

# Brain Protection with Acety-L-carnitine

by Massimo Picari

As life expectancy continues to increase worldwide, "older" adults will make up a growing portion of the population. In fact, it is estimated that one third of the world's population will be 60 or over by 2050. Progressive conditions affecting brain performance (cognitive functions) are one of the most common disturbances associated with aging and decreasing quality of life. As many as two-thirds of us will experience age-related changes in superior mental functions (attention, concentration and memory) as we grow older. The risk of more serious problems such as Alzheimer's disease also increases with age: it affects 10 percent of people over 65 and about 50 percent of those over 85.

With conditions such as cognitive function decline expected to reach epidemic proportions and the high cost of prescription drugs, natural compounds that can preserve and enhance normal brain function as we get older are gaining in popularity.

One of the best-known compounds with strong scientific evidence for preserving cognitive function is acetyl L-carnitine (ALC), a short chain acyl-carnitine, is a naturally occurring acetyl ester of carnitine ((-acetyloxy-(trimethylamino)butyric acid).

ALC plays multiple roles in cellular functions. It affects cellular metabolism, especially in nerve cells and other highly differentiated cells like sperm cells by acting as a source of acetyl groups. These can be used for various functions in any type of cell, like providing energy for the synthesis of cellular membranes and for the biosynthesis of the neurotransmitter acetylcholine, which is vital for proper brain function. In addition to being structurally similar to acetylcholine, research has shown that ALC readily crosses the blood-brain barrier and increases the activity of the enzyme which produces this important neurotransmitter.

ALC is a mitochondriotropic substance necessary for optimal mitochondrial function. It acts as a defense for mitochondrial metabolism and provides structural integrity to the mitochondrial and plasma membranes upon which cell survival and neurotransmission depends. This makes neurons a preferred target for the metabolic actions of ALC. This preference is reinforced by the fact that ALC, besides playing a role in the synthesis of acetylcholine, also displays cholinomimetic activity. Together with the energy and the acetylcholine related properties, ALC has beneficial effects in various neurodegenerative diseases associated with aging like memory and cognitive loss. In addition, the effects elicited by ALC in experimental and clinical settings are not mimicked by carnitine.

## Metabolic Actions

ALC has multiple functions, which include the facilitation of mitochondrial energy supply, enhancement of membrane stability, enhancement of cholinergic transmission and secondary antioxidant defense line activity. It has demonstrated significant neuroprotective activity and represents a readily available substrate that can spark mitochondrial energy-linked processes.

ALC brings activated acetate directly into the mitochondrial matrix where it is transformed to acetyl CoA which can be oxidized by the Krebs' cycle without further expenditure of energy. ALC stimulates aerobic metabolism by acting as an alternative source for acetyl CoA, and restoring the oxidation of fatty acids which is impaired in altered or aged mitochondria.

ALC also plays an important role in the synthesis and maintenance of cell membranes (maintenance of optimal membrane fluidity).

In fact, it is the initial precursor for the cytosolic synthesis of structural phospholipids. The lipids acylation process is stimulated by the pool of acetyl groups from ALC.

This action can be regarded as a real secondary antioxidant defense line activity. For example, ALC preserves the function of the enzyme complexes of the oxidative phosphorylation respiratory chain located on mitochondrial membrane.

Due to its amphiphilic nature, ALC exerts a stabilizing action on cell membranes. This is especially important in the mitochondria of older individuals, when free radical damage affects membrane integrity, which in turn results in lower energy production with an increased production of reactive oxygen species (ROS). It has been demonstrated that ALC acts directly on the inner mitochondrial membrane preventing this destabilization and its consequences.

### **Nutritional Uses**

Acetyl L-carnitine HCl has been shown to have a number of positive actions on several cerebral functions such as mental performance, learning, concentration and mood levels.

In aging and various other situations like inadequate diet and conditions of increased metabolic demands, a 'secondary' deficiency of conditionally essential metabolic factors such as ALC may frequently occur. This leads to a reduction in the function of body systems. Maintaining optimal levels of ALC helps protect the various systems directly via an increase in metabolic potential and indirectly via an improvement of the secondary line antioxidant defense system. This prevents or reduces the risk of chronic diseases leading to cognitive decline and also directly augments the function of the CNS system resulting in increased cognitive potential.

ALC exerts a neuroprotective action in various conditions of metabolic stress like ischemia, hypoxia, aging, alcohol, and diabetes. It has also shown to play a protective role in in vivo experimental models of toxicity induced by amyloid beta 25-35 (Alzheimer), MPTP (Parkinson's disease), and AZT (a drug used in AIDS), as well as in traumatic injury like nerve transection. Thanks to these unique properties ALC can improve memory, learning and mood levels.

Researchers have also demonstrated that the ALC multiple neuromodulatory and neurotrophic properties play a role in restoring the body's overall physiological balance during stress or disease characterized by lack of attention and depression and associated with reduced cognitive functions. A number of clinical studies have shown that ALC improves symptoms of depression as well as cognitive parameters in aging, Alzheimer's disease, and in chronic alcoholics.

ALC has been recommended as a useful and safe therapeutic agent that should be used particularly during the early stages of these cognitive function disturbances.

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