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# The Effect of Respiratory Chain of CoQ10

## CoQ10'nin Solunum Zincirindeki Etkisi

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**Abstract**

CoQ10 levels are known to decrease with aging. Maintaining healthful levels of CoQ10 is important for heart health. CoQ10 functions as an electron carrier in the mitochondrial respiratory chain as well as serves as an important intracellular antioxidant. Coenzyme Q10 is a fat-soluble compound primarily synthesized by the body and also consumed in the diet. CoQ10 is an essential element of food that can now be used medicinally to support the sick host in conditions where nutritional depletion and cellular dysfunction occur. Some chronic disease conditions (cancer, heart disease, etc.) are also thought to reduce the biosynthesis and increase the demand for CoQ10 in the body.

**Keywords:** IFood, repiratory chain, CoQ10

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**Özet**

CoQ10 seviyesinin yaşlanmayla birlikte azaldığı bilinmektedir. Kalp sağlığı için CoQ10'nin seviyesi önemlidir. CoQ10 mitokondrial solunum zincirinde bir elektron taşıyıcısı olarak, bunu yanı sıra önemli bir hücre içi antioksidan olarak görev yapar. CoQ10 yağda çözünebilen bir bileşiktir ve öncelikli olarak vücut tarafından sentezlenir ve ayrıca diyetle alınabilir. CoQ10, hasta tedavisinde besleyici ve hücresel bozuklukların tedavisinde destekleyici olarak kullanılan yiyeceklerin elzem bir maddesidir. Bazı kronik hastalıklar vücudun ihtiyacı olan CoQ10'in azalması ve biyosentezinin düşmesi ile bağlantılıdır.

**Anahtar Kelimeler:** Yiyecek, solunum zinciri, CoQ10.

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## Introduction

Coenzyme Q10 is a naturally-occuring compound found in every cell in the body. Coenzyme Q10's alternative name is ubiquinone, comes from the word ubiquitous, which means "found everywhere". Coenzyme Q10 (or CoQ10) is a natural chemical compound that we make in our bodies and consume in our diets, primarily from oily fish, organ meats such as liver, and whole grains. Ubiquinones are fat-soluble molecules with anywhere from one to 12 isoprene (5-carbon) units. The ubiquinone found in humans, ubidecaquinone or coenzyme Q10, has a "tail" of ten isoprene units (a total of 50 carbon atoms) attached to its benzoquinone "head". Pharmacokinetics of CoQ10 in reaching the mitochondrial respiratory chain is delayed; short-tail ubiquinone analogs cannot replace CoQ10 in the mitochondrial respiratory chain under conditions of CoQ10 deficiency; and oxidative stress and cell death can be counteracted by administration of lipophilic or hydrophilic antioxidants[1].

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CoQ10 is required in stage 3 of energy production: The Electron Transport Chain stage the final step of converting glucose into energy. It may prevent or even reverse heart problems, skin damage, breathing problems, nerve damage, brain cell deterioration, gum disease, muscle wasting, headaches, chronic fatigue syndrome, etc.[2].

It is a fat-soluble vitamin-like substance present in every cell of the body and serves as a coenzyme for several of the key enzymatic steps in the production of energy within the cell. It also functions as an antioxidant which is important in its clinical effects. It is naturally present in small amounts in a wide variety of foods but is particularly high in organ meats such as heart, liver and kidney, as well as beef, soy oil, sardines, mackerel, and peanuts. To put dietary CoQ10 intake into perspective, one pound of sardines, two pounds of beef, or two and one half pounds of peanuts, provide 30 mg of CoQ10[3].

Although the amount of CoQ10 obtainable from food seems small, research indicates that the body's ability to create CoQ10 combined with a healthy diet ensures that most people do not have a deficiency.

## The mechanisms of action

CoQ10 is also synthesized in all tissues and in healthy individuals normal levels are maintained both by CoQ10 intake and by the body's synthesis of CoQ10. CoQ10 is an enzyme which is naturally found in many cells of the body. In fact, it is found in every single mitochondrial cell and about 95% of our body's energy is produced by this way, which converts sugars and fats into energy. Some of the organs such as heart, liver and kidneys have the highest concentrations of CoQ10 as these organs need a lot of energy for their functioning[4].

CoQ10 shares a common biosynthetic pathway with cholesterol. The synthesis of an intermediary precursor of CoQ10, mevalonate, is inhibited by some beta blockers, blood pressure-lowering medication, and statins, a class of cholesterol-lowering drugs. When the respiratory system is inhibited, electrons accumulate in the early stages of the ETC (complex I and CoQ10), where they are donated directly to O2 to produce O2-.

