



-Clinical Perspective-

Mitochondrial Support for Immune Enhancement

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Immune Support through Nutraceuticals

The human immune system is a complex network involving numerous cells and mechanisms designed to protect the body from pathogens and infections. When working properly, the immune system fends off pathogens; however, when these systems fail, or are overwhelmed by a pathogen, the immune system becomes compromised, leading the way for infection and other diseases.

The health of the immune system itself is often considered to be important for treating or preventing infectious diseases, but can be difficult to achieve, especially in those already suffering with an immunodeficiency such as AIDS, chronic fatigue syndrome, or cancer. The roles of diet, lifestyle, stress reduction and nutraceuticals have all been studied for their ability to improve immune system function. Researchers at the Department of Medicine at the University of California at San Francisco Medical School, led by Dr. Jon Kaiser, have been using a blend of vitamins, minerals and antioxidant therapy to improve immune function in HIV-infected patients. They have recently reported the results of some of their work in a double-blind, placebo-controlled trial.¹

We asked Dr. Kaiser to share with us his philosophy on why this micronutrient therapy is able to support the immune system in these patients, as well as others with less severe immune dysfunctions. His answer follows.

Mitochondrial Support for Immune Enhancement

All cellular systems depend on an adequate supply of energy. Hepatocytes require adequate energy to detoxify unhealthy substances. Neurons require adequate energy production to send signals and process sensory data. Immune system cells, including B-cells, T-cells, macrophages, and monocytes, require an abundant supply of energy to protect us from foreign invaders. It is therefore logical to assume, that if we can increase the amount of energy produced within the cells of the immune system, they will function more effectively to resist infection and protect us from disease.

Many people know that mitochondria are the cellular organelles responsible for producing all of the cell's energy. Like any good furnace, the mitochondria burn fuel (glucose and free fatty acids) to produce both energy (ATP) and a variety of waste products (free radicals and carbon dioxide). Given the toxicity of free radicals, it is fortunate that nature has provided a well-designed system to deal with these byproducts of cellular respiration. Carbon dioxide diffuses into the bloodstream, is absorbed by red blood cells, and then expired by the lungs. Reactive oxygen species (ROS) are detoxified by an elegant cascade of reactions which depend upon an abundant supply of micronutrient antioxidants.

It is well known that vitamins C, E, beta-carotene, zinc and selenium are antioxidants that must be consumed from the diet to maintain good health. Alpha lipoic acid and N-acetyl-cysteine (NAC), when supplemented in therapeutic amounts, have been shown to support immune, hepatic, and nervous system functioning.² However, when the above micronutrients are combined with a therapeutic amount of acetyl-L-carnitine, the mixture can be used as a high octane fuel supplement to enhance mitochondrial energy production and produce clinically significant results.

Many single antioxidants, as well as several antioxidant combinations, have been studied in well-performed clinical trials. However, no antioxidant combination has clearly risen to the top as a potent and dependable immune booster that produces

consistently positive clinical results. Like many other integrative medicine physicians, I have utilized many different micronutrient combinations over the years to treat my patients. I've also treated patients with severe immunodeficiency states (cancer, AIDS, and CFIDS) for the past twenty years and have written two books on how to comprehensively strengthen the immune system. In both my books, I've recommended a potent micronutrient supplement program to enhance the health of the immune system. Those recommendations have included multivitamins, multiminerals, and therapeutic dosages of vitamins E, C, and beta-carotene, as well as significant amounts of coenzyme Q-10 and N-acetyl cysteine.

While I realized positive clinical results with these micronutrient combinations, it wasn't until I modified the above program and combined three highly potent antioxidants, in therapeutic dosages using the highest-quality raw materials, that I noticed a profound improvement in the clinical results I was seeing. Since beginning to prescribe this enhanced formula, I have seen AIDS patients consistently rebuild their immune systems, CFID patients have more sustained energy, and cancer patients achieve frequent remissions without recurrences. The use of this immune support formula has also helped my patients suppress herpes simplex, eliminate frequent urinary tract infections, and avoid winter colds and respiratory infections.

The three highly potent antioxidants I combined were:

- 1) Alpha Lipoic Acid (400 mg per day)
- 2) Acetyl L-carnitine (1000 mg per day)
- 3) N-acetyl-cysteine (1200 mg per day)

These antioxidants, combined with an "optimized backbone" of high-quality vitamins and minerals (vitamins C, E, B6, B12, beta-carotene, calcium, magnesium, zinc, and selenium), are designed to supply maximum support for immune, hepatic, and nervous system function. Within six months of prescribing this immune support formula to my patients with AIDS, cancer, and CFIDS I began to see dramatic improvement. My patients' energy levels improved, many drug side effects were eliminated, and key laboratory tests (i.e. CD4 counts and liver function tests) frequently improved.

