REVIEW ARTICLE

The Instability of the Lipid-Soluble Antioxidant Ubiquinol: Part 1—Lab Studies

William V. Judy, PhD

Abstract

Background: Coenzyme Q10 (CoQ10) is a popular nutritional supplement that is available in both the oxidized and reduced form. The marketing of CoQ10 to physicians often asserts that one form is superior to the other. This study was designed to compare and contrast the stability, absorption and claims made for the reduced form of CoQ10 (ubiquinol) compared with the oxidized form (ubiquinone). There is a need for studies that examine the contents of commercially available ubiquinol products microscopically at room, body and 50°C temperatures. There is also a need for studies of the state of the ubiquinol contents when exposed to a 2.2 pH solution that simulates stomach acidity and an 8.2 pH solution that simulates acidity in the duodenum.
Methods: An investigation of the instability of ubiquinol supplements was conducted via an *in vitro* study of 13 ubiquinol products marketed in the United States that measured the extent of the conversion of the ubiquinol content to ubiquinone, when the ubiquinol was squeezed out of the capsule at room temperature and when the ubiquinol contents were exposed to a 2.2 pH solution and an 8.2 pH solution.
Results: In the *in vitro* study, the percentage of ubiquinol converted to ubiquinone at body temperature was greatest in the 8.2 pH simulated small intestinal juice: 76%. The percentage of ubiquinol converted to ubiquinone at body temperature in the 2.2 pH gastric juice that simulated conditions in the stomach was 54%.
Conclusions: Ubiquinol in commercial nutritional supplements is fairly stable inside the gelatin capsule but unstable in gastric and small intestine digestive fluids. Based on the data from the lab studies, most of the ubiquinol from the capsule will be converted to ubiquinone prior to reaching the absorption cells in the small intestines. Animal studies are needed to test this hypothesis.

William V. Judy, PhD, Founder and President, SIBR Research.

Corresponding author: William V. Judy, PhD
E-mail address: sibrinc@cs.com

Introduction

Coenzyme Q10 (CoQ10) is a redox molecule with 2 bioactive states, an oxidized state (ubiquinone) and a reduced state (ubiquinol), as well as an ephemeral intermediate state, semiquinone (ubisemiquinone), which may have as yet unclarified biologic functions.[1] In the literature, the fully oxidized form, ubiquinone, is commonly referred to as Q10 (European usage) or CoQ10 (American usage); the fully reduced form, ubiquinol, is, correspondingly, referred to as QH2 or CoQH2. Both redox forms of CoQ10 are bioactive. CoQ10 is essential for cellular adenosine phosphate (ATP) energy production; CoQH2 is an important lipid-soluble antioxidant preventing peroxidation of the low-density lipoproteins in the blood circulation.[1,2]

To assert that one form of CoQ10 is more important than the other would be misleading.[3,4] Both forms are important. Ubiquinol is the inherently unstable form; it is ubiquinol's property of donating electrons that makes it useful as an antioxidant. When it donates 2 electrons, it is oxidized to the ubiquinone form.

CoQ10 is a vitamin-like substance that has vital biologic functions in human cells:[2]

- acting as an essential cofactor in the cellular process of ATP energy generation
- acting as a lipid-soluble antioxidant protecting cells against oxidative damage
- protecting against atherosclerosis by improving endothelial function
- acting as a factor in the expression of genes that code for proteins involved in cell signaling
- having anti-inflammatory effects

It is ubiquinone that is synthesized in the human cells, not ubiquinol.[3] Adequate intake of CoQ10 in the