance**

Given its role in ATP production, it's not surprising that supplementation with CoQ10 has benefit for physical performance. In a double-blind cross-over study, 25 top-level cross-country skiers were given 90 mg/day of CoQ10. The results were that all measured indexes of physical performance (AET, ANT and VO2Max) improved significantly. During supplementation, 94 percent of the athletes felt that the preparation had been beneficial in improving their performance and recovery time vs. only 33 percent in the placebo periods. Similar benefits in power increases during exercise were seen in other double-blind research with 100 mg and 30 mg of CoQ10.

**Reduced & Oxidized States**

CoQ10 can exist in three oxidation states. The first is ubiquinol, fully reduced form (CoQ10H2). The second is the radical semiquinone intermediate (CoQ10H·), and the third is the fully oxidized ubiquinone (CoQ10). Most CoQ10 products on the market today provide ubiquinone, the oxidized version. [Note: Ubiquinone and Ubidecarenone are different names for the same substance—CoQ10. Ubiquinone is a generic name. Ubidecarenone is the official name in the United States Pharmacopeia (USP)].

However, it is ubiquinol that provides virtually all of benefits associated with CoQ10. When ubiquinone is supplemented, the body must first convert it to ubiquinol before the benefits can be enjoyed. In fact, ubiquinol may be thought of as the “active antioxidant” form of CoQ10. If ubiquinone has not been converted to ubiquinol, it is inactive as an antioxidant. That is not to say that ubiquinone has no value. In fact, the body will convert ubiquinone into ubiquinol, in which case it will function as fully active CoQ10.

So is there an advantage to choosing ubiquinol over ubiquinone? Perhaps. It is true that ubiquinol levels tend to decline in various important tissues of the body in relation to age and disease. Therefore, supplementing with ubiquinol can certainly help to compensate; but supplementing with ubiquinone can also do the job. In fact, many if not most CoQ10 studies have been conducted on older and diseased people using ubiquinone, and the body converts ubiquinone to ubiquinol anyway. One argument in favor of ubiquinol is a human clinical study, which found daily supplementation with 150 mg of ubiquinol resulted in a 5.9 times increase of ubiquinol levels after 28 days.

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Nevertheless, this may ultimately be an issue of solubility and absorption.

**Therapeutic Value of Ubiquinol**

In addition to all of the research previously discussed on CoQ10 as ubiquinone, supplementation with ubiquinol has been researched and found to offer benefits. Following is a brief review of ubiquinol clinical research.

**Down Syndrome**

Children with Down syndrome have decreased levels of ubiquinol compared to that of healthy children. After three months of supplementation with ubiquinol (10 mg/kg/day, equivalent to 228 mg for a 50-lb. child), the average ubiquinol:total CoQ10 ratio increased significantly in Down syndrome children, with 80 percent of individual ratios changing to normal ranges.

Furthermore, ubiquinol supplementation was effective in reducing the oxidative stress in children with Down syndrome.34

**Quality of Life**

In a pilot study, healthy elderly subjects residing in a care home were treated with 100 mg ubiquinol daily for six months. The results of assessment questionnaires showed significant increases in the “vitality” and “mental health” scores. This was especially true of subjects whose initial scores were low, but markedly improved after ubiquinol therapy.35

**CHF**

Patients with class IV CHF (the most severe CHF, where patients should be at complete rest, confined to bed or chair; any physical activity brings on discomfort and symptoms occur at rest) originally received 450 mg of ordinary ubiquinone CoQ10 daily, but were switched to 580 mg of ubiquinol daily. The results were that the amount of blood pumped out of the ventricle of the heart with each beat improved from 22 up to 39 percent, and on average patients decreased from class IV to II (patients have only slight, mild limitation of activity; they are comfortable with rest or with mild exertion), and some even decreased to class I (patients have no limitation of activities; they suffer no symptoms from ordinary activities). These improvements correlated with the increase in ubiquinol levels.36

**Supplementation & Absorption**

With CoQ10 benefits undisputed, the real question is: what is the best way to obtain this critical substance? Surprisingly, diet is not a particularly effective means. Typically, dietary sources of CoQ10 such as dairy products, eggs, fish and vegetables do not significantly affect plasma concentrations of CoQ10. It is possible, however, to increase the CoQ10 status through the use of dietary supplements.

CoQ10 powder in the form of tablets, two-piece capsules or soft gel capsules containing an oil suspension, are the most commonly available types of CoQ10 supplements on the market. It should be noted, however, that pure CoQ10 is insoluble in water and has limited, although better, solubility in oils and fats. As a result, powder-based products tend to dissolve poorly in laboratory tests and show relatively poor bioavailability in human testing. Consequently, there are significant difference between the forms of dietary supplements used and the efficacy of CoQ10 absorption.38

In a review38 of studies on the absorption of CoQ10 supplements, large single doses of CoQ10 either as a powder or as an oil-suspension (soft gel) resulted in practically no response in human subjects or a marginal response. On the other hand, with ongoing dosing there was a dose-dependent increase in plasma CoQ10 administered as a soft gel, with a 2.8-fold increase at 30 mg, and a 6.5-fold increase at 200 mg over a two to three month period. In another controlled trial, supplementation with either 30 or 100 mg CoQ10 as a soft gel for two months resulted in increases in serum CoQ10 values of 0.637 and 1.575 mmol/l from baseline values of 1.483 and 1.332 mmol/l, respectively. While these increases sound relatively good, the limited solubility of CoQ10 has also limited bioavailability.

**Absorption of Solubilized CoQ10**

To address this issue of limited solubility, a special solubilized form of CoQ10 was created that allows for 90 to 100 percent of it to be dissolved. This meets the dissolution standards of the USP—compared to 0 to 3 percent of regular, non-solubilized CoQ10, which fails USP standards.39 If it seems that the solubilized form of CoQ10 would have greater bioavailability, you are correct. Consider that solubilized formulations of CoQ10 resulted in much higher plasma values, increasing from 0.579 to 3.834 mmol/l with the solubilized formulation, compared to only 0.579 to 1.587 mmol/l with a regular soft gel in just three weeks (see chart).40 This certainly indicated the superiority of the solubilized formulation of CoQ10 with regard to bioavailability.

**Conclusion**

CoQ10 is a popular dietary supplement, with multiple applications to human health, including cardiovascular health, Parkinson’s disease, diabetes and physical performance. In addition, CoQ10 is available in the oxidized and reduced states of ubiquinone and ubiquinol, respectively—with either form offering a viable option for supplementation. Furthermore, the use of either ubiquinone or ubiquinol in a solubilized form has been shown in research to offer considerably better absorption/bioavailability than ordinary, non-solubilized forms. VR

For a full list of references, visit www.vitaminretailer.com

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