ENERGY EXPLORATION

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Many of us complain that our days are filled with excessive demands to work more, yet we don't have enough energy to meet those demands. For this reason, many people are searching for natural "fuel" that will solve this energy crisis. We seek an energy-boosting product to give us mental alertness, the ability to stay awake, and that will help us acquire the physical and mental stamina to address and complete the job at hand.

Many consumers like canned energy drinks and related, highly-caffeinated products, but a large contingent also feel these caffeinated drinks are not healthful. In reality, caffeine—a major ingredient in energy drinks—is not as bad as some make it out to be. Like any supplement ingredient, caffeine can cause negative, harmful effects in certain sensitive individuals and/or when excessive amounts are consumed. But in moderation, caffeine can improve physical performance and significantly enhance the mental performance parameters of concentration and memory. A large portion of our population desires greater energy, but caffeine can make certain individuals feel nauseated or jittery.

Another popular source of energy is green tea, which naturally contains caffeine and the amino acid theanine. Theanine induces mental and physical relaxation without drowsiness. With this combination of actives, green tea provides energetic wellbeing without the jitters.

Citrus aurantium (bitter orange) contains synephrine, an active that will induce weight loss through thermogenesis. Bitter orange and synephrine are also often found in energy-promoting formulations because of their stimulant activity. Caffeine and synephrine definitely boost the feeling of energy because they both stimulate the central nervous system (CNS).

Coenzyme Q10 (Co-Q10) provides energy at the cellular level due to its key role in adenosine triphosphate (ATP) production within the mitochondria. You will sometimes see ATP referred to as the cellular energy currency. In other words, every human cell contains varying numbers of mitochondria and these so-called cellular power plants require Co-Q10 for their energy-producing operation.

D-Ribose, a pentose sugar, is also critical to cellular energetics because of its incorporation into the ATP chemical structure. Ribose facilitates the formation of the high-energy ATP molecule. Myocardial cells appear to benefit the most from ribose supplementation because these heart muscle cells are generally regarded as having the largest number of mitochondria of any cell in the body. Several studies have demonstrated the energy-yielding benefit of ribose supplementation in patients with congestive heart failure (1).

Certain B vitamins and amino acids are important to cellular energetics. Vitamins B1 (thiamin), B2 (riboflavin), B3 (niacin), B5 (pantothenic acid) and B7 (biotin) are known to be directly involved with cellular biochemical energy production and appear to influence mitochondrial function. L-carnitine and several of its derivatives, such as acetylcarnitine, are naturally occurring organic acids known to facilitate the metabolism (oxidation) of fatty acids at the level of the mitochondria. Therefore, carnitine analogs will definitely boost cellular energy production and are commonly found in energy-yielding formulas.

Two general research areas that are of great interest to me involve biological and biochemical descriptions/theories of aging mechanisms as well as process concepts of efficient biological energy production.

A landmark paper was published online in February 2011 by the prestigious journal *Nature* (2). This paper scientifically describes a link between the telomere-shortening theory of aging and energy-yielding mitochondrial function. Bear with me as I present the following explanation because I believe this complex research offers some insight as to why we age and why older individuals simply do not seem to produce the energy that is seen with younger individuals.

When the cell's mitochondria are operating efficiently, there is more than enough energy/power to operate the cell and, collectively, the organism (human). If for some reason there is mitochondrial dysfunction, power failure results.

As we age, the chromosomal cap—called a telomere—becomes shorter with each successive division of the cell. At some point in time, cells with short telomeres enter senescence (the state of being old), fail to replicate, and eventually die.

Long before cell death, the gradual shortening of the telomere in the aging cell affects mitochondrial function. It seems that this mitochondrial dysfunction is associated with DNA damage that results from excessive free radical production during the ATP-producing electron transport process. Previous research has shown that this increased

concentration of free radicals in the mitochondria not only causes mitochondrial DNA damage but also contributes to telomere shortening (3). The short telomere suppresses mitochondrial DNA repair and thus the dysfunctional mitochondria continue to produce more free radicals and less energy. It's definitely a vicious cycle that offers some explanation as to why we age and why older people feel short-changed when physical energy is required.

An obvious intervention would be to reduce mitochondrial dysfunction by combating the free radical-induced damage of mitochondrial DNA. The well known antioxidants do not appear to concentrate in the mitochondria and thus the traditionally recognized polyphenols may not be of too much value here.

Glutathione occurs naturally in the mitochondria and is quite effective in preventing mitochondrial oxidative stress. N-Acetyl-cysteine is often used to provide a precursor molecule during glutathione synthesis and may increase mitochondrial glutathione levels. Alpha-lipoic acid is a powerful antioxidant and appears to have the solubility characteristics for fairly efficient delivery to the mitochondria. Co-Q10 readily penetrates the mitochondria not only to provide antioxidant protection but to function as part of the energy-producing electron transport chain.

Research continues in an effort to discover or to develop antioxidants that will accumulate in the mitochondria to provide some very important health benefits. We can now make the case for antioxidants improving energy production by preventing mitochondrial DNA damage as well as increasing longevity by diminishing the effects of excessive free radical production on telomere shortening.

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References:

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