The New Q Technology Finally Arrives

By Sid Shastri, M.Sc.

New records are advanced on a regular basis. Whether it is through the creation of the tallest skyscraper or the creation of the smallest microchip for an ocular implant, humans continue to raise the limits of their potential. This is primarily because our intelligence has been applied to develop and advance a variety of technologies. Consider this: what one person can do today would have been difficult for a whole organization only a generation ago. Of particular interest to us is the use of these technologies to improve health, such as the recent introduction of a new form of coenzyme Q-10 (CoQ-10) called ubiquinol.

Ubiquinone: A Solid Suite of Data Backing Efficacy: The vast majority of CoQ-10 available in the market today is in the ubiquinone form. This is the yellow-orange-colored nutrient that you may have seen, or used and found dependable. In terms of its nomenclature, it's correctly referred to as ubiquinone or oxidized CoQ-10. Since the discovery of CoQ-10 in 1957 by F.L. Crane, and subsequent delineation of its structure by Dr. Karl Folkers, ubiquinone has been available in the dietary supplements industry for the last three decades.[1]

Mechanistically, ubiquinone is a carrier of reducing equivalents in the mitochondrial electron transport chain's I and II complexes. Clinically, ubiquinone has demonstrated positive results in the nutritional support of angina pectoris, hypertension, and congestive heart failure; in Japan, ubiquinone has been an approved drug for congestive heart failure since 1974. Indeed, the majority of clinical and experimental investigations have been done using ubiquinone.

Ubiquinone is also listed as an essential cofactor for the synthesis of ATP (adenosine triphosphate, the universal currency of energy) in the *Physician's Desk Reference (PDR)*. So the ubiquinone form of CoQ-10 will always be a crucial member of the dietary supplements industry. But the focus is about to shift to the other, relatively unfamiliar form of CoQ-10, known as ubiquinol.

Ubiquinol: The *Other* Form of Q is Here: In 2006, the U.S. dietary supplements industry witnessed the emergence of the *unoxidized* form of CoQ-10, known as ubiquinol. This is almost identical to ubiquinone, the only difference being two daltons in molecular weight (ubiquinone 863 versus ubiquinol 865) and the color (ubiquinol is pure, unoxidized white).

While scientists have been investigating ubiquinol for years, the research has mostly been retrospective. It never was stabilized because of its high proclivity to be oxidized.[2] Keeping ubiquinol stable in this unoxidized format will always be an issue, but some major advancements have occurred in the last two years that have allowed for the commercialization of ubiquinol. Just recently, the FDA accepted the NDI (new dietary ingredient) application from Kaneka Corporation for its ubiquinol, known as KanekaQH (Kaneka is believed to be the only supplier of ubiquinol in the world).

Ubiquinol: The Power of H: The only difference between ubiquinone and ubiquinol is hydrogen. That's the only difference literally, but biologically there are significant differences between the two forms of CoQ-10.

For example, the dominant form of CoQ-10 in human blood and liver is in the ubiquinol form (over 80%).[3] The preponderance of the ubiquinol form can be explained by its importance as an antioxidant the in blood and liver. CoQ-10 scientists have been investigating the relationship between disease states marked by high levels of oxidative stress and the levels of ubiquinol in the body. Disorders of elevated oxidative stress cause major changes in the amounts of ubiquinol and ubiquinone in the body, a factor that is referred to by scientists as *the ratio of ubiquinol to ubiquinone* (ubiquinol:ubiquinone). An easy way to view the percentage of blood CoQ-10 in the ubiquinol form is through the ubiquinol ratio percent, which is equal to 100% minus Ubiquinone ratio (%). The following studies offer us a greater understanding of ubiquinol's antioxidant function, including the quantification of the effects of oxidation on ubiquinol.

Diabetes and Liver Disorders' Effects on Ubiquinol Levels: It has been known for some time that Type 2 diabetics suffer from elevated oxidative stress resulting in autonomic nervous system dysfunction.[4] In 2005, Japanese researchers investigated the effects of the diabetic condition upon oxidative stress throughout the day (from morning to night) and the ubiquinol:ubiquinone ratio.[5] The researchers saw that as the day proceeded, the levels of oxidative stress increased, and the ubiquinol:ubiquinone ratio declined throughout the day (Incidentally, the scientists also hypothesized that bedtime snacks or nighttime eating would be harmful as a result of longer exposure to oxidative stress).

