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Report

DHA: An Essential Brain Food

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When NASA scientists began their search for the perfect space food for astronauts, they turned their attention to marine algae. What they discovered was that algae was a rich source of the fatty acid DHA (docosahexaenoic acid). The result of their investigation produced a nutrient dense food that could be used not only for astronauts but for those here on earth.¹

DHA is a brain food. Studies show that brain tissue contains the highest concentration of DHA in the body, which indicates its value for brain function.² Within the brain itself, regions most closely related to memory show the greatest DHA concentrations.³⁻⁶ Those with a DHA deficiency often show cognitive deficiencies and an increased risk for Alzheimer's.^{7,8} Children with high levels of

DHA often perform better on tests.⁹ As a key fatty acid, DHA plays critical roles throughout the body and is a component of the brain's cerebral cortex, the retina, and human sperm.

As we age, DHA levels normally drop off in older individuals, especially in the all-important hippocampus region of the brain. Studies have shown that supplementation to older animals results in the normalization of hippocampal DHA content.^{10,11}

Algae-based DHA supplementation increases the *omega-3 index* by **75%**!¹² A low omega-3 index indicates high risk for developing coronary artery disease. While most people obtain their DHA from fish or fish oil supplements, NASA's discovery created an option for those who need to boost their vital DHA levels to avoid cognitive degeneration. Thanks to our space program, the benefits of DHA are available for everyone who seeks to avoid the risks of a DHA deficiency.

DHA: Triple-Acting Neuroprotection

Brain tissue has the highest concentration of DHA in the body, suggesting that brain function relies in unique ways on this powerful fatty acid.² Within the brain itself, regions most closely related to memory show the greatest DHA concentrations.³⁻⁶ And even at the cellular level, DHA concentrates in the structures involved in forming new memories, such as synaptic membranes and tiny outgrowths called "neurites."^{3,13}



Large-scale epidemiological studies reveal the benefits of sustained high DHA intake on brain function. Consuming an average of **3g/day** of fatty fish offers a **19** to **23%** reduction in the risk of mild cognitive impairment, a condition associated with later progression to Alzheimer's disease.¹⁴ People who eat still larger amounts of fatty fish may experience protection of up to **75%**.¹⁴ On the other hand, low fish intake and low blood DHA levels correlate strongly with increased risk of cognitive impairment and especially Alzheimer's.⁷ Animal studies show learning and memory deficits under conditions of DHA deficiency; studies of the animals' brains demonstrate inflammatory and oxidative damage to neurons.^{7,8} All of these deleterious effects resolve when adequate DHA intake resumes.

Unlike other fats, which accumulate in fat cells for storage and later release for energy, DHA resides almost exclusively in cell membranes, which undergo continuous degradation and renewal.² That means in turn that your body needs a constant dietary supply of DHA to avoid depletion and neuronal injury.

One study showed that DHA supplementation in humans at **2g/day** provides sufficient DHA to maintain healthy function, but levels drop when the patients stopped taking the supplements.² To achieve these levels often requires additional DHA supplementation beyond eating a regular diet of fish.

DHA influences how the brain develops and functions; it helps to determine brain structure, and it protects brain tissue from damage. DHA's protective effects come from three distinct mechanisms:

1. **DHA protects brain tissue from inflammatory damage.** It accomplishes this by promoting development of anti-inflammatory molecules while suppressing pro-inflammatory molecules in brain cell membranes.^{15,16} That alone offers powerful protection against oxidative and other stresses that age brain tissue.
2. **DHA stimulates physical changes that underlie learning and memory.** DHA promotes outgrowth of neurites, the tiny projections that form intimate connections between cells as memories form.^{6,17} DHA promotes rapid signal transduction across synapses and helps membranes maintain their fluidity, a condition required for rapid changes in shape and function we recognize as memory.^{18,19}
3. **DHA promotes healing after injury to brain tissue.** Immediately after such an injury, cell membranes release DHA in massive amounts for conversion into compounds called *protectins*.^{4,5,13,15,20}

Protectins are nature's way of maintaining the balance between oxidant damage and recovery. They begin to form at the very first sign of damage at the cellular level, whether from a seizure, a stroke, or a traumatic brain injury.^{4,5,13,15,20}

Scientists say that DHA-derived *protectins* function in a dual manner: they trigger anti-inflammatory processes and simultaneously begin the process of injury resolution.^{13,15} Acting fast enough and in sufficient quantities, *protectins* may be able to quash widespread brain degeneration, stopping or slowing neurodegenerative diseases like mild cognitive decline, and even Alzheimer's and Parkinson's diseases.

