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Comparative Bioavailability of Coenzyme Q10 in Four Formulations

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Introduction

Coenzyme Q_{10} (CoQ_{10}) plays an essential role in mitochondrial electron transport, and as such, is fundamental for energy production in cells (1). Further, CoQ_{10} is an antioxidant whose activity is particularly important in regenerating vitamin E. Its ability to quench free-radicals also helps to maintain the structural integrity and stability of mitochondrial and cellular membranes—including intracellular membranes (2). CoQ_{10} supplementation has been shown to have therapeutic benefits for several diseases, the best documented of which involve cases of heart failure and ischemic heart disease (3). But because CoQ_{10} is a lipid-soluble nutrient, its bioavailability from pharmaceutical and nutritional products can be limited. USANA uses a patented solubilization system in its current CoQuinone product, which is highly effective in promoting high CoQ_{10} absorption; however, many of the solubilizing ingredients are synthetic, and we would prefer an all-natural formula. The study reported here was designed to compare the bioavailability of CoQ_{10}, as delivered by four formulas, including a new proprietary, all-natural formula developed by USANA scientists.

Methods

This prospective crossover study involved 14 healthy subjects and compared the bioavailability (plasma levels) of coenzyme Q_{10} derived from four formulations: a dry tablet without cyclodextrins, a dry tablet containing a preformed cyclodextrin-CoQ_{10} complex, the current CoQuinone liquid formula in a soft-gel capsule, and USANA's new proprietary liquid formula in a hard gelatin capsule. Given the crossover design, each subject participated in each of the four treatments in serial fashion, with a washout period (six days) between treatments. On the morning of the first test, subjects reported to the laboratory for a baseline blood draw, after which they were given the CoQ_{10} supplement with a standard meal. Additional blood samples were then drawn at 3, 5, and 8 hours after supplementation. This protocol, beginning with a baseline blood draw, was repeated three more times as the subjects rotated through the four treatments. All blood samples were processed, and plasma fractions were analyzed for CoQ_{10} via HPLC with an electrochemical detector. Increases from baseline in plasma CoQ_{10} concentrations were calculated, and statistical comparisons between treatments were run. In addition, the increases in plasma CoQ_{10} were plotted as a function of time following supplementation, and the Areas Under the Curve (AUCs) were calculated as indicators of bioavailability over time. Statistical comparisons were also made for these AUCs.

Results

The four formulas tested in this study showed dramatic differences in CoQ_{10} bioavailability (Figures 1 and 2). The dry tablet formula without cyclodextrins gave only marginal increases in plasma CoQ_{10} over baseline levels. The dry tablet formula with cyclodextrins appeared to be slightly better, but again, increases over baseline were modest. The two liquid formulas, however, produced significant rises in plasma CoQ_{10}. A 100 mg dose of CoQ_{10} delivered in USANA's current CoQuinone formula boosted plasma levels of this coenzyme to about 225% of baseline levels at five hours after supplementation. Levels declined by eight hours. USANA's new proprietary liquid formula gave similar results. Plasma CoQ_{10} concentrations rose to over 200% of baseline by five hours after supplementation, but then retained these elevated levels through eight hours (Figure 1). Comparisons of AUCs further highlight the differences between treatments (Figure 2). Importantly, USANA's current CoQuinone formula and the new proprietary, all-natural formula gave virtually identical results with respect to this time-integrated measure of CoQ_{10} bioavailability.

Discussion

This study was undertaken as part of a program to develop a new CoQ_{10} formula with the high bioavailability of our current CoQuinone product, but without the synthetic solubilizers found in CoQuinone. Two new formulas were tested. The first, a dry tablet formula, contained CoQ_{10} complexed with cyclodextrins—ring-shaped starch polymers that have been used successfully to promote the solubility and bioavailability of fat-soluble active ingredients (4). The second was an all-natural liquid formula based on lecithin, medium chain triglycerides, and glycerine monooleate.

The dry tablet formula with cylcodextrins did not provide the high levels of bioavailability necessary to meet USANA's standards. The new all-natural liquid formula did. Results showed that time courses for normalized plasma CoQ_{10} levels following supplementation with USANA's current CoQuinone formula versus the new all-natural liquid formula were similar. Furthermore, these two formulas performed identically when results were subjected to a time-integrated AUC measure of bioavailability. We conclude that USANA new liquid CoQ_{10} formula, comprising all natural ingredients, delivers the same high level of CoQ_{10} bioavailability as the company's current CoQuinone formula.

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References

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Figure 1.

Increase from baseline in plasma CoQ_{10} concentrations following supplementation with 100 mg of CoQ_{10}, as delivered by four different formulas.

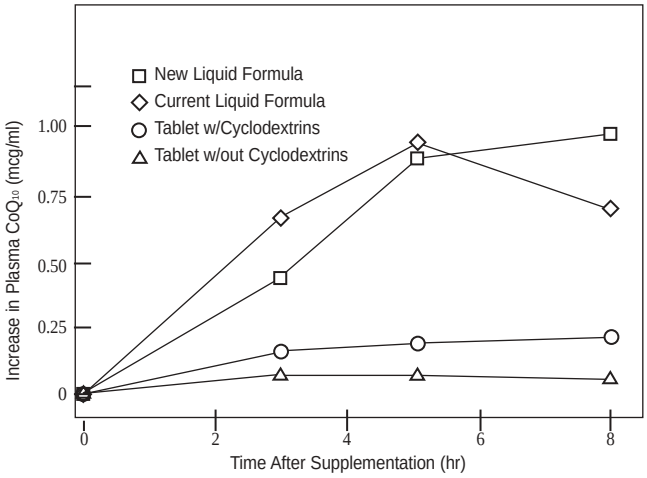

Figure 2.

Comparison of Areas Under the Curve (AUC) for the eight-hour plasma CoQ_{10} response curves shown in Figure 1.