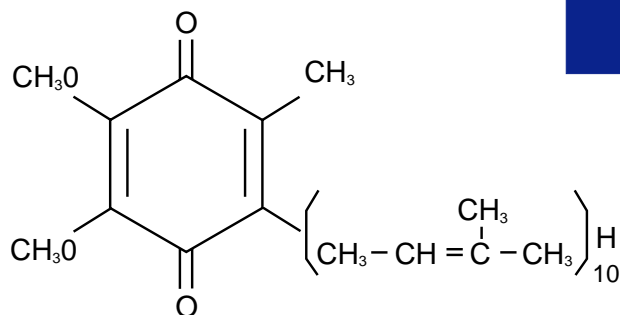


Monograph



Coenzyme Q₁₀

Synonyms: ubiquinone; CoQ₁₀

Biochemistry

The primary biochemical action of CoQ₁₀ is as a cofactor in the electron-transport chain – a series of oxidation-reduction reactions involved in cellular respiration and the synthesis of ATP.

Pharmacokinetics

CoQ₁₀ can be synthesized *in vivo*. Situations may arise, however, when the need for CoQ₁₀ surpasses the body's ability to synthesize it. CoQ₁₀ is well-absorbed by oral supplementation as evidenced by significant increases in serum CoQ₁₀ levels after supplementation.¹ There is some evidence that CoQ₁₀ in oil suspension has the highest bioavailability.²

Mechanisms of Action

CoQ₁₀, due to its involvement in ATP synthesis, affects the function of all cells in the body, making it essential for the health of all human tissues and organs. CoQ₁₀ particularly affects the cells that are the most metabolically active: heart, immune system, gingiva, and gastric mucosa.

Clinical Indications:

Immune Function – enhances phagocytic activity of macrophages and increases granulocyte proliferation.³⁻⁵ Its antioxidant activity helps prevent AIDS-related diseases caused by oxidative stress.⁶ Blood levels of CoQ₁₀ are lower in AIDS patients and 200 mg/day increased T-helper/suppressor ratios.⁷

Cancer - prevents metastasis and enhances remission in breast cancer.^{8,9} Mechanisms in cancer include immune system enhancement and antioxidant activity.

Periodontal Disease - Gingival biopsies yield subnormal tissue levels of CoQ₁₀ in patients with periodontal disease.¹⁰⁻¹³ Supplementation speeds healing after periodontal surgery.¹⁴⁻¹⁶

Gastric Ulcers - protective of the gastric mucosa due to its antioxidant effects.¹⁷ Production of protective mucus and rapid cell turnover of gastric mucosa are highly energy-dependent processes.

Obesity - Individuals with a family history of obesity have a 50% reduction in thermogenic response to a meal and are often found to have low CoQ₁₀ levels.¹⁸ CoQ₁₀, being essential for energy production, can be of benefit.

Physical Performance - Supplementation may enhance aerobic capacity and muscle performance, especially in sedentary individuals.¹⁹

Muscular Dystrophy - CoQ₁₀ deficiency is found in cardiac and skeletal muscle in animals and humans with hereditary muscular dystrophy.²⁰⁻²²

Allergy - inhibits release of histamine and SRSA in antigen-challenged animals.²³

Cardiovascular Disease - CoQ₁₀ is especially indicated for the enhancement of myocardial function by enhancing energy production, improving contractility of the cardiac muscle, and providing potent antioxidant activity, in particular prevention of LDL oxidation. Specific cardiac problems which may benefit from CoQ₁₀ include:

- cardiomyopathy²⁴⁻²⁶
- congestive heart failure²⁷⁻²⁹
- angina³⁰
- arrhythmias³¹
- prevention of adriamycin toxicity³²⁻³⁵
- protection during cardiac surgery³⁶
- mitral valve prolapse³⁷
- hypertension³⁸⁻⁴⁰

Male Infertility - CoQ₇ (CoQ₁₀ analog) at 10 mg/day resulted in significant increases in sperm count and motility.⁴¹

Diabetes mellitus - The electron-transport chain is integrally involved in carbohydrate metabolism. CoQ₇ at a daily dose of 120 mg for 2-18 weeks reduced fasting blood sugar by at least 30% in 31% of patients.⁴²

Dosage

Typical dose for most conditions is 30-60 mg BID; some studies on breast cancer treatment used 400 mg daily.