The best way to stimulate *protectin* synthesis? Make DHA maximally available to brain cells, where it's available for immediate release.²⁰

Let's now look at laboratory and human studies that demonstrate how DHA protects memory, enhances learning, and slows brain aging.

DEFEND BRAIN HEALTH WITH ALGAL-DERIVED DHA

- DHA from fish oil is a proven brain protective nutrient that provides multiple cardiovascular benefits.
- Recent studies show that DHA is especially beneficial in improving the memory loss that accompanies aging.
- But those who prefer not to eat fish are at risk for developing low DHA levels and losing that neuroprotection.
- A new technique for extracting DHA directly from algae makes DHA supplementation more widely available.
- Algal-derived DHA oil is equivalent to that derived from fish oil in terms of its bioavailability and impact on the human body.
- Now, everyone, regardless of dietary preference or habits, can enjoy the myriad neuroprotective, memory-defending benefits of DHA supplementation.



Studies Highlight DHA Memory-Protection in Brain



Animal studies repeatedly demonstrate the strongly neuroprotective effects of DHA supplementation in brain structure and function. While DHA levels normally drop off in older individuals, especially in the all-important hippocampus region of the brain, supplementation to older animals results in the normalization of hippocampal DHA content.^{10,11}

As a result, supplemented animals' brains show all the effects that DHA produces, including enhanced outgrowth of connections between neurons, more rapid transmission of electrical pulses across synapses, and protection against the physical and biochemical changes associated with Alzheimer's disease.^{6,10,11,18,21-24} Blood flow to memory-critical regions of the brain increases following DHA supplementation, and new brain cells form in older animals.^{25,26}

Animals' behavior, especially related to learning and memory, is markedly enhanced after DHA supplementation. Supplemented animals better remember the location of a submerged platform in the Morris water maze test, a standard test of spatial memory of the kind so readily lost in Alzheimer's disease.^{17,27,28} Similarly, supplemented animals outperform controls on tests of reference memory (the ability to relate current conditions to those experienced in the past).²⁹ And in those animals, brain regions related to memory show higher concentrations of DHA than do controls.²⁹

Exercise enhances brain plasticity, the neuronal flexibility that underlies learning; now studies reveal that DHA supplementation provides a synergistic boost to regular exercise.³⁰ Exercised and supplemented animals perform better on memory tasks than do those receiving either treatment alone.^{30,31}

DHA-protected brains function better in the event of physical trauma to the head. Animals supplemented with DHA before undergoing experimental traumatic brain injury show reduced injury responses in brain tissue, including a reduction in the tragic diffuse axonal injury suffered by many human victims of head trauma.³²

Low brain concentrations of DHA are thought to contribute to the cognitive decline seen in Alzheimer's disease.^{22,33,34} Conversely, higher DHA levels correlate well with improved performance on tests of memory and learning, as seen in a landmark study of school children in Canada. Children followed from birth to 11 years of age, and who had higher DHA levels in their blood at birth and at the time of testing, had better performance on memory and learning tests.⁹

Numerous studies have demonstrated the protective effects of DHA supplementation on cognitive function and memory. The effects are most pronounced in people with minimal cognitive impairment, or MCI, which is a mild form of cognitive decline that often proceeds to Alzheimer's disease. Roughly **15%** of people with MCI will progress to Alzheimer's disease

each year, while only about **1%** of those without MCI do so.

In one such study, a relatively low dose of DHA and another fatty acid improved memory and attention scores in patients with MCI and organic brain injury, but not in the Alzheimer's disease patients.³⁵

Similarly, older adults with MCI took DHA plus melatonin and tryptophan as an emulsion for 12 weeks, and underwent a battery of cognitive, behavioral and nutritional tests. Their memories, mental status, and verbal fluency all improved significantly.³⁶ And a combination of DHA with phosphatidylserine, another brain nutrient, improved verbal recall in non-demented older adults with mild cognitive impairment.³⁷

People with mild cognitive impairment may progress to full-blown dementia; if they have symptoms of depression that progress may be faster. In a study of 40 adults with both MCI and depression, a DHA supplement of **1.55 g/day** reduced their scores on a depression scale, while at the same time improving their verbal fluency. Those with the highest post-supplement DHA levels reported the greatest improvement in overall physical health.³⁸

In another study, people with age-related cognitive decline, which may or may not progress to Alzheimer's disease, supplemented with **900 mg/day** of DHA.³⁹ They made significantly fewer errors on tests of visual and spatial learning and memory, along with improved immediate and delayed verbal recognition memory, compared with control patients. DHA levels in these patients doubled during supplementation, and were closely correlated with improved memory scores.

