Mito-PQQ™

To support optimal mitochondrial biogenesis

By David Brady, ND, DC, CCN, DACBN & Suzanne Copp, MS

THIS INFORMATION IS PROVIDED FOR THE USE OF PHYSICIANS AND OTHER LICENSED HEALTH CARE PRACTITIONERS ONLY. THIS INFORMATION IS INTENDED FOR PHYSICIANS AND OTHER LICENSED HEALTH CARE PROVIDERS TO USE AS A BASIS FOR DETERMINING WHETHER OR NOT TO RECOMMEND THESE PRODUCTS TO THEIR PATIENTS. THIS MEDICAL AND SCIENTIFIC INFORMATION IS NOT FOR USE BY CONSUMERS. THE DIETARY SUPPLEMENT PRODUCTS OFFERED BY DESIGNS FOR HEALTH ARE NOT INTENDED FOR USE BY CONSUMERS AS A MEANS TO CURE, TREAT, PREVENT, DIAGNOSE, OR MITIGATE ANY DISEASE OR OTHER MEDICAL CONDITION.

Mitochondria, whose main function within cells is the production of energy in the form of adenosine triphosphate (ATP), require continuous regeneration throughout life. These vital cellular components, nicknamed the "powerhouse of the cell," are a primary site of free radical production and are particularly susceptible to damage from oxidative stress. Because aging is associated with deterioration at the cellular level, proper *mitochondrial biogenesis* – growth and division of pre-existing mitochondria – is critical for the promotion of healthy aging, as well as optimal energy production, and protection from reactive oxygen species (oxidative stress). Mitochondrial dysfunction, with its associated ATP deficiency, is related to a host of diseases, including chronic fatigue syndrome, degenerative neurological disorders, cardiovascular disease, obesity, and even diabetes, as reduced mitochondrial biogenesis has been demonstrated in metabolic syndrome.

Mito-PQQ™ is designed to help support optimal mitochondrial biogenesis, which not only encompasses the formation of new mitochondria, but is also accompanied by variations in size, number, and mass or density of the mitochondria. Thus, the focus of **Mito-PQQ™** is on making new mitochondria and increasing their density (as opposed to strictly supporting mitochondrial function). With an increase in mitochondria density, more ATP is formed, which translates into more energy as well as a greater capacity to burn fat for energy as opposed to storing it as body fat.

Highlights of Mito-PQQ™

Pyrroloquinoline quinone (PQQ) is a water-soluble, vitamin-like compound, although not a vitamin itself. While the body cannot make PQQ, it can be found in a variety of foods including parsley, green tea, green peppers, kiwi and papaya. It is an enzyme cofactor possessing antioxidative, neuroprotective, and cardioprotective properties:

- **Cardioprotective:** PQQ was shown to reduce myocardial infarct size (site of cardiac muscle death due to blocked blood supply in a heart attack) and protect the mitochondria from resultant oxidative damage (*Zhu BQ, et al, J Cardiovasc Pharmacol Ther. 2006*).
- **Neuroprotective:** PQQ helps to prevent neuron cell death from oxidation and enhances the production of nerve growth factor (NGF), which is important for the growth and maintenance of brain and peripheral nerve cells. NGF is essential for the survival of sympathetic and sensory neurons. Research suggests that PQQ's involvement with NGF could play a beneficial role in helping to prevent neural diseases in the central and peripheral nervous system. (*Urakami T, et al, Biofactors. 1995-1996*).

PQQ & Mitochondrial Biogenesis

PQQ works as a potent antioxidant and actually encourages mitochondrial biogenesis. This attribute distinguishes it from other anti-aging and energy-stimulating nutrients such as l-carnitine, which works via a transport system, shuttling fat inside the mitochondria where it can be burned as fuel. PQQ stimulates cell-signaling pathways that can initiate the potential for increased mitochondrial production. It works by influencing the activity of PGC-1, a major protein involved in the regulation of energy metabolism and mitochondrial biogenesis (*Gleyzer N, et al, Mol Cell Biol. 2005*). For this reason, PQQ may be beneficial in a wide range of conditions associated with mitochondrial dysfunction.

Rhodiola rosea, also known as "golden root," is a popular adaptogenic herb, which means it works in the cells to normalize their function and stimulate healing. Adaptogens such as Rhodiola rosea assist the body in adapting to stress, anxiety, and fatigue by helping to support the adrenal glands.

Research shows that Rhodiola rosea is a powerful herb for enhancing mitochondrial energy production. It works by activating the synthesis of ATP in mitochondria and stimulating reparative energy processes (*Abidov M, et al, Bull Exp Biol Med. 2003*). Rhodiola rosea is also a potent antioxidant and helps to defend against oxidative damage to the nervous system, as well as the mitochondria.

Similar to PQQ, Rhodiola rosea exhibits both neuroprotective and cardioprotective traits. Its affect on the central nervous system mainly stems from its ability to influence and stabilize levels of the neurotransmitters dopamine, serotonin, and norepinephrine in the brain. It also helps to allow serotonin's precursor tryptophan to cross the blood brain barrier.

