

Benefits of a diet with walnuts in Alzheimer's disease

Alzheimer's disease is a severe neurodegenerative disorder, responsible for 60-70% of cases of dementia. The most common symptoms are memory loss, disorientation and loss of cognition. To date, there is no known cure for this disease, but Dr Abha Chauhan, based at the New York State Institute for Basic Research in Developmental Disabilities, New York, USA, has shown how supplementation with walnuts in the diet can help Alzheimer's mice slow down the development of the disease. Her research demonstrates that walnuts can limit the oxidative stress characteristic of this condition, as well as promote the body's natural antioxidant defence mechanisms.

Alzheimer's disease is a severe neurodegenerative disease that primarily affects the elderly. Over the course of 5 to 20 years, patients experience gradual loss of memory, language skills and cognitive functions, with great impact on their quality of life. Although Alzheimer's disease affects more than five million Americans, there is currently no known cure.

This condition develops in the brain when toxic amyloid beta-protein accumulates as amyloid plaques, which surround brain cells, leading to cell death. Although the exact mechanisms have not yet been fully uncovered, there is some evidence to point in the direction of increased oxidative stress induced by amyloid beta-protein as one of the culprits.

The good news is that several studies suggest that consumption of walnuts in the diet may significantly slow down progression of this disease. Dr Abha Chauhan from the New York

State Institute for Basic Research in Developmental Disabilities, New York, USA, suggests this is likely due to a high antioxidant* content (including gamma tocopherol (vitamin E), flavonoids and melatonin) and significant amount of plant-based omega-3 essential fatty acid [alpha-linolenic acid (ALA), 2.5g/oz] in walnuts. She has spent the past few years trying to determine whether a diet with walnuts can help to reduce the risk of dementia or slow the onset or progression of Alzheimer's disease, and its underlying mechanisms.

WALNUTS PROTECT AGAINST ALZHEIMER'S AMYLOID BETA-PROTEIN-INDUCED OXIDATIVE STRESS AND CELL DEATH

The first step on this journey was to establish the link between walnuts, Alzheimer's disease and oxidative stress. For this, the researchers used cells cultured in a petri dish to which synthetic amyloid beta-protein was added to



mimic the conditions of Alzheimer's disease. Not surprisingly, this resulted in high levels of lipid peroxidation, DNA fragmentation and production of free radicals, eventually leading to cell death. In the cells with added walnut extract, however, the effects of the synthetic amyloid beta-protein were reduced, and cell mortality was lower.

These results indicated that walnuts have the ability to scavenge free radicals, limit oxidative stress and prevent cell death induced by the amyloid beta-protein characteristic of Alzheimer's.

Researchers suggest this is due to a high content of antioxidants present

in walnuts. In fact, these nuts rank second from a list containing over 1,000 foods with anti-oxidative properties. "This effect of walnut extract could be due to the active compounds present in walnuts, which may increase the capacity of endogenous antioxidant defence and may modulate the cellular redox state," says Dr Chauhan. "A diet rich in walnuts may therefore reduce amyloid beta-protein-mediated cytotoxicity, neuronal loss, and the risk of developing Alzheimer's disease."

WALNUTS IN THE DIET IMPROVE MEMORY DEFICIT IN ALZHEIMER'S MICE

Following from the success with walnut supplementation in laboratory experiments on cultured cells, the authors examined their theory on live animals, specifically a transgenic mice model of Alzheimer's disease (AD-tg). AD-tg mice received 6% or 9% walnuts added to their normal diet. This is equivalent to 1 oz and 1.5 oz, respectively, and it represents the daily suggested intake of walnuts for humans. The diets for the experimental

improved memory and cognitive function in the AD-tg mice in our study because of the cumulative effects of walnuts' ingredients to reduce oxidative stress and inflammation."

Based on these results, it's reasonable to suggest that supplementation with walnuts may help in reducing the risk of developing Alzheimer's disease, delaying its onset and/or slowing its progression due to the antioxidant and anti-inflammatory effects of different components of walnuts. At the very least, these results indicate that it may be worth conducting similar studies in humans.

Although Alzheimer's disease affects more than five million Americans, there is currently no known cure.

and control mice were comparable in the contents of protein, carbohydrate and fat, as well as the total calorie intake.

