

Cellular Health: Nutraceutical Support

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Our bodies are made up of tens of trillions of cells.¹ They are the fundamental building blocks of our tissues, organs and virtually everything that makes us a living organism. Naturally, it is vital that our cells stay healthy so they can function optimally, including the ability to replicate and make new cells as needed.

Despite the importance of maintaining optimal cellular function, most of us never think about what we can do to help support cellular health. Rather, we think in more macro terms like what we can do to improve the health of our joints or cardiovascular system. However, if we pay some attention improving cellular health, it is more likely that everything will function better. This article will discuss a few nutraceuticals that can play a key role in supporting cellular health. But first, let's take a brief look at the biology of the cell so that you can better appreciate how the nutraceuticals perform their valuable tasks.

Biology of a Cell

In general, our cells are comprised of a cell membrane, a nucleus, cytoplasm and various organelles. To understand the role that these components play, it helps to use a chicken egg as an analogy:

- the shell is like the cell membrane, protecting the cell and keeping it everything on the inside that's supposed to be there
- the yolk is like the nucleus, containing all of the genetic information neces-

sary to reproduce the cell

- the egg white is like the cytoplasm, a gel-like substance that provides internal structure to the cell.

This is not a perfect analogy since there are significant differences between a chicken egg and a cell. For example, eggshells are designed to keep foreign substances out of the egg. Cell membranes, however, are made of phospholipid bilayer with certain proteins embedded in it with pores that allow nutrients to enter and waste material to leave the cell. The membrane also receives and transmits certain biochemical signals. Another example is the various organelles within the cytoplasm are not really analogous to anything within the egg white, yet each of the organelles has important roles to play. One such organelle is the mitochondrion. Mitochondria can be considered as cellular power plants because they generate adenosine triphosphate (ATP) which cells use as a source of energy.

Phosphatidylserine for Cellular Membrane Support

Phosphatidylserine (PS) is the most abundant phospholipid in our cell membranes, comprising much of the structure of the phospholipid bilayer.² Furthermore, PS is not just a passive component of the membrane, but rather plays an important role in the cell's internal environment, signal transduction (activating a specific receptor located on the cell surface or inside the cell), secre-

tory vesicle release (transport of hormones, neurotransmitters or other cargo from an organelle to specific sites at the cell membrane), cell-to-cell communication and cell growth regulation.^{3,4,5} PS is also a component of the mitochondrial membrane, where it might function as a metabolic reservoir for other phospholipids.⁶ Although the body obtains most of its PS from dietary sources, PS is only present in small quantities in most foods.⁷ Consequently, supplementation provides a viable source of PS, and has been shown in research to affect neuronal membranes, cell metabolism, and specific neurotransmitter systems.⁸ Given the role of PS in cellular health, it is not surprising that human clinical studies have demonstrated that supplementation has been able to improve:

- age-related memory impairment⁹⁻¹²
- Alzheimer's and other dementias¹³⁻¹⁶
- attention-deficit hyperactivity disorder (ADHD) in children¹⁷⁻¹⁹
- cognitive function and learning in students²⁰
- depression in geriatric patients²¹
- muscle soreness associated with exercise and overtraining²²⁻²⁴

Doses of 100-300 mg PS have been most commonly used in human research.

PQQ and CoQ10 for Mitochondrial Support

Pyroloquinoline quinone (PQQ), a natural substance made by the body, is an

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essential cofactor in important, enzyme-catalyzed reduction-oxidation (redox) reactions, including the production of ATP.²⁵ Furthermore, PQQ has been shown to stimulate mitochondrial activity, including the production of new mitochondria (mitochondrial biogenesis).²⁶ Research in mice demonstrated that those supplemented with PQQ had 20-30 percent more mitochondria than PQQ deficient mice.²⁷ This ability to stimulate the production of new mitochondria has significant ramifications for increasing ATP production (i.e. more mitochondria to make ATP). In addition, PQQ was found to be an effective antioxidant protecting mitochondria against oxidative stress-induced lipid peroxidation, protein carbonyl formation and inactivation of the mitochondrial respiratory chain. In human clinical research, supplementation with PQQ was shown to:

- promote cognitive function^{29,30}
- reduce markers of inflammation³¹

Doses of 20 mg PQQ have been most commonly used in human research.

Coenzyme Q10 (CoQ10) is found in virtually all cells in the body. Within the cell, 25 to 30 percent of total CoQ10 is found in the nucleus, 40 to 50 percent in mitochondria, 15 to 20 percent in the microsomes and 5 to 10 percent in the cytosol (a major component of cytoplasm).^{32,33} CoQ10 acts as an antioxidant, a membrane stabilizer and as a cofactor in many metabolic pathways, particularly in the production of adenosine ATP in mitochondria by functioning as an electron carrier.³⁴⁻³⁸ In addition, CoQ10 provides a source of needed protons to special digestive enzymes (from lysosomes) that clean up cellular debris within cells,³⁹ and acts as a powerful, fat-soluble antioxidant in cells, inhibiting lipid peroxidation in cell membranes, DNA and low-density lipoproteins (LDL).⁴⁰ The human clinical research on CoQ10 is far too extensive to summarize in this article.

While a range of CoQ10 doses have been used in human research, supplementation with at least 100 mg of CoQ10 daily is capable of significantly reducing oxidative damage⁴¹⁻⁴³ and promoting energy/physical performance.^{44,45}

Conclusion

In addition to those presented here, there are many more nutraceuticals that support cellular health. However, given space restrictions, I've limited my discussion to the contributing roles of PS, PQQ and CoQ10. Nevertheless, supplementation of these three nutraceuticals has great potential to promote healthy cellular function, especially with regard to mitochondria and ATP production. **VR**

For the full list of references, visit www.vitaminretailer.com

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