Supplement Facts

Serving Size 2 capsules
Servings per container 30

Amount Per Serving		% Daily Value
Rhodiola (*Rhodiola rosea*)(root) [standardized to contain 3% rosavins and 1% salidroside]	300 mg	*
Pyrroloquinoline quinone disodium salt (as Bio-PQQ™)	20 mg	*

*Daily Value not established.

Other Ingredients: Microcrystalline cellulose, vegetable stearate.

Rhodiola rosea is cardioprotective in that it works to prevent stress-induced cardiac damage by decreasing myocardial catecholamine levels and reducing adrenal catecholamine release during times of stress (*Maslova LV, et al, Eksp Klin Farmakol.1994*). These catecholamines are part of the sympathetic nervous system and are the neurotransmitters released by the adrenal glands in response to stress.

How to Take:

- Take two capsules per day
- Do not take close to bedtime, due to its potential energizing effect
- Possible contraindication with Rhodiola rosea – may be too stimulating for anyone with anxiety or panic attacks
- Can be taken together with **Mitochondrial NRG™** for maximum mitochondrial support

References

1. Mitochondrial biogenesis and healthy aging. López-Lluch G, Irusta PM, Navas P, de Cabo R. Exp Gerontol. 2008 Sep;43(9):813-9. Epub 2008 Jul 9.
2. Pyrroloquinoline quinone modulates mitochondrial quantity and function in mice. Stites T, Storms D, Bauerly K, Mah J, Harris C, Fascetti A, Rogers Q, Tchaparian E, Satre M, Rucker RB. J Nutr. 2006 Feb;136(2):390-6.
3. Control of mitochondrial transcription specificity factors (TFB1M and TFB2M) by nuclear respiratory factors (NRF-1 and NRF-2) and PGC-1 family coactivators. Gleyzer N, Vercauteren K, Scarpulla RC. Mol Cell Biol. 2005 Feb;25(4):1354-66.
4. Comparison of pyrroloquinoline quinone and/or metoprolol on myocardial infarct size andmitochondrial damage in a rat model of ischemia/reperfusion injury. Zhu BQ, Simonis U, Cecchini G, Zhou HZ, Li L, Teerlink JR, Karliner JS. J Cardiovasc Pharmacol Ther. 2006 Jun;11(2):119-28.
5. Stimulation of nerve growth factor production by pyrroloquinoline quinone and its derivatives invitro and in vivo. Yamaguchi K, Sasano A, Urakami T, Tsuji T, Kondo K. Biosci Biotechnol Biochem. 1993 Jul;57(7):1231-3.
6. Synthesis of esters of coenzyme PQQ and IPQ,and stimulation of nerve growth factor production. Urakami T, Tanaka A, Yamaguchi K, Tsuji T, Niki E. Biofactors. 1995-1996;5(3):139-46.
7. Pyrroloquinoline quinone preserves mitochondrial function and prevents oxidative injury in adultrat cardiac myocytes. Tao R, Karliner JS, Simonis U, Zheng J, Zhang J, Honbo N, Alano CC. Biochem Biophys Res Commun. 2007 Nov 16;363(2):257-62. Epub 2007 Aug 14.
8. Pyrroloquinoline quinone stimulates mitochondrial biogenesis through cAMP response element-binding protein phosphorylation and increased PGC-1alpha expression. Chowanadisai W, Bauerly KA, Tchaparian E, Wong A, Cortopassi GA, Rucker RB. J Biol Chem. 2010 Jan 1;285(1):142-52. Epub 2009 Oct 27.
9. Effect of extracts from Rhodiola rosea and Rhodiola crenulata (Crassulaceae) roots on ATP content in mitochondria of skeletal muscles. Abidov M, Crendal F, Grachev S, Seifulla R, Ziegenfuss T. Bull Exp Biol Med. 2003 Dec;136(6):585-7.
10. Chronic Rhodiola rosea extract supplementation enforces exhaustive swimming tolerance. Lee FT, Kuo TY, Liou SY, Chien CT. Am J Chin Med. 2009;37(3):557-72.
11. Evidence-based efficacy of adaptogens in fatigue, and molecular mechanisms related to their stress-protective activity. Panossian A, Wikman G. Curr Clin Pharmacol. 2009 Sep;4(3):198-219. Epub 2009 Sep 1.
12. [The cardioprotective and antiadrenergic activity of an extract of Rhodiola rosea in stress]. [Article in Russian] Maslova LV, Kondrat'ev BIu, Maslov LN, Lishmanov IuB. Eksp Klin Farmakol. 1994 Nov-Dec;57(6):61-3.
13. Rhodiola rosea: a possible plant adaptogen. Kelly GS. Altern Med Rev. 2001 Jun;6(3):293-302.
14. Reducing mitochondrial decay with mitochondrial nutrients to delay and treat cognitive dysfunction, Alzheimer's disease, and Parkinson's disease. Liu J, Ames BN. Nutr Neurosci. 2005 Apr;8(2):67-89.