

# Education News



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## COENZYME Q10

### THE CRUCIAL COG IN THE WHEEL THAT KEEPS US MOVING

Coenzyme Q10 has developed an excellent name for itself for keeping the heart healthy. Its antioxidant action and ability to recycle vitamin E helps it to protect the heart and blood vessels from damage, while its irreplaceable role in making energy keeps the heart pumping and strong. Which is probably why there is more CoQ10 to be found in the heart and other major organs like the liver than elsewhere in the body.

We now also know that coenzyme Q10 is involved in the regulation of hundreds of genes, which may be one of the reasons why low levels of CoQ10 have been linked to so many neurological diseases, such as Parkinson's and Huntington's disease, as well as breast cancer, type 2 diabetes and heart disease.



## MAKING ENERGY FROM FOOD

The heart is our most crucial organ, and so that alone is a good enough reason to look at coenzyme Q10. This hardworking nutrient is also important for every cell in the body, as every cell in the body needs to make energy, and we can't produce energy from food without it. CoQ10 is valuable as an antioxidant within each cell too, but it is indispensable when it comes to making ATP, our molecules of energy that help power everything in the body from transport to muscle contraction.

The process of making ATP is fairly complex, but our cells can be very efficient at producing these miniscule batteries of energy, as long as

there is enough oxygen present. CoQ10 is involved in the final stage of ATP production in a part of the cell called the mitochondrion, where electrons need to be transported along a dam-type system that harnesses energy. Without CoQ10, those electrons have nothing to carry them.



“The heart is our most crucial organ, and so that alone is a good enough reason to look at coenzyme Q10”

## PREVENTING OXIDATIVE STRESS

This can lead to the presence of too many free radicals in the mitochondrion, which can then cause oxidative damage. Free radicals are particles such as electrons that are not engaged in a specific beneficial process. They are so reactive that they will react with anything – which can be potentially very damaging. So reduced levels of CoQ10 in the mitochondria can result in electrons causing harm instead of producing ATP molecules. Scientists have hypothesised that this kind of damage in the mitochondria of the nerve cells is what leads to many of the symptoms of Parkinson's disease and Huntington's disease.

## UBIQUINOL OR UBIQUINONE – WHICH FORM IS BEST?

As the CoQ10 picks up and drops electrons, it changes form between ubiquinone, which is full of electrons, and ubiquinol, which is free of electrons and so ready for work. Both forms are available as supplements, but it is the ubiquinol that is more useful.

As we convert ubiquinone into ubiquinol and vice versa in the cell's mitochondria, it would be easy to think that it doesn't matter which form we take. Studies show, however, that as we age, we become less efficient in converting ubiquinone to ubiquinol.<sup>1</sup> Our total coenzyme Q10 level may stay the same, but our ubiquinol levels are lower, and this is the form which is ready to act as an antioxidant, as an electron carrier in the mitochondria and as a gene regulator. Ubiquinol is the form that is already oxidised, therefore full of electrons, and so unavailable for work until those electrons have been deposited elsewhere.

This suggests that as we age, ubiquinol is more frequently being used as an antioxidant, and so being converted to ubiquinone. As we get older our bodily functions usually become less efficient and more sluggish, and so there is a much greater demand for antioxidants to “mop up the mess” and protect us from faster deterioration. Ubiquinol could therefore be seen as an anti-ageing nutrient for every cell in our body, including our brain cells – one that we need more of the older we get.

## HEALTHY HEARTS

Several studies have looked at coenzyme Q10 and heart disease and found significant benefits. A Texas study worked with severe congestive heart failure patients to investigate why their coenzyme Q10 levels were usually also low, and produced astonishing results.

They initially tried supplementing with ubiquinone, but even doses of up to 900mg daily failed to bring the patients' blood serum levels of CoQ10 up to where they should be. At first the researchers thought that oedema could be preventing absorption of the CoQ10, but then they tried ubiquinol instead.

