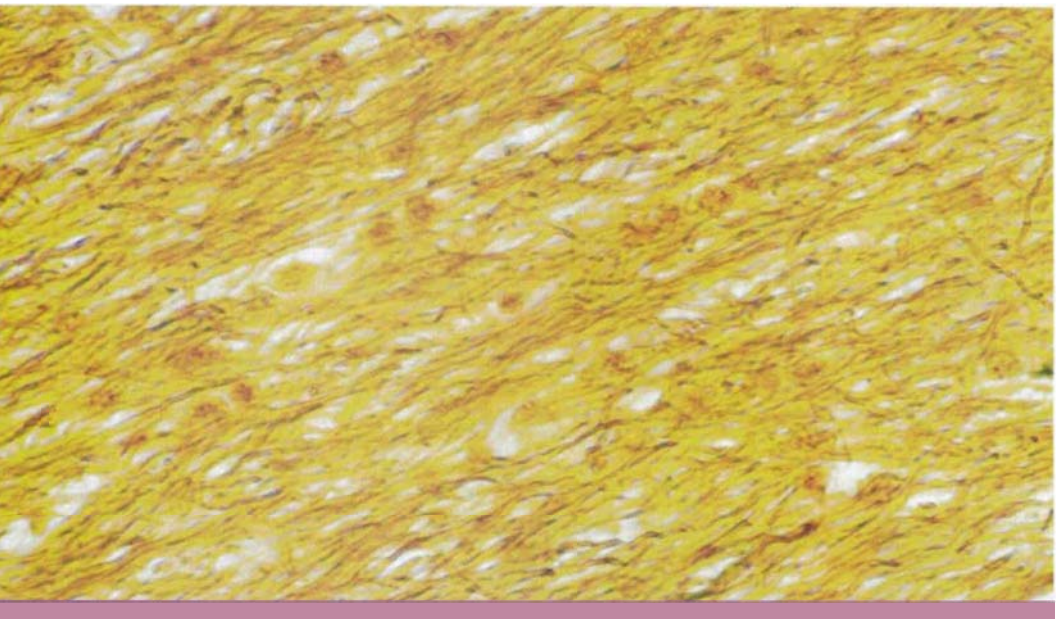
Calcium's Effects on Brain Functions

by Dan Moran, Ph.D.

Calcium plays a critical role in normal brain cell function, though higher levels may contribute to brain aging.



In the March issue of *Natural Products Marketplace*, we addressed the mitochondrial decay theory of brain aging. A second theory is called "the calcium hypothesis." It states that as brain cells age, they lose the ability to control calcium ions. Thus, the concentration of calcium increases inside the cells. Understanding calcium's role in normal brain cell function might help explain how higher levels of calcium can contribute to brain aging.

Calcium is required for the electrical signals of the nervous system.[1] It is also a "secondary messenger" because when chemical signals arrive at a brain cell, the calcium ions "carry" the message from the outside to the inside of the cell by binding to certain important proteins.[2,3] These proteins become "activated" by calcium and cause changes in the cell, including turning on new sets of genes.

The concentration of calcium is 10,000 times lower on the inside than on the outside of brain cells.[4] Even a tiny flux of calcium into the cell will cause huge changes in cellular activity. For this reason, brain cells have the ability to control calcium through pumps and an elaborate network of calcium-binding proteins that protect the cell from excess calcium. If any one of these pumps or proteins begins to fail, the cell would begin to suffer from chronic activation; ultimately, the calcium signal would trigger the cell to die.[5]

Studies have implicated calcium as a mediator of the normal aging process.[6] A number of calcium-binding proteins that are central to managing excess calcium are not as abundant in the cells of older brains.[7,8,9,10,11] The loss of these important proteins is thought to lie in the genetics of aging. Furthermore, some calcium pumps may increase in number but may not be as active in older brain cells.[12,13] This means each time brain cells fire, more calcium enters the cell; in older cells, the calcium concentrations rise for longer periods of time before returning to normal. Without the collaboration of calcium-binding proteins to protect the cell from excess calcium, calcium is free to over-activate proteins. This brings about stress on the cell, increases free radical formation and eventually, damage to the cell.[14]

There is great potential to keeping calcium mechanisms running well in the brain via calcium-binding proteins. Restoring these protective proteins could increase brain health and may prove an ideal solution to the aging of the brain. A number of important dietary supplements and restrictions have shown significant effects on the health of aging brain cells. For example, lower calorie intake reduces free radical generation, maintains calcium balance and reduces cell death in the aging brain.[15,16,17] Some dietary supplements, such as red Korean ginseng, have been shown to moderate the activity of calcium ion pumps, effectively reducing the kinds of cellular stress experienced by aging brain cells.[18,19,20,21] It is this kind of activity that may be responsible for ginseng's reputation as a remedy for old age. Vitamin D supplementation has also been shown to reduce the impact of age-related, calcium-dependent processes in brain cells.[22,23] This is not surprising since vitamin D is required for the synthesis of the hormone that regulates calcium metabolism for the whole body. Finally, antioxidants such as grape seed and other berry extracts, coenzyme Q, green teas and any mitochondrial nutrient such as lipoic acid and N-acetyl-L-carnitine will maintain the health of the energy factories of brain cells. This will assure that calcium pumps have the cellular energy to manage the flow of calcium ions and therefore protect the cell from age-related stress and death.

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