Life Extension Magazine®

PQQ Revitalizes Aging Cells

PQQ promotes production of new mitochondria. Human studies continue to validate its efficacy. A recent animal model showed PQQ increased lifespan by 30%.

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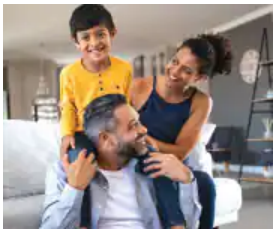


The **mitochondria** are referred to as the **energy** powerhouses of our cells.

But like parts in a machine, they become damaged and dysfunctional over time.[1]

Mitochondrial dysfunction is associated with an array of age-related health problems, including insulin resistance, macular degeneration, cognitive decline, and osteoarthritis.[2-4]

A compound called **pyrroloquinoline quinone(PQQ)** helps stimulate the creation of healthy ***new mitochondria***.[5-8]

This has the potential to ward off multiple health issues including blood sugar dysregulation, neurodegeneration, and more.[9-12]

In an animal model used to study **longevity**, PQQ increased **lifespan** by an average of **30%**.[13,14]

Consider including **10 mg** to **20 mg** of **PQQ** each day as part of an anti-aging program.

What Is PQQ?

PQQ (pyrroloquinoline quinone) is a water-soluble, vitamin-like compound found in plants, yeast, and certain bacteria.[15]

PQQ plays a key role in supporting **mitochondria**. These "power plants" of cells generate the energy that cells need to **function**.[16]

Mitochondria are critical regulators of cell processes, including immune system activation, cellular signaling, and inflammation.[1,17,18]

As we age, mitochondria become damaged.[19] That can interfere with the **function** of many organs and tissues, especially ones with **higher energy requirements**. These include the heart, brain, retina, kidney, liver, pancreas, and musculoskeletal system.[20]

Supporting the Mitochondria

PQQ fortifies mitochondria in a few distinct ways:

- In animal models, it has been shown to enhance the action of **enzymes** that help mitochondria increase energy production.[21,22]
- In mice, it has improved **mitophagy**, the clearing out of *defective* mitochondria.[23] Damaged mitochondria must be cleared to ensure cell survival.[24]
- It promotes the creation of healthy, **new mitochondria** to replace those that are damaged or dysfunctional.[5,25]

PQQ boosts the synthesis of new mitochondria by activating a protein called **PGC-1 alpha**.[11,26]

In a study of healthy men who completed a 6-week aerobic training program, those given **20 mg** of **PQQ** daily more than ***doubled*** their **PGC-1 alpha** levels. Men given a **placebo** had a significantly smaller increase of this mitochondrial-generating protein.[6]

In mouse models, PQQ helps undo the harm caused by dysfunctional mitochondria, reducing the tendency of **chronic inflammation**, and preventing **oxidative damage**.[22,27]

Promoting Longevity

The potential benefits of PQQ are so extraordinary, one of the world's leading nutritional scientists has called it a "**longevity vitamin**."[28]

Increasing the number of healthy mitochondria can preserve youthful function and vitality.

Preclinical research has shown PQQ helps prevent or delay chronic, low-grade inflammation in cells. This inflammation is so closely tied to the aging process, it is sometimes referred to as **inflammaging**.[29]

When human lung cells were pretreated with PQQ and then exposed to **inflammatory cytokines** (signaling proteins), fewer dysfunctional **senescent cells** developed, compared to untreated cells.[29] These senescent cells are a major driver of disease and accelerated aging.

Other research has shown PQQ promotes the activity of longevity genes.[29] It also promotes resistance to **oxidative stress**, which helps ward off premature aging.[13]

These benefits add up. In a roundworm model used to study longevity, PQQ was found to **increase lifespan** by an average of **30%**.[13,14]

Brain and Nerve Protection

Mitochondrial function is vital for the health of the **brain**, which uses about **20%** of the energy of the body.[16]

Mitochondrial production and function are *impaired* in both **Alzheimer's** and **Parkinson's disease**.[30,31] Research suggests **mitophagy** is also impaired in these brain conditions.[24]

Animal models of Parkinson's disease show PQQ *reduces* the loss of neurons that produce **dopamine**.[32] This nerve messenger is essential for regulating movement of the body. Dopamine shortfalls lead to shaking, stiffness, and difficulty walking, hallmarks of Parkinson's.[33]

Preclinical research has also shown that PQQ *protects* nerve cells from damage from **beta-amyloid**, a harmful protein that accumulates in patients with Alzheimer's disease.[34]

An animal model suggests PQQ may even help reduce **brain damage** when taken before or shortly after a **stroke**.[35]

WHAT YOU NEED TO KNOW

PQQ Promotes Health and Longevity

- In aging cells, **mitochondria** become damaged, trigger inflammation, and produce insufficient energy.
- **Mitochondrial dysfunction** is associated with many age-related health problems, including insulin resistance, macular degeneration, brain disorders, and joint pain.
- **PQQ (pyrroloquinoline quinone)** is a compound that can promote the recycling of defective mitochondria and the creation of healthy, **new mitochondria**.
- In preclinical research, PQQ helps protect the health of the brain and eyes, reduce blood sugar and cholesterol, defend against kidney and liver damage, combat osteoporosis and osteoarthritis, and more

- PQQ is sometimes referred to as a "**longevity vitamin**." In roundworms, it increased lifespan by an average of **30%**.

