

Coenzyme Q10

Coenzyme Q10 (CoQ10), also known as ubiquinone and ubiquinone, is often described as a vitamin or at least a vitamin-like substance. However, it is not strictly a vitamin as it can be synthesised in the liver. CoQ10 is synthesised from the amino acid tyrosine (this synthesis in turn requires other vitamins and minerals) but is also absorbed from a wide variety of foods.

There has been a proliferation of research results showing possible causes of deficiency. It is possible to evaluate these to try and identify indications for supplementation in health and disease. Evidence of benefit from supplementation is harder to find.

As with other vitamins and dietary supplements the strongest case for use can be made in conditions where deficiency is associated with disease and where supplementation corrects or prevents the disease. It is more difficult to establish benefit in health maintenance and disease prevention. In common with other naturally-occurring antioxidant compounds, many claims are made for benefit through antioxidant activity.

Background

In common with other coenzymes, it is a cofactor upon which other enzymes depend for their function. It appears to be a coenzyme for a number of cell enzymes including enzymes within the mitochondrial oxidative phosphorylation pathway which produces adenosine triphosphate (ATP). This is fundamental to energy production within cells. It may also have a role as an antioxidant and it undoubtedly has antioxidant activity.^{1,2,3,4} It was discovered in the United States and England in 1957 and, by the 1970s, could be produced in large enough quantities to allow more research to be done.

Indications

Since the 1980s it has been possible to measure normal blood and tissue levels of CoQ10. It has thus been possible to define deficiency of CoQ10 and possible associated disease. Deficiency can arise through:

- Reduced biosynthesis
- Increased utilisation
- Reduced dietary intake
- A combination of these factors (probably most often the cause)

There is now a lot of interesting research being done on CoQ10. There are a number of interesting therapeutic possibilities. At the moment there is evidence to suggest possible benefit from supplementation but perhaps not enough for firm recommendations. Some enthusiasts are keen to recommend taking supplements and it is helpful to acquire background knowledge to understand the basis for these recommendations. Supplementation appears to be safe.

Some examples of possible indications and interesting research findings include:

Use with statins

- Administration of HMG-CoA reductase inhibitors ('[statins](#)') has been associated with a reduction in CoQ10 levels (due to inhibition of mevalonate synthesis).^{5,6}
- The [myopathy](#) associated with statins is poorly understood.^{7,8,9} There has been speculation that this reduction in CoQ10 may be associated with statin-induced myopathy.¹⁰ However, the reduction may just reflect reduction in the lipoprotein carriers of CoQ10 and may not be statin specific.¹¹
- There are mixed reports on the benefits of CoQ10 in helping statin-associated myalgia.^{12,13}
- The reduction of CoQ10 is corrected by supplementation and does not affect the cholesterol-lowering effect of [simvastatin](#).¹⁴
- There are studies to support supplementation with CoQ10 in patients on statins.^{15,16} However, supplementation if used should not divert from routine monitoring and use of lowest effective dose of statin.^{17,18}
- A recent review of the literature did not recommend routine CoQ10 supplementation but suggested that certain subpopulations might benefit:
 - Patients with familial [hypercholesterolaemia](#)
 - Patients with heart failure
 - Patients over 65 years¹⁹
- Other reviews highlight the lack of evidence to support routine CoQ10 supplementation even though there are few safety concerns with such supplementation.²⁰ More research is needed to support such a recommendation.
- One of the limitations with some studies is that they measure plasma CoQ10 rather than tissue levels.²¹
- There are lots of studies indicating that the clinical benefits of statins outweigh the low rates of adverse effects.²²

Parkinson's disease

- There is increasing evidence that impairment of mitochondrial function and oxidative damage contribute to the pathophysiology of [Parkinson's disease](#) (PD).²³
- Changes in levels of CoQ10 in the cerebrospinal fluid of patients with PD have been found, but the clinical significance is unclear.²⁴
- A study from the Institute of Neurology shows evidence of a deficit in brain CoQ10 status that may be involved in the pathophysiology of PD.²³
- There may be a neuroprotective benefit from CoQ10 supplementation.^{25,26}
- A large phase III clinical trial is underway to examine whether high-dose oral CoQ10 will slow disease progression.²⁷

Heart disease

- There are good theoretical reasons for expecting benefit from CoQ10 supplementation in heart disease.^{21,28,29}
- There is concern that therapies (such as statins) that may lower CoQ10 levels may also precipitate worsening of heart failure, particularly in those patients who already have low CoQ10 levels associated with heart failure.
- A lot of clinical studies on congestive [cardiac failure](#) and CoQ10 supplementation have been done and some report clinical improvements. There is generally an enthusiasm about a nutritional approach to treatment.³⁰ However, concerns about the designs of these studies (including the small numbers of patients and the use of plasma CoQ10 measurement) have limited acceptance of the findings.³¹

- There have also been trials on use in idiopathic dilated [cardiomyopathy](#) but not showing statistically significant improvement.

