All Humans Have An Amazing 3lb Chunk of tissue embedded within our skull that controls virtually all biological functions called the brain. With nearly 100 billion neurons making thousands of synaptic connections per neuron, many would admit that the human brain is by far one of the most complex and intricate processing and storage systems on the planet. As impressive as this biological computer might seem, it, like many other body parts, gets old and defective with time. However, both the mature Alzheimer's sufferer and the mentally exhausted college student may be interested in knowing that there are many different natural supplements that can greatly benefit our amazing brains.

Ginkgo Biloba
Native to China, the maidenhair tree (ginkgo) has many interesting constituents that play different roles in cognitive function. Within the extracts of these ginkgo leaves are found flavone glycosides and different terpenoids which exert different biological effects on the brain and nervous system. One such effect is a reduction in memory loss, as one study suggests regarding the possible effect of ginkgo extract on monoamine oxidase (MAO)\(^1\). This is especially beneficial since one particular monoamine, dopamine, is directly involved in cognitive endurance and memory. In fact, dopamine (and a little involvement of norepinephrine) have been used to treat Alzheimer's disease. So, inhibiting the synaptic reuptake of this neurotransmitter by ginkgo has a very large impact on improving memory. Interestingly, one of the constituents of the extract of ginkgo leaves, bilobalide, has shown great promise for improving learning and memory. This terpenoid has demonstrated outstanding neuroprotective effects in vivo by increasing superoxide dismutase and glutathione activity, decrease nitric oxide synthase, alleviate neuronal apoptosis (programmed cell death), and decrease TNF-alpha expression in the brain\(^2\). This 5-hit punch to decreasing cognitive function yields bilobalide a hot commodity to the ginkgo extract. Since ginkgo has also been linked to increased circulation, the outcome of one study that shows ginkgo extract (along with fish oil and multi vitamins) increasing regional cerebral blood flow to healthy individuals\(^3\) seems to makes sense.

Phosphatidyl Serine
Of all phosphatides found within the cell membrane in humans, phosphatidylserine is one of the most active players in memory and cognitive performance. The amino acid portion of this phospholipid hangs out within the inner cytosolic part of the membrane and has been shown to greatly enhance memory, executive functions, and mental flexibility\(^4\). Phosphatidylserine seems to work its magic by having a trophic effect on the brain, namely the cerebellum, hippocampus, and other zones. It does this by increasing nerve growth factor (NGF)-receptor density in these areas\(^5\). Phosphatidylserine also seems to have the ability to improve cognitive function and memory by stimulating the release of dopamine and acetylcholine.
Bacopa monniera

Various alkaloids, saponins, and flavonoids found in the leaves of water hyssop have been shown to improve memory and cognitive endurance. Although many studies performed on Bacopa monniera extract seem to include co-supplementation with other herbs and phytonutrients, it packs a very powerful punch on improving memory when administered alone. One of the routes in which it is postulated to improve memory dysfunction for example, is through decreasing neuronal oxidative stress, neuroinflammation, and neuronal loss^{11}. Specifically, it has been shown to do this by increasing acetylcholinesterase inhibition in the brain (extending the synaptic half life of one of the most abundant neurotransmitters involved in memory) and by enhancing synaptic plasticity-related signaling (neural firing) within hippocampal regions^{12}. Bacopa monniera has been used traditionally in India and other parts of the world as an Ayurvedic treatment for many different disorders, but has recently been discovered for its use in cognitive dysfunction.

**Huperzine**

The primary source of the sesquiterpene alkaloid Huperzine A is extracted from the Huperzia serrata plant and has been used in Asia for many years to treat different ailments. Just recently, huperzine has been explored in the United States for its dynamic role in memory loss. Much insight has been uncovered thanks to scientific research as to its pharmacology and how it does what it does. Recent studies have shown huperzine to act in a similar manner to many prescription drugs for Alzheimer's disease. It does this by acting as a cholinesterase inhibitor and is actually used so as a treatment for Alzheimer's in China and parts of the United States^{13}. Huperzine also exhibits its fascinating work on reducing oxidative stress and glutamate-induced damaged in the brain by antagonizing n-methyl-d-aspartate (NMDA) receptors^{14}, which benefits both Alzheimer's sufferers and the rest of the population alike. All in all, this alkaloid packs a powerful one-two punch to both neural stimulation and protection simultaneously.