The mechanism by which this nutrient combination works is fairly straightforward. A combination of antioxidants is required to detoxify a single free radical. This antioxidant cascade is necessary because antioxidant molecules are adversely affected (oxidized) when they react with a free radical. They must be converted back to their native state by interacting with other antioxidant compounds. For instance, ascorbate regenerates tocopherol molecules after they are oxidized. Alpha lipoic acid and glutathione (as part of the glutathione peroxidase enzyme system) are potent antioxidants that help to further reduce the oxidative state of ascorbate. This is why supplementing just one or two antioxidants doesn't make sense, from a biochemical standpoint. When mitochondria are highly stressed, as in conditions such as AIDS, cancer, and CFIDS, they have more oxidative stress and more free radicals to process. This situation requires higher levels of antioxidant supplementation to maintain homeostasis. If the level of oxidative stress becomes too high, the cells become apoptotic and die.

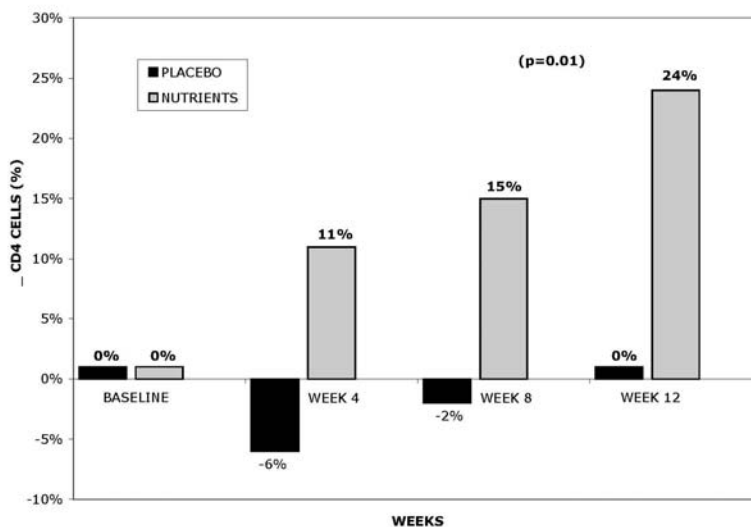
Once the proper balance of antioxidants is in place, the most important final step is to add a significant amount of acetyl-L-carnitine. This micronutrient has the ability to enrich the potency of the fuel mixture being channeled into the mitochondrial engine.

Normally acetyl Co-A (a 2-carbon breakdown product of glucose) is the primary energy source of mammalian mitochondria. In times of stress, mitochondria make use of a greater percentage of free fatty acids to enrich the potency of the fuel mixture and generate increased amounts of energy. Acetyl-L-carnitine is the primary transport molecule used to ferry these fatty acids across the mitochondrial membrane.³

Dr. Bruce Ames, noted researcher at the University of California at Berkeley, has published several articles on this topic. By supplementing acetyl-L-carnitine alone, signs of increased mitochondrial energy production are observed. However, a simultaneous increase in the flux of reactive oxidative species (ROS) precipitates quicker mitochondrial demise. When a potent antioxidant such as alpha lipoic acid was also provided, the increased ROS levels returned to normal.^{4,5} When this combination of nutrients is provided to aging rats, it restored several important mitochondrial markers and reversed several gross indicia of aging, including motor activity, muscle tone, coat appearance and kidney morphology.⁵

I have added to Bruce Ames' significant contribution to anti-aging research by further enhancing the antioxidant potential of this mixture with the addition of a high dosage of N-acetyl-cysteine and an optimized backbone of antioxidant vitamins and minerals. The addition of N-acetyl-cysteine is necessary because it provides the mitochondria a ready supply of glutathione. Glutathione and the selenium dependent enzyme - glutathione peroxidase - are critical to eliminating harmful free radicals and maintaining a healthy redox balance. Both glutathione and ascorbate function in tandem to protect the mitochondria from oxidative damage. Glutathione deficiency has also been associated with a poor prognosis in many immune-mediated conditions including AIDS and cancer.^{6,7}

With the addition of an optimized backbone of antioxidant vitamins and minerals, the health and energy output of the mitochondrial furnace is maximally supported and



enhanced. When increased energy becomes available for immune system cells to use in their daily functioning, the health and functioning of the entire organism is enhanced. This was recently demonstrated when this immune support formula was given to HIV/AIDS patients in a double-blinded, placebo-controlled study. At the end of 12 weeks, the

CD4 count (the most important marker of immune system strength in HIV infection) had increased by 24% in the micronutrient group compared to no change in the patients taking the placebo (see Figure). The micronutrient group also experienced a 42%

reduction in their peripheral neuropathy symptoms. No significant side effects were seen. These results were recently published in the Journal of Acquired Immune Deficiency Syndromes.¹

In summary, I have tried to outline both the history and mechanism responsible for how this unique combination of micronutrients was developed and how it can be used to support and enhance immune function. In my experience, it produces consistent and clinically observable benefits. I hope it helps you to improve the health and well-being of your patients.

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