

## Coenzyme Q10 for Cardiovascular Prevention

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Cardiovascular disease including stroke is the leading cause of death and disability worldwide and is an enormous economic burden to our societies [1]. Based on the latest statistics released for heart and stroke disease, an estimated 83,600,000 adults in the United State (US) (>30%) have one form or another of Cardiovascular Disease (CVD), including more than 90% with hypertension, 18% with Coronary Heart Disease (CHD), close to 10% with Myocardial Infarction (MI) and 8% with stroke. The total direct and indirect cost in the US alone for treatment of CVD (hospitalization, drugs, home healthcare, etc.) and lots of productivity and morbidity is estimated at close to \$315 billion US per year [2]. Thus prevention and early treatment of the major CV risk factors could provide huge savings in health care costs worldwide. Despite major advances in treatment of cardiovascular disease, the prevalence of hypertension, Ischemic Heart Disease (IHD) and stroke is still on the rise. Identifying optimal strategies for cardiovascular prevention and slow disease progression remains a therapeutic challenge.

In addition to diet and exercise, natural products and nutraceuticals are increasingly used in our societies to enhance health and prevention of chronic diseases [3-10]. One of the natural products which may have significant cardiovascular protective effect is coenzyme Q10 (CoQ10) [11-15]. CoQ10 is an ubiquinone and an endogenous anti-oxidant which is involved in mitochondrial energy production and preserving membrane integrity [12,14,16]. It has been shown to have beneficial effects in patients with coronary artery disease (CAD), CHF [12,14,17,18], hypertension [19,20], neuromuscular and neurodegenerative disorders [21,22] and migraine [23]. Patients who have lower serum CoQ10 concentrations have poorer prognosis from CHF [21], and those on long term statin therapy may have a decrease of plasma CoQ10 concentrations as a result of inhibition of HMG-CoA reductase. These patients may require supplementation with CoQ10 to reduce the risk of statin induced myopathy [11,21-26]. On the other hand, it has been suggested that CoQ10 may interfere with the cardio protective effect of the statins [27], which would deter the use of CoQ10 in patients requiring statins, and this controversy and conflicting opinion clearly warrants further investigation. There are also evidence to suggest that CoQ10 may be used to enhance the therapeutic effects of conventional medicines such as the statins, anti-hypertensive agents and perhaps others as well [19,28]. It has been suggested that CoQ10 may also be used to reduce cardio toxicity induced by anti-cancer drugs without interfering with their anti-tumor effect [29,30]. While the mechanism for the protective effect is not fully understood, it could be related to the anti-oxidant, anti-inflammatory and anti-ischemia properties of CoQ10 [17,31], which are important contributing factors for ischemia preconditioning and cardiovascular protection. Deficiency in CoQ10 could lead to mitochondrial and vascular endothelial dysfunctions resulting in CV and metabolic diseases [15,32,33]. Furthermore, there are evidence to suggest that CoQ10 may inhibit first pass metabolism by cytochrome P-450 isozymes (CYP450), which could enhance oral drug absorption and improve safety and efficacy profiles of many cardiovascular drugs [34,35], and that they may be incorporated in traditional cardiovascular drug therapies [13,14,36].

In summary it is conceivable CoQ10 has significant potential for cardiovascular prevention as a standalone nutritional supplement

and as an adjunct to complement the therapeutic effect of traditional cardiovascular medicines. However, there are a number of challenges which need to be overcome in order to exploit the full potential of CoQ10 in cardiovascular therapy. Firstly, the high molecular weight and lipophilicity of CoQ10 makes it poorly water soluble and consequently leads to low systemic availability after oral dose. This may require development of suitable formulation strategies such as using suitable carriers like liposome's, microspheres, nanoparticles or using pro-drugs or derivatives of CoQ10 to enhance oral absorption [16,37]. Secondly, development of an effective fortification strategies may be necessary to adopt CoQ10 in food processing (e.g. in animal feed, genetic modification in cereal crops, addition of CoQ10 to processed food products) which will allow greater dietary consumption of the natural product in the general population [38]. Thirdly, despite its promising potential for health management, there is a need for better understanding of the importance of anti-oxidants in mitochondrial energetic and whole body energy metabolism in disease management, and their contribution to the safety and effectiveness of traditional cardiovascular medicines. Finally, more data about the long-term safety and the true cost-effectiveness and risk-benefit ratio of CoQ10 will further advance our knowledge of using the natural product as a potential therapeutic agent for widespread use in a general population and for management of CVD [10].

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