Other findings

- **Asthma:**
 - [Corticosteroids](#) in asthma reduce CoQ10 levels and supplementation with CoQ10 reduces the dosage of corticosteroids required to control asthma and, hence, the potential for steroid side-effects.³²
- Thyroid disease:
 - CoQ10 levels are low in [hyperthyroidism](#) and high in [hypothyroidism](#).³³
- **Infertility:**
 - In male infertility low CoQ10 levels have been found in seminal fluid and supplementation improved sperm motility^{34,35,36}
- **Pre-eclampsia:**
 - CoQ10 levels in cord blood were lower in normal woman compared to women with pre-eclampsia³⁷
 - Supplementation with CoQ10 has been found to reduce the risk of developing pre-eclampsia in women at risk for the condition.³⁸
- **Neurological disease:**
 - Primary CoQ10 deficiency does exist but is very rare. It causes an encephalomyopathic disease, and supplementation has been reported to benefit the myopathy.^{39,40,41} This is not replicated in other studies.⁴²
 - There are some interesting reports suggesting possible therapeutic benefit of CoQ10 in Huntington's disease (HD).²⁵ The suggestion is that the mitochondrial dysfunction found in HD may be improved with CoQ10 supplements.
 - It has also been tried with apparent benefit in [Friedreich's ataxia](#).⁴
 - It has been recommended in [migraine prophylaxis](#).
- **Oestrogen use:**
 - [Hormone replacement therapy](#) (HRT) lowers serum CoQ10 levels and it is postulated that this may increase cardiovascular disease risk.⁴³
 - Lower levels of CoQ10 have been found in the follicular phase of the menstrual cycle compared with the luteal phase. Oral contraceptive use significantly reduced CoQ10 levels but the clinical significance of this is unclear and more research is needed.
- **Antioxidant effects:**
 - Prevention of vascular disease and cancer with antioxidants is a theoretical possibility. It has been suggested that antioxidants are best taken in combination. It has been suggested that widespread use of antioxidants for protective effects should await the results of ongoing clinical trials.⁴⁴ Some trial results are not encouraging, so far failing to confirm protective effect from other antioxidant vitamins.⁴⁵ Some express high hopes for CoQ10 in neurodegenerative disease, cancer, cardiovascular disease and diseases of aging.⁴⁶
 - There may be a neuroprotective effect from the toxic effects of cocaine and [methamphetamine](#) according to animal research on mice.⁴⁷

Contra-indications

It appears to be safe and the reduced form (ubiquinol), when fed to healthy volunteers at different doses over 4 weeks, did not cause safety concerns or adverse events.⁴⁸ Other safety assessments have been favourable.⁴⁹ It seems sensible to avoid supplementation in pregnancy.

Initiation

The possible indications for CoQ10 are many and varied. However, with current evidence it is difficult to make firm recommendations. Some patients may initiate therapy themselves as it is widely available.

CoQ10 dissolved in an oil matrix rather than a crystalline form appears to be better absorbed.¹ Dosages used in clinical trials have varied, but there appears to be a trend towards higher doses. Recommendations on dosage often relate to specific diseases and there is no firm recommendation for use in prevention of disease. What dosage should be taken remains an open question with suggestions in disease states ranging from 30 mg per day to 300 mg per day.

Monitoring

It is important that monitoring of any disease or condition be continued. No CoQ10 specific monitoring is recommended in routine clinical use. CoQ10 levels can be measured but such testing should certainly be discussed with the laboratory.

Complications and reasons to discontinue

A possible interaction with coumarin [anticoagulants](#) has been reported at high doses.

History

CoQ10 was first isolated in 1957 by a Dr Crane in Wisconsin and by Professor Morton in England. Professor Morton came up with the name ubiquinone (ubiquitous quinone). Production of large quantities was perfected in the 1970s in Japan, enabling larger scale clinical trials. The role of CoQ10 in the energy production within mitochondria was better understood after the contribution of 1978 Nobel Prize winning scientist Peter Mitchell.

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