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File: ■ Ginkgo (*Ginkgo biloba*)
■ Working Memory
■ Cognition

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RE: Ginkgo Extract Improves Working Memory while Attenuating Brain Electrophysiology

Silberstein RB, Pipingas A, Song J, Camfield DA, Nathan PJ, Stough C. Examining brain-cognition effects of *Ginkgo biloba* extract: brain activation in the left temporal and left prefrontal cortex in an object working memory task. *Evid Based Complement Alternat Med*. 2011;2011:164139. doi:10.1155/2011/164139.

Ginkgo (*Ginkgo biloba*) extract is used to improve cognition. Numerous studies have shown that it improves working memory. Working memory is a type of short-term memory; it is a system for temporarily storing and managing information to complete a complex task. The mechanism by which ginkgo improves working memory is unknown. The purpose of this randomized, double-blind, crossover study was to better understand the neurophysiology of this action by monitoring brain steady state visually evoked potentials (SSVEP) while subjects completed a working memory task known to be improved by ginkgo treatment.

Nineteen right-handed subjects between 50 and 61 years of age and with normal, uncorrected vision participated in this study conducted at Swinburne University, Victoria, Australia. Exclusion criteria included past history of head injury requiring hospitalization, intellectual developmental disability, neurological or psychiatric illness, epilepsy, and/or a history of substance abuse. Subjects were randomly selected to be treated with placebo or 80 mg (2 tablets) ginkgo extract (Ginkgoforte®; Blackmores; Warriewood, NSW, Australia) daily for 14 days. Each tablet contained 40 mg of ginkgo extract (equivalent to 2 g dry leaf), standardized to 10.7 mg ginkgo flavonol glycosides and 2.7 mg ginkgolides and bilobalide. Following 14 days of treatment, there was a 14-day washout period, after which the subjects were crossed-over to the other treatment. Steady state topography (SST) was measured at the two baselines and after 14 days of each treatment. During each SST recording session, subjects performed 3 cognitive activation tasks. Only the working memory task was reported in this article. The working memory task involved briefly showing the subject 1 or 2 irregular polygons on a screen and then, after a 3-second hold period, presenting an irregular object. The subject had to decide if it was a match to the polygon on the screen. Reaction time and accuracy were recorded. The brain electrical activity was recorded from 64 scalp electrodes.

There was a significant, modest increase in accuracy after ginkgo treatment (76.8% accuracy) compared with after placebo treatment (71.7% accuracy) (P = 0.037). There was no significant difference in reaction time between ginkgo and placebo treatment. Compared with placebo, ginkgo significantly increased the SSVEP amplitude at the frontal, prefrontal, and occipital [Note: The article says occipital in the abstract and at the beginning of 3.2.3, but states parietal in 3.2.2.] sites, and increased the SSVEP latency at the left temporal, left prefrontal, and midline frontal sites.

The authors speculate that the increase in SSVEP amplitude and the improvement in performance were related. The reason that an increase in amplitude is associated with an increase in performance is unclear. The increase in SSVEP represents lower levels of cortical activity or "cortical idling," indicating reduced cognitive effort. Alternately, the increase in SSVEP could indicate more efficient neural processing.

The SSVEP latency increase (slower processing) indicates reduced synaptic excitation or increased inhibition. The effects of the Alzheimer's disease drug physostigmine are mediated by cholinergic processes, and other researchers have shown that during the working memory task physostigmine improves performance (reaction time) and is associated with reduced brain activity in the left temporal and prefrontal sites. Therefore, the authors hypothesize that the cognitive-enhancing effects of ginkgo were mediated in part by cholinergic mechanisms.

The authors conclude that the improvements in ginkgo-associated working memory are attributed to enhanced synaptic inhibition, which may be working through a cholinergic mechanism.

The brains of cognitively impaired individuals differ from the brains of healthy ones. Therefore, this study needs to be repeated in other populations to confirm the findings.

—Heather S. Oliff, PhD

Referenced article can be found at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3166615/pdf/ECAM2011-164139.pdf.