The ubiquinol showed a different story. Levels of CoQ10 in the bloodstream increased from an average of 1.6mcg/ml to 6.5mcg/ml. At the same time, the patients' EF measurements – which demonstrate how well the heart is beating – improved substantially. In addition, the classification of the patients was reduced from "severe" to "mild" on the New York Heart Association scale, which meant that they went from "unable to carry out any physical activity without discomfort" to "no limitation" or "slight limitation" of physical activity.<sup>2</sup>

## CoQ10 REDUCES NEED FOR HIGH BLOOD PRESSURE MEDICATION

Another group of researchers wanted to test CoQ10 with hypertension, and so took 109 patients with high blood pressure and started adding coenzyme Q10 to their prescription on top of their antihypertensive medication. The trial was so successful that patients were needing to reduce their blood pressure medication within 1-6 months of starting CoQ10 therapy, and over half of them came off their medication altogether.

The significant improvements in symptoms that were displayed included improved systolic and diastolic blood pressure and a thickening of the left ventricle wall.<sup>3</sup>

In addition, a recent laboratory study on rats with kidney disease demonstrated that where a high salt diet increased blood pressure, ubiquinol therapy reduced it.<sup>4</sup>

## UBIQUINOL REDUCES CHOLESTEROL

A recent German study took 53 healthy men with an average age of 30 and gave them daily ubiquinol supplements for 2 weeks. As their blood plasma levels of CoQ10 increased, their LDL cholesterol levels were reduced by 12.7%, a reduction that is "comparable to the described effects of plant sterols" say the researchers, who attribute this to CoQ10's effect on gene expression.<sup>5</sup> Again, it was noted that ubiquinone did not have the same beneficial effect.

## REGULATING GENE EXPRESSION

The same research highlighted ubiquinol's ability to induce gene expression patterns involved in inflammation, cell death and cell differentiation. This has ramifications for a number of disease conditions, ranging from asthma to cancer.

Our current understanding of CoQ10's importance is probably only the tip of the iceberg.

Further research has linked coenzyme Q10 to the expression of 694 genes in a human intestine cell line, many of which were involved in cell signalling, intermediary metabolism, transport, transcription control, disease mutation, phosphorylation, embryonal development and binding, i.e. many of the basic functions of a healthy cell.<sup>6</sup>

# CoQ10 AND BREAST CANCER

Cancer cells notoriously struggle with basic healthy functioning, in particular healthy ATP production in their mitochondria as described above. It is no surprise then that blood levels of coenzyme Q10 are frequently reduced in cancer patients.<sup>7</sup>

Studies involving CoQ10 and cancer are limited but with promising results, and largely focus on breast cancer. Once such Danish study followed 32 breast cancer patients for 18 months.<sup>8</sup> In all of these patients the cancer had spread to the axillary lymph nodes, and some had metastases elsewhere. All received a range of antioxidants, omega 3 and 6 oils, vitamins and minerals, plus 90mg daily of coenzyme Q10, in addition to orthodox treatment, involving surgery, radiation therapy and chemotherapy, with or without tamoxifen.

In such a group receiving just orthodox treatment, 4 deaths would have been expected at 18 months, however the survival rate for those taking CoQ10 was 100%. Six patients were reported to show some evidence of remission, although evidence for this was only documented for 3 of them. All 6 had evidence of the cancer having not spread further, however. At 24 months, 6 deaths would have been the norm, but again, all 32 patients remained alive.<sup>9</sup>

In addition, each of the 32 patients in the study reported a decreased use of painkillers, improved quality of life, and an absence of weight loss.

