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The powerhouse of the body

Examining the far-reaching benefits of healthy mitochondria and how to support these power centers

Mitochondria, often referred to as the powerhouse of the cell, are vital to cell survival. Present in nearly all types of human cells, they generate the majority of the body's adenosine triphosphate (ATP), the molecular unit of currency that powers metabolic processes. Mitochondria do much more than just produce energy.

They also produce chemicals that that body needs for other purposes, break down waste products so they're less harmful, and recycle some of those waste products to save energy. Cell function is not always the first line of thought for nutritional supplement seekers, because many are not educated on the subject and it can be challenging to notice a subjective boost in mitochondrial function. However, the science is clear that healthy mitochondria play a role in supporting important indicators of cognition, physical performance and aging.

Mitochondrial decline

Cells have herds of mitochondria, which divide like bacteria in a process known as mitochondrial biogenesis. A healthy rate of mitochondrial biogenesis is crucial for maintaining healthy mitochondria, and therefore cells, with age. When damaged, some mitochon-

dria are removed, a function of cell activity known as mitophagy. This quality-maintenance mechanism that facilitates the removal of damaged mitochondria from the cell is particularly important to forestalling aging and keeping cells healthy.

Dysfunctional regulation of mitochondrial processes contributes to oxidative stress and cell death during the aging process. With advancing age, a cell's mitochondria may become damaged and can cause significant harm. The capacity for mitochondrial biogenesis also diminishes with age, which is an important parameter in the mitochondrial dysfunction associated with aging (Fannin et al., 1999; Sugiyama et al., 1993). Further research has found that the decline in mitochondrial turnover caused by reduced mitochondrial biogenesis and inefficient mitochondrial degradation seems to be a particularly crucial factor in the aging process (Terman et al., 2010).

Repairing mitochondrial damage

There are a number of measures people can take to realize higher levels of cell performance. Exercise of all types produces energy and can boost mitochondrial function, but high intensity interval training (HIIT) – a strategy of alternating short bursts of exercise with short periods of rest – has proven especially advantageous (Menshikova et al., 2006). Other habits that have shown promise in supporting mitochondria include a high fat and low-carb, low-protein ketogenic diet and minding sleep hygiene, which means taking measures to ensure better quality sleep like avoiding cell phone use before bed.

Complementing a healthy lifestyle with nutritional supplements that have been proven to enhance mitochondrial function can energize cells and protect them from damage. Pyrrolo-quinoline quinone (PQQ), manufactured by Mitsubishi Gas Chemical as MGCPQQ®,

a redox-active o-quinone found in various foods and mammalian tissues, has received an increasing amount of attention because of a number of health benefits that can be attributed to its ability to enhance mitochondrial biogenesis (Chowanadisai et al., 2010).

Dietary MGCPQQ® supplementation has been revealed to enhance mitochondrial function and biogenesis and improve metabolic homeostasis in mice and rats, and its function and efficacy has been studied in double-blinded human clinical trials. The ingredient increases the NAD⁺/NADH ratio, promoting the conversion of lactic acid into pyruvic acid to activate mitochondria. It also induces deacetylation of PGC1- α , enhancing the biogenesis of mitochondria. In fact, intake of 20 mg of MGCPQQ® resulted in the increase of mitochondria by 30 %, as well as increases of NAD⁺/NADH ratio and the ATP level in the cell. (Akagawa et al., 2016; Saihara et al., 2017).

What healthy mitochondria means for the body

That mitochondrial function declines with age, and that properly functioning mitochondria are crucial for longevity are irrefutable facts. Strategies directed at improving mitochondrial quality and function can have far-reaching health benefits, including improved sleep, vitality and cognitive functions.

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We Invest in Quality.



Mitsubishi MGPQQ® powder (Photo®: Mitsubishi Gas Chemical)

MGPQQ® has shown to have positive effects on stress, fatigue and sleep. In a clinical trial, 17 adult female subjects ingested 20 mg of MGCPQQ® daily for eight weeks. The subjects were measured for vigor, fatigue, tension-anxiety, depression, anger-hostility and confusion according to the Profile of Mood States-Short Form before and after the eight-week trial. Scores for all six mood states significantly improved following supplementation. Subjects were also tested according to the Oguri-Shirakawa-Azumi Sleep Inventory and showed significant improvement in drowsiness at awaking, sleep onset and maintenance and sleep duration (Nakano, M. et al., 2012). Studies conducted using this supplement have shown no adverse effects.

One randomized, placebo-controlled, double-blinded study examined the effect of MGCPQQ® on cognitive functions in 41 healthy, elderly subjects. The subjects were orally administered 20 mg of MGCPQQ® per day or a placebo for 12 weeks. The study measured cognitive function by monitoring selective attention using the Stroop and reverse Stroop tests, which measure subjects' ability to name the color of an incongruent stimulus – for example, the word “green” written in red. The subjects' visual-spatial cognitive function was also measured using a laptop tablet. In the Stroop test, the MGCPQQ® group performed significantly better than the placebo group. In the Touch M test, the stratification analyses dividing each group into two groups showed that the score significantly increased in the lower group of subjects administered MGCPQQ® (Ito T. et al., 2016).

Another positive effect of MGCPQQ® is its enhancement of Nerve Growth Factor (NGF) production. NGF is a protein composed of 118

amino acid residues and is well known as a neurotrophic factor required for the development and maintenance of peripheral sympathetic and sensory neurons. The supplement ingredient has shown to have a stimulatory effect on NGF synthesis and secretion. Studies conducted using it support that it can potentially stimulate Nerve Growth Factor (NGF), and that the ingredient may play a role in the growth and recovery of damaged nerves and organs (Murase K. et al., 1993; Yamaguchi K. et al., 1996). Neurons are susceptible to lethal damage from oxidative stress, and neuronal death is regarded as a causal factor in some cognitive disorders. By functioning as an antioxidant as well as an NGF enhancer, MGCPQQ® has shown to inhibit neurotoxicity.

Quality and safety

MGCPQQ® is produced using a proprietary fermentation technology that does not include chemical synthesis, but rather the purification of natural PQQ disodium salt derived by bacterial fermentation. PQQ may also be produced through synthetic processes, but these processes may use reagents and solvents which are not recognized as food additives or contain hazardous chemicals. It is the only PQQ ingredient backed by robust clinical safety data – supported by Mitsubishi Gas Chemical's long research history – and each lot of it is tested to ensure it is of food-grade standards.

The ingredient is registered on the European Union's list of Novel Food Ingredients. MGCPQQ® (known as BioPQQ in the United States and Canada) has NDI (New Dietary Ingredient) notification from the U.S. Food and Drug Administration (FDA), and GRAS (Generally Recognized as Safe) status. It has also received the Informed-Choice and Informed-Sports supplement manufacturing certification, ensuring that every batch is tested for WADA-banned ingredients and held to the highest safety standard. It is certified as a food ingredient by Japan's MHLW (Ministry of Health, Labour and Welfare), and is available to nutraceutical manufacturers in the European Union.

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