Also in 2005, Singaporean researchers demonstrated not only that ubiquinol ratios are low in diabetics, but also that the extent of ubiquinol loss was chilling: diabetics exhibited approximately 75% less ubiquinol as opposed to control (non-diabetic) subjects (Table 1). These diabetics were defined by a fasting plasma glucose of ≥ 6.9 mmol/L (blood glucose of ≥ 124 mg/dL). Clearly these studies demonstrate that the diabetic's oxidative stress causes the conversion of ubiquinol to ubiquinone.

Scientists found a similar loss of ubiquinol with subjects that have liver disease. People with certain types of liver disorders are also

Table 1. **Diabetes**

Blood Glucose	≤ 99 mg/dL	101 – 124 mg/dL	≥ 124 mg/dL
Ubiquinol ratio (%) Male	93 ± 6	43 ± 25	**24 ± 11**
Ubiquinol ratio (%) Female	95 ± 6	41 ± 15	**29 ± 16**

Reprinted with permission from WholeFoods Magazine, March 2007.

Table 2. **Liver Disorders**

	Control (n=16)	**Hepatitis** (n=28)	**Cirrhosis** (n=16)	**Hepatoma** (n=20)
Ubiquinol Ratio (%)	93.6	87.1	89.4	81.1
Decline	-	**6.5**	**4.2**	**12.5**

known to have elevated oxidative stress, as witnessed by the increase in biomarkers such as TBARS (serum thiobarbituric acid reactive substances). Researchers at the University of Tokyo showed that patients with hepatitis, cirrhosis, and hepatoma all exhibited a decrease in the ubiquinol ratio percent (table 2), while the total level of CoQ-10 (ubiquinol + ubiquinone) was not reduced.[6] These studies demonstrate that as the level of oxidative stress increases, the ratio of the ubiquinol:ubiquinone declines. These data are indication that certain types of physical states particularly require ubiquinol, and, they also provide support for the use of the ratio as a biomarker of oxidative stress.

The Future of Ubiquinol and Fate of Ubiquinone: The future of ubiquinol, which we can glean from the retrospective data, is quite positive. But there is one prospective study—in which human subjects (n=78) were administered different doses of ubiquinol—that changes everything. The incredible aspect of this preformatted ubiquinol softgel from Kaneka Corporation was that it demonstrated exceptionally high bioavailability, an issue that has a major impact on the full therapeutic utilization of CoQ-10.