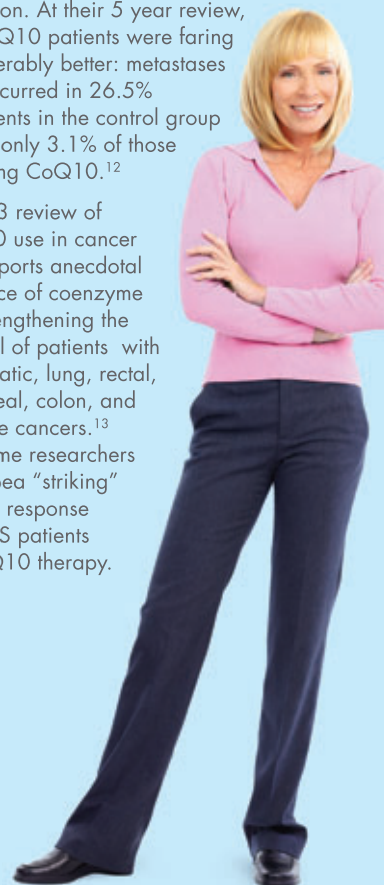
A further study by the same team gave 3 breast cancer patients a higher dose of 390mg of coenzyme Q10 daily for a total of 3-5 years. The results state that "the numerous metastases in the liver of a 44-year-old patient 'disappeared,' and no signs of metastases were found elsewhere. A 49-year-old patient, on a dosage of 390 mg of vitamin Q10, revealed no signs of tumor in the pleural cavity after six months, and her condition was excellent. A 75-year-old patient with carcinoma in one breast, after lumpectomy and 390 mg of CoQ10, showed no cancer in the tumor bed or metastases."<sup>10</sup>

The investigators appear to have used ubiquinone, the less potent form of coenzyme Q10, so it would be interesting to see similar studies carried out using ubiquinol.

With skin cancer and other types of cancer, CoQ10 has been shown to improve the outlook for patients with melanoma, considered to be the most dangerous type of skin cancer. A group of scientists in Rome identified lower levels of coenzyme Q10 in melanoma patients, and even lower numbers in those whose cancer had metastasised (spread).<sup>11</sup>

The same group conducted a 3 year trial on stage I and II melanoma patients with surgically removed lesions, giving some of them CoQ10 twice daily with their interferon injections, and the rest just interferon. At their 5 year review, the CoQ10 patients were faring considerably better: metastases had occurred in 26.5% of patients in the control group and in only 3.1% of those receiving CoQ10.<sup>12</sup>

A 1993 review of CoQ10 use in cancer also reports anecdotal evidence of coenzyme Q10 lengthening the survival of patients with pancreatic, lung, rectal, laryngeal, colon, and prostate cancers.<sup>13</sup> The same researchers describe a "striking" clinical response by AIDS patients to CoQ10 therapy.



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## DIABETES AND VASCULAR PROBLEMS

Diabetics have double the risk of vascular injury, or damage to the blood vessels, which can cause problems throughout the body ranging from ulcers in the foot and lower leg and decreased sensation in peripheral nerve endings, to heart failure, kidney failure and stroke.

It is generally thought that the blood vessels are damaged due to the increased levels of glucose leading to more glycoproteins being made, which makes the basement membrane thicker and weaker. However, more recent research is challenging this theory, as 40% diabetics who control their blood sugar still develop neuropathy<sup>14</sup>, and the non-diabetic children of many type 2 diabetics also develop neuropathy and blood vessel stiffness.<sup>15</sup>

A group of researchers at Singapore's Alexandra Hospital decided to have a look at coenzyme Q10's involvement, and found that their ubiquinol levels were severely low – in fact 75% lower than the non-diabetics tested.<sup>16</sup> They concluded that the diabetics' oxidative stress may cause increased conversion of ubiquinol to ubiquinone. Ubiquinol therapy, therefore, may well represent a novel treatment for diabetics and their offspring to help them regain integrity in their blood vessels.