Improved Eye Health

Age-related **macular degeneration** is a leading cause of blindness.[8]

Cell studies from eyes of human donors with macular degeneration show ***under-functioning*** **mitochondria** in the **retinal pigment epithelium**.[8]

Without enough energy, this tissue can't do its job.[8]

Abnormal mitochondrial function is also frequently found in **glaucoma** and **diabetic retinopathy**, two other conditions that can lead to blindness.[36]

In a recent preclinical study, scientists used PQQ to treat retinal pigment epithelial cells from human organ donors who had age-related macular degeneration.[8]

About half of the tissue samples had a **50%–350%** improvement in **mitochondrial function** of retinal pigment epithelial cells when **PQQ** was administered, compared to untreated donor cells.

Cells in the PQQ group also had a **59% increase** in production of **ATP,** the energy currency that cells use.

PQQ also regulates **antioxidant genes** in the retinal cells, helping protect them from further damage.[8]

Preserving Metabolic Health

Mitochondrial dysfunction can also contribute to **metabolic syndrome**, obesity, insulin resistance, type II diabetes, and cardiovascular disease.[21,37,38]

Scientists treated obese rats with PQQ for five weeks. These rats had been fed a high-fat, high-fructose diet to induce metabolic dysfunction.[21]

Compared to an untreated group of obese rats, **PQQ** significantly:

- Improved **blood sugar control**, **insulin levels**, and **insulin sensitivity**,
- Lowered harmful **inflammatory cytokines**, including TNF-alpha and IL-6, and
- Promoted **healthier blood lipid levels**, including total cholesterol, triglycerides, LDL ("bad") cholesterol, and HDL ("good") cholesterol.

PQQ may also help prevent unhealthy **heart enlargement**, based on promising results from a cell-based model. This type of heart enlargement, known as cardiac hypertrophy, can be caused by excessive free radicals and inflammation.[39]

In this preclinical research, PQQ ***decreased*** **free radicals** in human heart cells by up to **50%**. That could help reduce the risk of heart failure and other cardiac conditions.[39]

Averting Kidney and Liver Damage

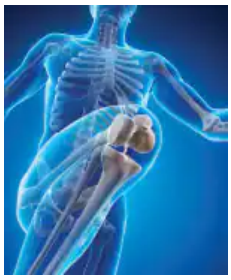
High blood sugar and diabetes often lead to **kidney damage**. PQQ may help counteract these causes of kidney problems.

In an animal model of diabetes, rats given **PQQ** for four weeks had a significant ***decrease*** in **free radicals** in kidney tissue.[40] **Structural damage** to the kidneys improved significantly and the kidneys worked better with PQQ, compared to the kidneys of untreated rats.

The **liver** is also vulnerable to the effects of metabolic dysfunction associated with diabetes and obesity.[41]

In a preclinical study of metabolic **fatty liver disease**, PQQ protected the liver from damaging fat accumulation. It did this by improving lipid metabolism, supporting the creation of new mitochondria, and boosting antioxidant protection.[42]

Supporting Musculoskeletal Health



Animal research has shown that PQQ can help combat the bone disease **osteoporosis**, in part by increasing **antioxidant** protection.[43-45] Osteoporosis occurs when bone breakdown, a normal process, outpaces bone building.

One potential contributing factor for osteoporosis is an excess of free radicals that hastens bone breakdown. Hormone changes that happen with aging accelerate this process.[45]

In a postmenopausal animal model, PQQ was as effective ***as estrogen replacement*** at preventing **bone loss**—but without the side effects of hormone therapy.[45]

The antioxidant benefits of PQQ may also support the healing of **bone fractures**, according to another study using a postmenopausal animal model.[27]

Similarly, other research shows that the progression of **osteoarthritis** is related to **oxidative stress**.[43]

Cartilage cells are rich in mitochondria. Disruption of **mitochondrial function** increases oxidative stress and inflammation and damages the cartilage that cushions joints.[46,47]

In preclinical research, PQQ significantly *decreased* mitochondrial damage and dysfunction caused by inflammatory cytokines in the mitochondria of **cartilage**.[48]

Supporting mitochondrial health is crucial for healthy aging.

Summary

Mitochondria, the energy factories of cells, play a key role in regulating the **aging** process and promoting longevity.

As we age, our mitochondria tend to wear out and become less likely to be replaced.

PQQ is a vitamin-like compound that promotes the production of healthy ***new mitochondria***. It is also a potent **antioxidant**.

By supporting mitochondria, PQQ promotes the health of organs that are especially vulnerable to energy deficits and oxidative stress, including the **brain**, **eyes**, and **heart**.

In an animal model, it increased **longevity** by **30%**.

Consider taking **10 mg** to **20 mg** of **PQQ** daily as part of an anti-aging program.

If you have any questions on the scientific content of this article, please call a **Life Extension** Wellness Specialist at 1-866-864-3027.

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