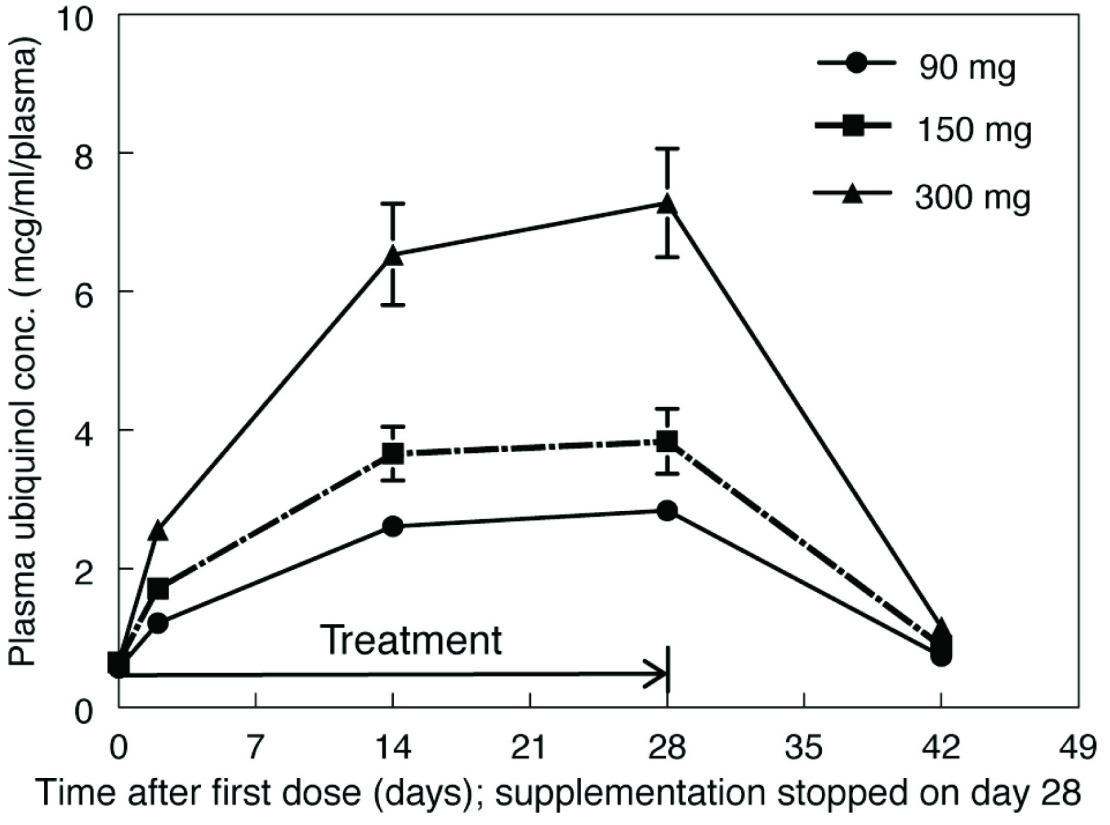
At the beginning of the study, the baseline values of CoQ-10 in the subjects were measured to be 0.57 to 0.66 mcg/ml of plasma. Subjects in the 150 mg per day ubiquinol supplementation group displayed peak values, within 28 days, of 3.84 mcg/ml of plasma.[7] The significance of this 3.84 value is apparent when you consider that, in a previous study, subjects required 1,200 mg of ordinary ubiquinone to reach this level.[8]

This is not to say that 150 mg of ubiquinol is bioequivalent to 1,200 mg of ubiquinone, because no such comparative study has been done and the subjects in these two studies are completely different. But, fresh out of the gates, ubiquinol is definitely a powerful way to raise blood CoQ-10 to the high, beneficial range (see Figure 1).

Today, consumers are already aware of some fine aspects of CoQ-10, such as the preference for the trans-isomer (endogenously produced) as opposed to the cis-isomer (which is a contaminant of the production process). Now, because of the commercialization of ubiquinol, we will see a slew of prospective clinical trials that will likely validate the exceptional power of this form of CoQ-10. Stay tuned for the exciting times ahead in the world of CoQ-10. **WF**

Sid Shastri, M.Sc. is the founder of Isomer Nutrition. Academically, Sid earned his degree in Exercise Physiology (Human Biodynamics) from U.C. Berkeley. In 2004, Sid earned his Master's of Science degree in Human Nutrition from the University of Bridgeport. In the past, Sid has worked and consulted for nationally recognized companies and has written for various industry publications. Sid can be reached at Sid@IsomerNutrition.com.

Figure 1. **Plasma Ubiquinol After Daily Ubiquinol Supplementation**



References:

1 Slater E.C., *J. Biol. Chem.*, 278(19): 16455-16461, May 9, 2003

2 Kontush A., *et al. Biofactors.* 1999;9(2-4):225-9.

3 Ibid.

4 Manzella D., *et al. Am J Clin Nutr.* 2001 Jun;73(6):1052-7

5 Hasegaqa G., *et al. Acta Diabetol.* 2005 Dec;42(4):179-81.

6 Yamamoto Y. and Yamshita S. *Biofactors.* 1999;9(2-4):241-6.

7 Hosoe K., *et al. Regul Toxicol Pharmacol.* 2007 Feb;47(1):19-28. Epub 2006 Aug 21.

8 Shults C.W., *et al. Arch Neurol.* 2002 Oct; 59(10):1541-50.

Reprinted with permission from WholeFoods Magazine, March 2007

Reprinted with permission from WholeFoods Magazine, March 2007.