Deficiency

A deficiency may result from: 1) impaired synthesis due to nutritional deficiencies, 2) genetic or acquired defect in synthesis or utilization, 3) increased tissue needs resulting from illness. CoQ₁₀ levels decline with advancing age.

Toxicity/Drug-Nutrient Interactions

Cholesterol-lowering drugs such as lovastatin and pravastatin inhibit the enzyme 3-hydroxy-3-methyl glutaryl (HMG)-CoA reductase, required for synthesis of cholesterol as well as CoQ₁₀. These drugs may therefore compromise CoQ₁₀ status. Beta blockers propranolol and metoprolol inhibit CoQ₁₀-dependent enzymes. Phenothiazines and tri-cyclic antidepressants have also been shown to inhibit CoQ₁₀-dependent enzymes.

Occasional reports of nausea, anorexia, or skin eruptions have been reported with supplementation of CoQ₁₀.

Review Articles

1. Gaby AR. The role of coenzyme Q10 in clinical medicine: Part I. *Alt Med Rev* 1996;1(1):11-17.
2. Gaby AR. The role of coenzyme Q10 in clinical medicine: part II. Cardiovascular disease, hypertension, diabetes mellitus, and infertility. *Alt Med Rev* 1996;1(3):168-175.
3. Rauchova H, Drahota Z, Lenaz G. Function of coenzyme Q in the cell: some biochemical and physiological properties. *Physiol Res* 1995;44(4):209-216