## LIVER AND KIDNEY DISEASE

A similar situation has been noted with patients with certain types of liver disease which are already associated with high levels of oxidative stress. These include hepatitis, cirrhosis of the liver and hepatoma. Scientists at the University of Tokyo found that patients with these diseases of the liver all had normal levels of total CoQ10

in their blood plasma, but that the levels of ubiquinol were very low. This also suggests a high rate of conversion to ubiquinone, as one would expect with oxidative stress.<sup>17</sup>

A laboratory study on rats with kidney disease found that ubiquinol supplementation lowered their systolic blood pressure and urinary albumin levels (where a high salt diet had raised both), as well as their renal superoxide function. The study concluded that "ubiquinol, the reduced form of CoQ10, effectively ameliorates renal function, probably due to its antioxidant effect. Thus, ubiquinol may be a candidate for the treatment of patients with kidney disease."<sup>18</sup>

## CoQ10 SUPPRESSES THE H1N1 FLU VIRUS

The H1N1 flu virus has been in the spotlight in recent years, and so one group of scientists decided to monitor its effect on mice given the virus. The mice were given ubiquinol from a week before infection to up to a week after infection with H1N1.

The ubiquinol was shown to suppress the virus possibly by activating an immune response, as it didn't demonstrate actual antiviral activity.<sup>19</sup> It is only unfortunate that this kind of information is gleaned from animal studies rather than human studies.

## GUM DISEASE AND WOUND HEALING

Coenzyme Q10 is somewhat less glamorously renowned for helping with gum disease. In one study, 30mg CoQ10 taken twice daily for 2 months led to a significant reduction in all the signs measured, including depth of periodontal pockets, levels of bleeding and discomfort (itching and stinging).

The study combined CoQ10 with the additional antioxidant vitamin E, which coQ10 helps to regenerate and so recycle.<sup>20</sup>

Not only is CoQ10 a useful antioxidant that helps to keep tissue healthy and free from damage, but it has also been shown to have wound healing properties. It does this by increasing cell proliferation as well as fibroblast mobility.<sup>21</sup> Fibroblasts are cells which produce substances used to make the collagen and ground substance that give tissue its structural integrity, and help to keep it hydrated enough to receive a continuous flow of healing resources. In addition, fibroblasts help to regulate inflammatory responses, including the switch from acute inflammation that is usually quickly resolvable, to chronic and persistent inflammation.<sup>22</sup>

## MUSCLE SPRAINS AND REPETITIVE STRAIN INJURY

Fibroblasts do this not only in the gums, but in all the connective tissue in the body, including muscles and the fascia that surrounds and infuses them. This means that coenzyme Q10 may be useful in resolving inflammation and injury throughout the body, from tennis elbow to muscle sprains to repetitive strain injury (RSI). Coenzyme Q10 has also been shown to regulate gene expression in skeletal muscle and so affect its behaviour and wound healing capacity.<sup>23</sup> Its additional role in improving energy production in the cells' mitochondria would logically help to fuel all this activity.

There is also evidence to support the use of coenzyme Q10 with muscular dystrophies, a group of genetic conditions characterised by muscle weakness and loss of muscle tissue. Patients with muscular dystrophy taking CoQ10 supplements showed improvements in exercise capacity, heart function, and overall quality of life.<sup>24</sup>



# FOOD SOURCES OF CoENZYME Q10

So with all these amazing health benefits, you must be wondering by now how you can improve your coenzyme Q10 levels. We make most of our own CoQ10, and can do so from one of two amino acids: tyrosine and phenylalanine, with the assistance of vitamin B6. Tyrosine can be found in meat, dairy and eggs as well as almonds, avocados and bananas, and phenylalanine is available from fish, meat, sesame seeds and lentils.