There are approximately 100 trillion cells in the human body and each must produce its own energy to carry out its functions. The mitochondria contain electron transport chains, which are the fundamental units for energy production in our cells. Through a series of chemical reactions along this electron transport chain, the ATP molecules are produced. Other familiar substances are involved in this electron transport chain. These include vitamin C, riboflavin (or vitamin B2), niacinamide (or vitamin B3), vitamin E and others[5].

Since CoQ10 plays a dual role as an antioxidant and bioenergetic agent in the respiratory chain, it has attracted increasing attention concerning the prevention of apoptosis in mitochondrial diseases cytoprotection by CoQ10 may be mediated by raising cellular resistance against the initiating steps of apoptosis, namely the decrease of DeltaPsim (mitochondrial membrane potential)[6].

CoQ 10 is a component of the mitochondrial electron transport chain and also a constituent of various cellular membranes. CoQ supplementation resulted in an elevation of CoQ homologues in tissues and their mitochondria, a selective decrease in protein oxidative damage, and an increase in antioxidative potential in the rat[7].

Coenzyme Q 10 (CoQ 10) protects myocardium from ischemia-reperfusion (IR) injury as evidenced by improved recovery of mechanical function, ATP, and phosphocreatine during reperfusion. The cardioprotective effects of CoQ10 can be attributed to the preservation of mitochondrial function during reperfusion as evidenced by improved FADH-dependent oxidation[8]. Preoperative oral CoQ10 therapy, increases CoQ10 content in atrial trabeculae and cardiac mitochondria, improves efficiency of mitochondrial energy production, improves posthypoxic myocardial contractile function, and reduces myocardial damage and shortens the hospital stay[9].

CoQ10 is a lipid soluble benzoquinone with a 10-isoprenyl unit side chain, is structurally similar to vitamin-K5. It is an essential component in the synthesis of ATP and exhibits both anti-oxidants and membrane stabilizing property. CoQ10 acts as a redox link between flavop-

roteins and cytochromes that are needed for oxidative phosphorylation and synthesis of ATP. It is thus an essential co-factor in the generation of metabolic energy and is particularly important in muscle function. It serves as an electron transport carrier during the processes of respiration and oxidative phosphorylation[10]. Thus, it is involved in the manufacture of ATP. CoQ10 must be reduced to ubiquinol to wield its anti-oxidative function, and supplementation with CoQ10 may inhibit lipid oxidizability. It is a central rate-limiting constituent of the mitochondrial respiratory chain, which generates most of the ATP within the cell. Thus CoQ10 acts as an energizer where it improves the efficiency of the cells to utilize all available energy from its sources. CoQ10 levels are reported to decrease with age and to be low in patients with some chronic diseases such as heart conditions, muscular dystrophies, Parkinson's disease, cancer, diabetes, and HIV/AIDS. Some prescription drugs may also lower CoQ10 levels[11].

**Conclusion**

Coenzyme Q10 (CoQ10) is a pro-vitamin like substance that appears to be efficient for treatment of neurodegenerative disorders and ischemic heart disease. Initially, doses as small as 30 to 45 mg per day were associated with measurable clinical responses in patients with heart failure. It is virtually impossible to adequately supplement CoQ10 from dietary sources. Since anyone who is low in CoQ10 needs much more than 30 mg per day[12,13].

CoQ-10 may be helpful in supporting the prevention or treatment of those diseases. CoQ10 is present in other cell membranes. In the outer membrane it may contribute to the control of cell growth, especially in lymphocytes (the implications are far reaching. The clinical experience with CoQ10 in heart failure is nothing short of dramatic, and it is reasonable to believe that the entire field of medicine should be re-evaluated in light of this growing knowledge.

Coenzyme Q10 (CoQ10) serves as an electron carrier within the mitochondrial respiratory chain, where it is integrally involved in oxidative phosphorylation and consequently ATP production.

CoQ10 has the potential to improve energy production in mitochondria by bypassing efective components in the respiratory chain as well as by reducing the effects of oxidative stress. CoQ10 is involved in basic energy production by every cell in the body, optimal amounts can be beneficial for a wide variety of complaints, symptoms and diseases. There is no evidence of any significant risks to humans taking CoQ10. As long as it has been carefully and rigorously purified, it appears to be safe as a nutritional supplement.

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