Unfortunately, DHA supplementation, like any other treatment, is much less effective in fully-developed Alzheimer's disease, presumably because so much irreversible damage has already been done. Still, supplementation may ameliorate some of the troubling features of the disease. Alzheimer's patients typically lose weight as a result of lost sense of smell and taste, and a general disinterest in food.³⁶ But supplementation with DHA at **1.7 g/day** improved weight gain in patients with mild to moderate Alzheimer's; and again blood concentrations of DHA correlated well with weight gain and appetite improvement.⁴⁰ Similar studies report improvement in the sense of smell and nutritional intake following DHA supplementation.³⁶

Vegetarians Dangerously Deficient in DHA

Those who follow a vegan diet run the risk of a serious DHA deficiency because their diets provide little or no DHA at all. Even a vegetarian diet with dairy and egg products only supplies about **20 mg/day** of DHA.⁴¹ Until recently, though, vegetarians and vegans could not find acceptable sources of supplemental DHA, leaving them vulnerable to chronic diseases, especially those of the brain that affect cognition and memory.

But fish do not make DHA. Predatory ocean fish, our best animal source of omega-3 fatty acids, consume smaller fish and crustaceans.^{42,43} Those animals, in turn, feed on algae. And algae use specialized enzymes, powered by solar energy, to produce the DHA (and EPA) that we need in order to remain healthy.

As a result, all of the DHA we consume originates with tiny one-celled algal organisms.

Advances in aquaculture now make large-scale DHA production possible from algal cells grown in culture. First, specialized batch fermenters grow algae under ideal conditions. After harvesting, dryers remove moisture from the biomass, leaving the oil-rich residue. Next, extraction equipment separates the valuable oil from other organic material.⁴³ At the end of the process, only the highly refined oil remains, rich in DHA and entirely free of animal products. This oil meets the strict standards of true vegetarians and even vegans. Can algae-derived DHA replace fish oil as a health-promoting dietary component?

Emphatically yes, according to recent human studies.

Dosing with algae-derived DHA among vegetarians produces precisely the same increase in serum, red blood cell, and platelet

DHA content seen with fish oil supplementation at equivalent doses.^{44,45}

One study showed increases of DHA in serum and platelets of **246%** and **225%**, respectively, after six weeks supplementation with **1.62 g/day** of algae-derived DHA oil.⁴⁶ As an additional benefit, levels of EPA, another vital omega-3 fatty acid, rose substantially as well, while levels of the inflammation-generating fat arachidonic acid decreased.⁴⁶

People with low DHA levels stand to gain the most from supplementation using algae-based DHA; one study found a **4 to 5-fold** increase in blood levels following supplementation in cystic fibrosis patients, who often have imbalances in their fatty acid content.⁴⁷

Other studies report that algae-based DHA supplementation increases the "omega-3 index" by **75%**.⁴⁸ A low omega-3 index (the sum of red blood cell membrane EPA plus DHA content) indicates high risk for developing coronary artery disease. After supplementation with **940 mg/day** of algal DHA, **69%** of supplemented subjects, but none in the placebo group, managed to get their omega-3 index above the recommended **8%**.¹²

And vegetarians supplemented with algae-based DHA enjoy the same drop in cardiovascular risk factors as do non-vegetarians consuming fish oil.⁴² Those include lowering triglycerides, and the important total cholesterol/HDL cholesterol ratio.^{12,48}

Studies routinely report no side effects or adverse outcomes when patients consume even large doses of algae-derived DHA; the oil has the same excellent bioavailability as fish oil-derived DHA.^{42,44,45,47-50}

Summary

Compelling scientific data point to the value of maintaining high DHA concentrations in blood and brain tissue. DHA supplements derived from fish oil are an excellent source of the valuable omega-3 fatty acid.

But vegans and vegetarians, until recently, had no practical and acceptable source for DHA.

A new process now enables DHA to be extracted from algae, by means of completely vegan-friendly techniques. This DHA oil is equivalent to that derived from fish oil in terms of its bioavailability and impact on the human body.

Availability of a vegan/vegetarian-approved form of DHA is especially essential for maintaining brain health, memory, and learning functions. DHA reduces brain inflammation, a main risk factor for Alzheimer's and similar diseases. DHA stimulates new nerve cell growth and production of neuronal features that underlie learning. And recent studies show that DHA is required for production of essential protectins, molecules that initiate healing from the very onset of brain cell injury.

An algae-derived DHA enables anyone to increase their DHA intake.

If you have any questions on the scientific content of this article, please call a Life Extension® Health Advisor at 1-866-864-3027.

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