A small percentage of our CoQ10 quota is available ready made in our diet. Just as CoQ10 is present in every cell in the human body, it is also ubiquitous in meat and fish, in particular the organ meats such as liver,

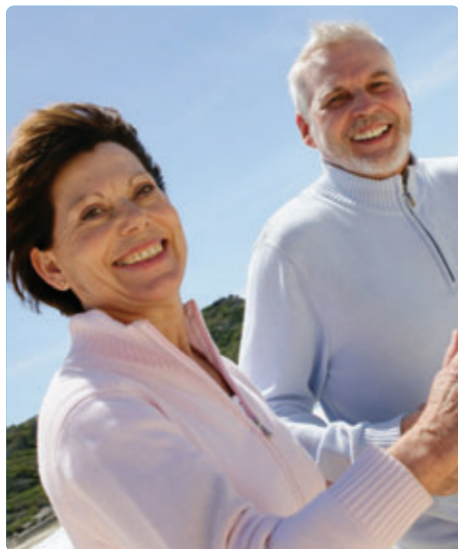
kidneys and heart. Herring and trout are particularly good fish sources. CoQ10 is also present in the germs of wholegrains, as well as sesame seeds, peanuts and pistachios, and broccoli and cauliflower.



“We make most of our own CoQ10, and can do so from one of two amino acids: tyrosine and phenylalanine, with assistance of vitamin B6”

## AGE-RELATED MACULAR DEGENERATION

Studies have shown that levels of coenzyme Q10 in the retina can decrease by approximately 40% as we age. The resultant lowering in both antioxidant activity and ATP (energy) production has been linked to age-related macular degeneration.<sup>25</sup> A 2005 study gave 106 patients with early age-related macular degeneration either a placebo or a combination of fish oil, acetyl-L-carnitine and CoQ10, and found significant improvement in the treated group.



## MALE FERTILITY

Male fertility has been an increasing problem in recent years, with sperm count and quality often reduced. Coenzyme Q10 has improved the sperm count as well as the sperm motility and morphology in infertile men in a Middle Eastern study. Again, this could be due to a combination of enhanced energy production, genetic regulation and antioxidant activity.<sup>26</sup> CoQ10 is also able to recycle vitamin E, which has also been shown to aid fertility in men.

## HELPING THOSE WITH HUNTINGDON'S DISEASE

Huntingdon's disease and Parkinson's disease are both neurological disorders with extremely debilitating effects.

Huntington's disease is characterised by the presence of a faulty gene on chromosome 4. This gene produces a protein that interferes with each of the 2 main stages of ATP production, including the final stage described above where CoQ10 is involved. As the brain and nervous system is deprived of energy and exposed to more oxidative stress, its ability to function deteriorates, leading to the typical symptoms of slight uncontrollable muscle movements, difficulty swallowing and breathing, poor short term memory and concentration, depression and mood swings.

As well as being necessary for electron transport in the final stage of energy production, coenzyme Q10 may also have a role in making sure there is enough oxygen available to make ATP efficiently. When the mitochondria cannot make ATP in the usual way, usually because oxygen levels are too low, they switch to a far less efficient method called fermentation, where lactate is produced as a by-product. Lactate levels measured in Huntington's disease patients taking coenzyme Q10 have been shown to drop, and then to rise again once the CoQ10 treatment was stopped, demonstrating CoQ10's importance in the more efficient and healthy form of energy production.<sup>27</sup>

In another study, the progression of disease slowed enough with CoQ10 supplementation to allow Huntington's patients an extra year of independent living.<sup>28</sup>

## PROTECTION FROM PARKINSON'S DISEASE

Coenzyme Q10 has also been shown to slow down functional decline in Parkinson's patients. Parkinson's disease is caused by the loss of brain cells that produce the neurotransmitter dopamine, and has obvious motor (movement-related)

symptoms such as tremors, slowness and muscle rigidity. It can also result in symptoms such as pain, depression, constipation and sweating.