References

1. Weber C, Bysted A, Holmer G. Intestinal absorption of coenzyme Q₁₀ administered in a meal or as capsules to healthy subjects. *Nutr Res* 1997;17:941-945.
2. Weis M, Mortensent SA, Rassing MR, et al. Bioavailability of four oral coenzyme Q₁₀ formulations in healthy volunteers. *Molec Aspects Med* 1994;15 (Suppl):s273-s280.
3. Mayer P, Hamberger H, Drews J. Differential effects of ubiquinone Q7 and ubiquinone analogs on macrophage activation and experimental infections in granulocytopenic mice. *Infection* 1980;8:256-261.
4. Saiki I, Tokushima Y, Nishimura K, Azuma I. Macrophage activation with ubiquinones and their related compounds in mice. *Int J Vitam Nutr Res* 1983;53:312-320.
5. Bliznakov E, Casey A, Premuzic E. Coenzymes Q: stimulants of the phagocytic activity in rats and immune response in mice. *Experientia* 1970;26:953-954.
6. Sugiyama S, Kitazawa M, Ozawa K. Anti-oxidative effect of coenzyme Q10. *Experientia* 1980;36:1002-1003.
7. Folkers K, Langsjoen P, Nara Y, et al. Biochemical deficiencies of coenzyme Q10 in HIV-infection and exploratory treatment. *Biochem Biophys Res Commun* 1988;153:888-896.
8. Lockwood K, Moesgaard S, Hanioka T, Folkers K. Apparent partial remission of breast cancer in 'high risk' patients supplemented with nutritional antioxidants, essential fatty acids and coenzyme Q10. *Molec Aspects Med* 1994;15(Suppl):S231-S240.
9. Lockwood K, Moesgaard S, Yamamoto T, Folkers K. Progress on therapy of breast cancer with vitamin Q10 and the regression of metastases. *Biochem Biophys Res Commun* 1995;212:172-177.
10. Nakamura R, Littarru GP, Folkers K, Wilkinson EG. Study of CoQ10-enzymes in gingiva from patients with periodontal disease and evidence for a deficiency of coenzyme Q10. *Proc Natl Acad Sci* 1974;71:1456-1460.
11. Hansen IL, Iwamoto Y, Kishi T, Folkers K. Bioenergetics in clinical medicine. IX. Gingival and leucocytic deficiencies of coenzyme Q10 in patients with periodontal disease. *Res Commun Chem Pathol Pharmacol* 1976;14:729-738.
12. Littarru GP, Nakamura R, Ho L, et al. Deficiency of coenzyme Q10 in gingival tissue from patients with periodontal disease. *Proc Natl Acad Sci* 1971;68:2332-2335.
13. Nakamura R, Littarru GP, Folkers K, Wilkinson EG. Deficiency of coenzyme Q in gingiva of patients with periodontal disease. *Int J Vitam Nutr Res* 1973;43:84-92.
14. Wilkinson EG, Arnold RM, Folkers K. Bioenergetics in clinical medicine. VI. Adjunctive treatment of periodontal disease with coenzyme Q10. *Res Commun Chem Pathol Pharmacol* 1976;14:715-719.
15. Wilkinson EG, Arnold RM, Folkers K. Treatment of periodontal and other soft tissue diseases of the oral cavity with coenzyme Q. In Folkers K, Yamamura Y (eds.). *Biomedical and Clinical Aspects of Coenzyme Q*, Vol. 1, Elsevier/North-Holland Biomedical Press, Amsterdam, 1977, pp. 251-265.
16. Wilkinson EG, Arnold RM, Folkers K, et al. Bioenergetics in clinical medicine. II. Adjunctive treatment with coenzyme Q in periodontal therapy. *Res Commun Chem Pathol Pharmacol* 1975;12:111-124.
17. Kohli Y, Suto Y, Kodama T. Effect of hypoxia on acetic acid ulcer of the stomach in rats with or without coenzyme Q10. *Jpn J Exp Med* 1981;51:105-108.
18. van Gaal L, de Leeuw ID, Vadhanavikit S, Folkers K. Exploratory study of coenzyme Q10 in obesity. In Folkers K, Yamamura Y (eds.). *Biomedical and Clinical Aspects of Coenzyme Q*, vol. 4, Elsevier Publishers, 1984, pp. 369-373.
19. Vanfraecchem JHP, Folkers K. Coenzyme Q10 and physical performance. In Folkers K, Yamamura Y (eds.). *Biomedical and Clinical Aspects of Coenzyme Q*, vol. 3, Elsevier/North-Holland Biomedical Press, Amsterdam, 1981, pp. 235-241.
20. Littarru GP, Jones D, Scholler J, Folkers K. Deficiency of coenzyme Q10 in mice having hereditary muscular dystrophy. *Biochem Biophys Res Commun* 1970;41:1306-1313.
21. Folkers K, Wolaniuk J, Simonsen R, et al. Biochemical rationale and the cardiac response of patients with muscle disease to therapy with coenzyme Q10. *Proc Natl Acad Sci* 1985;82:4513-4516.
22. Folkers K, Wolaniuk J, Simonsen R, et al. Biochemical rationale and the cardiac response of patients with muscle disease to therapy with coenzyme Q10. *Proc Natl Acad Sci* 1985;82:4513-4516.
23. Ishihara Y, Uchida Y, Kitamura S, Takaku F. Effect of Coenzyme Q10, a quinone derivative, on guinea pig lung and tracheal tissue. *Arzneimittelforsch* 1985;35:929-933.
24. Langsjoen PH, Langsjoen PH, Folkers K. Long-term efficacy and safety of coenzyme Q10 therapy for idiopathic dilated cardiomyopathy. *Am J Cardiol* 1990;65:521-523.

