The bioavailability of reduced coenzyme Q10 water-dispersive powder after single oral administration.

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Abstract

In this study, we showed the bioavailability of ubiquinol (QH) in the form of water-dispersive powder. Two groups of 5 healthy young subjects received single oral administration of 100 mg of QH in the form of a soft capsule containing QH dissolved in safflower oil or 40% water-dispersive powder in the fasting period, and changes in the plasma QH concentration were monitored over time. The water-dispersive powder form of QH exhibited superior bioavailability even when administered in the fasting period.

Introduction

Coenzyme Q10 (CoQ10) is a lipid-soluble substance with a quinone structure and is widespread in nature. It exists either in an oxidized state (ubiquinone) or a reduced state (ubiquinol)[1)]. CoQ10 is essential for ATP production in the electron transport chain located in the mitochondrial inner membrane. In addition, its ubiquinol form is a strong antioxidant[1-3)]. However, CoQ10 levels are known to be reduced because of aging or excessive oxidative stress[4,5)], and the usefulness of daily CoQ10 intake is being actively studied.

Only the reduced state, ubiquinol, has an antioxidative effect, and it has been reported that ubiquinol was superior than ubiquinone with regard to delaying aging[6)], improving the QOL of elderly people[7)], enhancing the motivation and mood of athletes[8)], and improving the oral environment[9)].

CoQ10 is lipid soluble and non-dispersible in water, and is hardly absorbed by oral administration[10,11)]. In this study, we determined plasma concentration changes in humans after administration of Ubiquinol 40% Water-dispersive Powder, which has superior dispersibility in water.

Material and methods

1. Test subjects

Ten healthy physiotherapists in their 20s (8 males, 2 females) were enrolled in this study. Before starting this study, written consent from each subject was obtained after explaining to them the following items, orally or in writing: the aim of this study, methods to be used, health hazard risks, the voluntary nature to participate in this study, privacy observance, and the management and publication of data. This study was conducted with the approval of the Seisen Orthopedic Clinic and with staff members of our institution.

2. Test foods

Hard capsules (1 capsule contained 125 mg of Ubiquinol 40% Water-dispersive Powder (ShiroQ), which corresponded to 50 mg of ubiquinol) were provided by Petroeuroasia Co., Ltd. As a control, ubiquinol-processed food soft capsules (1 capsule contained 50 mg of ubiquinol dissolved in safflower oil, glycerin, glycerin-fatty acid ester, and others) were used.

3. Test methods

Test subjects confirmed not to have been administered CoQ10 for 2 weeks. They were divided into 2 groups with 5 subjects per group (4 males, 1 female); one group was the test food administered group and the other

was the control group. They were not allowed to drink alcohol on the day before the test or to have any meal after 10:00 pm on the day before the test or in the morning of the test. During the test, their water intake was not restricted. Blood was collected at 7:30 am on the test day using heparin vacuum blood collection tubes, and 2 capsules of each food (100 mg of ubiquinol) were then administered. Blood samples were collected 3 hours and 6 hours after the food administration, and no restrictions for eating or drinking were set after the 6-hour sample was collected. Blood was also collected 9 hours, 12 hours, and 24 hours after the administration. Blood samples were centrifuged after each collection, and the separated plasma was stored at −80°C.

Frozen blood plasma samples were sent to Kaneka Techno Research Corporation for analysis on the basis of their "Measurement of Reduced- and Oxidized-CoQ10 Contents in Human Blood Plasma using Liquid Chromatograph-tandem Mass Spectrometer."

Results

Fig. 1 shows the changes in plasma ubiquinol concentrations after single oral administration. The plasma QH concentration before administration was 0.68 ± 0.08 μg/ml. Tmax was 6 hours after the administration. Cmax values compared with the pre-administration baseline in the soft capsule and water-dispersive powder groups were 0.4 ± 0.21 and 0.89 ± 0.27 μg/ml, respectively, and $AUC_{0\text{-}24hr}$ values were 3.59 ± 1.63 and 9.68 ± 2.35 μg·h/ml, respectively. The water-dispersive powder form of QH exhibited superior bioavailability even when administered in the fasting period.

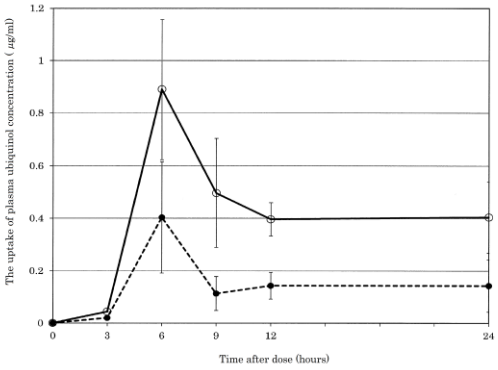

Fig. 1. The uptake of plasma ubiquinol concentration-time curves after single oral administration.

—○— : Ubiquinol 40% Water-dispersive Powder (ShiroQ) —●— : Soft gelatin capsule (Ubiquinol with Safflower oil, etc)

Fig. 2 shows the ubiquinol/CoQ10 ratios in blood plasma. Before administration, the concentration and the ratio of plasma ubiquinol were 0.68±0.08 μg/ml and 91.9±1.3%, respectively. After administration, the ratio showed a peak of 95.0±1.3% at Tmax and then gradually decreased.

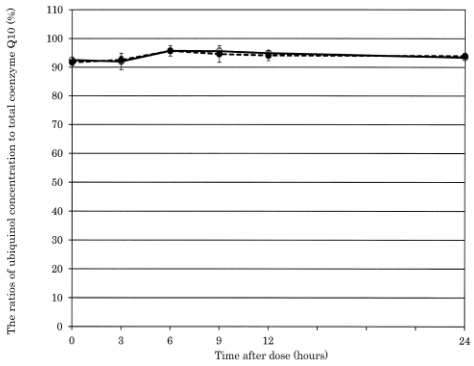

Fig. 2. The ratios of ubiquinol concentration to total coenzyme Q10.

—○— : Ubiquinol 40% Water-dispersive Powder (ShiroQ) —●— : Soft gelatin capsule (Ubiquinol with Safflower oil, etc)

Discussion

The two types of ubiquinol preparations that were compared in this study showed clear differences when they were administered once under fasting conditions; the water-dispersive powder type showed better results. A customary soft capsule that contains ubiquinol dissolved in lipids can be absorbed well when taken in conjunction with meals. However, it was found that this water-dispersive powder type could be absorbed whenever it was taken. This type can be processed into various forms, such as hard capsules, tablets, and powder. Furthermore, when dissolved in water, particles are dispersed stably with the average particle radius of 80 nm, and thus, the water-dispersive powder formulation may also be applicable to drinks.

Ubiquinol 40% Water-dispersive Powder (ShiroQ), which can be prepared in various forms, is anticipated to find new applications in supplements and drinks.

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