Walnut supplementation allowed the Alzheimer's mice to show better learning and motor skills when exploring a maze. In fact, these animals showed less stress and anxiety, made fewer mistakes and escaped faster than their counterparts on a diet without walnut supplementation. Dr Chauhan explains: "Diets enriched with walnuts may have provided



* Walnuts offer a variety of antioxidants (3.721 mmol/oz), including polyphenols (69.3 ± 16.5 μmol catechin equivalents/g) and gamma tocopherol (5.91 mg/oz).



Early intervention with a diet rich in walnuts may help maintain cognitive function and delay onset and progression of dementia and Alzheimer's disease.

It's difficult to say at this stage what exactly in the walnut is responsible for these benefits, but in addition to antioxidants in walnuts, ALA (omega-3 fatty acid) may also be a contributing factor. While most nuts contain

serotonin and dopamine concentrations, as well as modulating key inflammatory and immune functions.

The authors further explored the mechanism behind walnuts' beneficial

a diet with walnuts. In contrast, mice that did not receive walnut in their diets showed increased free radical production and oxidation of lipids and proteins, which was accompanied by decreased activities of protective antioxidant enzymes.

From these results, it seems that walnut supplementation can have a beneficial effect not only by limiting oxidative stress, leading to less damage to lipids and proteins present in cells, but also by boosting the body's ability to fight free radical production. It's a 2-in-1 win. Dr Chauhan explains: "Together, our findings suggest that supplementation with walnuts in the diet improved endogenous antioxidant function associated with removing accumulated free radicals and improving the balance between free radicals and antioxidants, thus reducing oxidative damage to lipids and proteins in AD-tg mice."

It's reasonable to speculate that early intervention with a diet rich in walnuts may help maintain cognitive function and delay onset and progression of dementia and Alzheimer's disease by limiting damage caused by free radicals and enhancing the body's defence mechanisms.

Walnuts in the diet reduce oxidative stress and improve the body's defence mechanisms in Alzheimer's mice.

monounsaturated fats, only walnuts consist primarily of polyunsaturated fat, of which ALA is the main constituent. This fatty acid is the precursor of vital fatty acids, important for regulating

effects in mice characteristic of Alzheimer's disease. Dr Chauhan's research demonstrates that 6% or 9% walnuts in the diet reduce oxidative stress and improve the body's defence mechanisms in Alzheimer's mice.

As expected, dietary supplementation with walnuts decreased the levels of free radicals, which in turn led to a decrease in lipid and protein oxidation. Free radicals are highly unstable and easily react with lipids and proteins. Lipids, for example, are an ideal target for free radical attack, leading to the production of unstable compounds that cause havoc inside cells.

These results can be explained by the increase detected in a few special antioxidant enzymes with the ability to fight free radicals in AD-tg mice on



Behind the Research

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Research Objectives

Dr Chauhan's research is focused on oxidative stress, mitochondrial dysfunction, signal transduction, membrane biochemistry, Alzheimer's disease, and autism.

Detail

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Bio

Abha Chauhan, Ph.D., is the Head of the Developmental Neuroscience Laboratory at the New York State Institute for Basic Research in Developmental Disabilities (IBRD) and adjunct professor of the Neuroscience doctoral program at the City University of New York. She has over 80 publications in the field of Neurochemistry.

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Personal Response

Your research has demonstrated protective effects of walnuts on cognitive functioning. What is next for your work?

Accumulation of amyloid beta-protein (A β) is determined by the rate of its generation versus its clearance. Amyloid precursor protein (APP) is processed by non-amyloidogenic and amyloidogenic pathways. In non-amyloidogenic pathway, APP is cleaved by α -secretase to yield a soluble N-terminal fragment (sAPP α), which is considered as neuroprotective. In amyloidogenic pathway, APP is cleaved by β -secretase with subsequent cleavage by γ -secretase, thus releasing A β . Therefore, activation of α -secretase and inhibition of β - and γ -secretases can inhibit A β production. In addition, the clearance of A β is accomplished by its proteolytic degradation. We would like to study whether walnuts in the diet can inhibit A β production and/or increase its degradation by proteases, thus reducing the levels of brain A β in Alzheimer's transgenic mice.