

# Abstract

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## Mechanisms of n-3 fatty acid-mediated development and maintenance of learning memory performance.

Su HM.

Department of Physiology, National Taiwan University College of Medicine, Taipei, Taiwan.

**BACKGROUND:** Docosahexaenoic acid (DHA, 22:6n-3) is specifically enriched in the brain and mainly anchored in the neuronal membrane, where it is involved in the maintenance of normal neurological function. Most DHA accumulation in the brain takes place during brain development in the perinatal period. However, hippocampal DHA levels decrease with age and in the brain disorder Alzheimer's disease (AD), and this decrease is associated with reduced hippocampal-dependent spatial learning memory ability.

**DISCUSSION:** A potential mechanism is proposed by which the n-3 fatty acids DHA and eicosapentaenoic acid (20:5n-3) aid the development and maintenance of spatial learning memory performance. The developing brain or hippocampal neurons can synthesize and take up DHA and incorporate it into membrane phospholipids, especially phosphatidylethanolamine, resulting in enhanced neurite outgrowth, synaptogenesis and neurogenesis. Exposure to n-3 fatty acids enhances synaptic plasticity by increasing long-term potentiation and synaptic protein expression to increase the dendritic spine density, number of c-Fos-positive neurons and neurogenesis in the hippocampus for learning memory processing. In aged rats, n-3 fatty acid supplementation reverses age-related changes and maintains learning memory performance.

**CONCLUSIONS:** N-3 fatty acids have anti-oxidative stress, anti-inflammation, and anti-apoptosis effects, leading to neuron protection in the aged, damaged, and AD brain. Retinoid signaling may be involved in the effects of DHA on learning memory performance. Estrogen has similar effects to n-3 fatty acids on hippocampal function. It would be interesting to know if there is any interaction between DHA and estrogen so as to provide a better strategy for the development and maintenance of learning memory.

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