One study gave Parkinson's patients varying levels of coenzyme Q10 together with vitamin E, or a placebo of just vitamin E on its own. The group that received the largest dose of coenzyme Q10, 1,200 mg per day, had 44 per cent less decline in both mental function and motor function, as well as ability to carry out daily activities such as feeding or dressing themselves. The greatest benefit was seen with activities of daily living. The groups that received lower levels of Q10 benefitted in a similar way but to a lesser extent. All groups showed a significant increase in energy production within their mitochondria.<sup>29</sup>





“Due to the promising research into coenzyme Q10 with Huntington’s disease and Parkinson’s disease, some scientists are now urging for further research into how CoQ10 may benefit people with Alzheimer’s disease”

Ubiquinol has also been shown to protect against a specific neurotoxin called MPTP that has been associated with Parkinson’s disease. As one would expect, ubiquinol has been more successful in this respect than ubiquinone.<sup>30</sup>

Interestingly, the cerebrospinal fluid of people with Parkinson’s has been shown to contain more ubiquinone than ubiquinol – thought to be the result of ubiquinol working hard as an antioxidant to protect the central nervous system, and being oxidised to ubiquinone in the process.<sup>31</sup>

## ALZHEIMER’S AND OTHER NEUROLOGICAL DISEASES

Due to the promising research into coenzyme Q10 with Huntington’s disease and Parkinson’s disease, some scientists are now urging for further research into how CoQ10 may benefit people with Alzheimer’s disease. These scientists describe Alzheimer’s as a “neurodegenerative disease with known defect in the inner mitochondrial membrane”, which would suggest that patients would benefit from CoQ10 therapy in a similar way.<sup>32</sup>

## AND FINALLY

Coenzyme Q10, or ubiquinol in its more active form, is so named because it is ubiquitous, i.e. found everywhere in the body, and each and every one of our hundred trillion or so cells relies on it for its livelihood. With such fundamental roles in keeping us healthy, it is easy to see how CoQ10 deficiency is associated with such a broad spectrum of disease. Coenzyme Q10 is important for the health of our hearts, brains,

### WHY SUPPLEMENT WITH COENZYME Q10?

With coenzyme Q10 deficiency, in particular ubiquinol deficiency, linked to so many diseases and conditions, and knowing that we tend to struggle to convert ubiquinone to ubiquinol the older we get, you may wish to consider a ubiquinol supplement. In fact at any time of life it would be wise to consider what kind of assistance we can give to our body’s most essential functions, such as energy production, gene expression and protection for oxidative stress.

Levels of B6 also tend to decline as we get older, and without sufficient levels of B6 we cannot produce our own ubiquinol or ubiquinone.<sup>33</sup>

Coenzyme Q10 supplements come in both forms, so it is important to check that you are getting the more active ubiquinol. In terms of finding a good B6 supplement to take alongside it, the biologically active form of B6 is pyridoxal-5-phosphate.

If you are taking any kind of statin medication for high cholesterol, then you would also be well advised to consider CoQ10 supplementation. Research shows that statins significantly reduce plasma levels of both ubiquinone and ubiquinol, and so will negatively affect energy production, genetic expression and protection from damage in our blood vessels, as well as ubiquinol’s own cholesterol lowering activity.<sup>34</sup> How ironic that ubiquinol has been shown to lower cholesterol, and yet cholesterol medication will lower ubiquinol.

Supplements usually contain levels of 30mg and upwards, and the studies referred to above use an incredibly wide range. One study testing the safety and bioavailability of ubiquinol found it to be completely safe at all levels tested (90mg, 150mg and 300mg), and they observed good levels of absorption in the gastrointestinal tract.<sup>34</sup> Coenzyme Q10 is oil soluble, so a diet containing an appropriate amount of good quality fats and oils will help to optimise absorption.

muscles, nerves, liver, kidneys and much more. It regulates the expression of the genes we have inherited from our parents, and it helps us successfully carry those genes forward to the next generation. Whether it is carrying electrons through the mitochondrial dam to harness energy, or protecting us from oxidative stress, coenzyme Q10 is a small but crucial cog in the wheel that keeps us moving through life.

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This newsletter was co-written with and for NutriGold Ltd by Kirsten Chick, a well respected qualified Natural Nutritionist who is a member of the Federation of Nutritional Therapists. To find out more please visit [www.connectwithnutrition.co.uk](http://www.connectwithnutrition.co.uk).