25. Langsjoen PH, Folkers K, Lyson K, Muratsu K, Lyson T, et al. Effective and safe therapy with coenzyme Q10 for cardiomyopathy. *Klin Wochenschr* 1988;66:583-590.
26. Langsjoen PH, Vadhanavikit S, Folkers K. Effective treatment with coenzyme Q10 of patients with chronic myocardial disease. *Drugs Exptl Clin Res* 1985;11:577-579.
27. Mortensen SA, Vadhanavikit S, Baandrup U, Folkers K. Long-term coenzyme Q10 therapy: a major advance in the management of resistant myocardial failure. *Drugs Exptl Clin Res* 1985;11:581-593.
28. Baggio E, Gandini R, Plancher AC, Passeri M, Carmosino G, et al. Italian multicenter study on the safety and efficacy of coenzyme Q10 as adjunctive therapy in heart failure (interim analysis). *Clin Invest* 1993;71:S145-S149.
29. Morisco C, Trimarco B, Condorelli M. Effect of coenzyme Q10 in patients with congestive heart failure: a long-term multicenter randomized study. *Clin Invest* 1993;71:S134-S136.
30. Kamikawa T, Kobayashi A, Yamashita T, Hayashi H, Yamazaki N. Effects of coenzyme Q10 on exercise tolerance in chronic stable angina pectoris. *Am J Cardiol* 1985;56:247-251.
31. Fujioka T, Sakamoto Y, Mimura G. Clinical study of cardiac arrhythmias using a 24-hour continuous electrocardiographic recorder (5th report) - antiarrhythmic action of coenzyme Q10 in diabetics. *Tohoku J Exp Med* 1983;141(Suppl):453-463.
32. Domae N, Sawada H, Matsuyama E, Konishi T, Uchino H. Cardiomyopathy and other chronic toxic effects induced in rabbits by doxorubicin and possible prevention by coenzyme Q10. *Cancer Treat Rep* 1981;65:79-91.
33. Karlsson J, Folkers K, Astrum H, Jansson E, Pernow B, et al. Effect of adriamycin on heart and skeletal muscle coenzyme Q (CoQ10) in man. In Folkers K and Yamamura Y (eds.). *Biomedical and Clinical Aspects of Coenzyme Q*, volume 5, Elsevier, 1986.
34. Judy WV, Hall JH, Dugan W, Toth PD, Folkers K. Coenzyme Q10 reduction of adriamycin cardiotoxicity. In Folkers K, Yamamura Y (eds.). *Biomedical and Clinical Aspects of Coenzyme Q*, vol. 4, Elsevier Publ., 1984, pp. 231-241.
35. Cortes EP, Gupta M, Chou C, Amin VC, Folkers K. Adriamycin cardiotoxicity: early detection by systolic time interval and possible prevention by coenzyme Q10. *Cancer Treat Rep* 1978;62:887-891.
36. Tanaka J, Tominaga R, Yoshitoshi M, Matsui K, Komori M, Sese A, et. al. Coenzyme Q10: the prophylactic effect on low cardiac output following cardiac valve replacement. *Ann Thorac Surg* 1982;33:145-151.
37. Oda T, Hamamoto K. Effect of coenzyme Q10 on the stress-induced decrease of cardiac performance in pediatric patients with mitral valve prolapse. *Jpn Circ J* 1984;48:1387.
38. Digiesi V, Cantini F, Oradei A, Bisi G, Guarino GC, et al. Coenzyme Q10 in essential hypertension. *Molec Aspects Med* 1994;15(Suppl):S257-S263.
39. Langsjoen P, Langsjoen P, Willis R, Folkers K. Treatment of essential hypertension with coenzyme Q10. *Molec Aspects Med* 1994;15(Suppl):S265-S272.
40. Digiesi V, Cantini F, Brodbeck B. Effect of coenzyme Q10 on essential hypertension. *Curr Ther Res* 1990;47:841-845.
41. Tanimura J. Studies on arginine in human semen. Part III. The influences of several drugs on male infertility. *Bull Osaka Med School* 1967;12:90-100.
42. Shigeta Y, Izumi K, Abe H. Effect of coenzyme Q7 treatment on blood sugar and ketone bodies of diabetics. *J Vitaminol* 1966;12:293-298.