Alpha GPC

L-α-glycerophosphorylcholine (alpha-GPC) is an enzymatically derived choline source that has shown much promise in enhancing cognitive function. As phosphatidylcholine gets its fatty acids chemically or enzymatically clipped off and then rearranged, alpha-GPC is born and becomes a source of choline delivered across the blood-brain barrier to be used as brain food. Besides just being a source of choline (namely acetylcholine), high levels of alpha-GPC within hippocampal regions of the brain have been found to have a significant impact on memory capacity and permanency in healthy human brains as well as Alzheimer's sufferers^{17}. Further, clinical trials show prolonged beneficial effects in Alzheimer's patients on cholinergic therapies supplementing with alpha-GPC^{18}. So, we can almost think of alpha-GPC as being a dual functioning form of choline for memory enhancement.

Vinpocetine

As a derivative of the alkaloid vincamine from the periwinkle plant, vinpocetine has been used worldwide with recent focus in the United States for its vasodilative properties, especially in the brain. Additionally, as an anti-inflammatory, vinpocetine has shown neuroprotective properties in the brain by inhibiting microglial inflammation mediated by the usual proinflammatory culprits (IL-1β, TNF-α, and IL-6)^{15}. This kind of inflammation is seen in Parkinson's and Alzheimer's disease sufferers. Further, vinpocetine acts as a phosphodiesterase inhibitor^{16}, which is where it gets its vasodilating effects – vasorelaxing smooth muscle cells in the brain. In fact, many other prescription medications work in this manner with their aim toward the same outcome.
Gotu Kola
Native to many different countries, the Centella asiatica plant has many culinary uses, but it is most known for its usefulness in mental acuity promotion. One interesting aspect of this extract is its unique neurotogenic ability (nerve growth). Centella asiatica has shown to be able to actually stimulate neurite outgrowth in human neuroblastoma cells\textsuperscript{19}. The neuroprotective properties of Gotu Kola may also be attributed to its phospholipase A2-blocking actions\textsuperscript{20} acting as an anti-inflammatory within cortical neurons. This would be especially helpful for people who are suffering from memory loss due to a variety of different physiological circumstances.

L-tyrosine
It is well known that the non-essential amino acid L-tyrosine can be manufactured by the body from adequate amounts of phenylalanine and can be used to biologically synthesize norepinephrine and dopamine (the feel-good neurotransmitters). However, there is evidence that this particular amino acid has the capacity to target cognitive-control operations and promote performance in working memory\textsuperscript{21}. Apart from indirectly helping with focus and concentration due to mood enhancement via norepinephrine and dopamine production, tyrosine in and of itself seems to be able to improve mental endurance, memory, and overall cognitive performance in a number of subject groups in different environmental and physiological circumstances\textsuperscript{22,23}. So tyrosine, while multi-functional, seems to be able to increase certain areas of mental capacity as a solo player or in conjunction with other supplements.

L-Glutamine
Glutamine is one of the most multi-functional amino acids in the human body. Of specific interest to neurology, it is the chief supplier of glutamate, the main excitatory neurotransmitter in the central nervous system\textsuperscript{24}. Glutamine readily gets converted by quick deamination (an NH\textsubscript{3} gets removed) to glutamate within presynaptic neurons via the glutamine-glutamate cycle. This in turn provides the amino acid responsible for the formation and retrieval of memories, spatial recognition and the maintenance of consciousness\textsuperscript{25}. Too much glutamate within the synaptic cleft, and we create a problem with excitotoxicity. Fortunately, our bodies have a very intricate system of regulating the amount of glutamate being produced from glutamine via this cycle. This is why it would be extremely dangerous to administer large amounts of glutamate by itself\textsuperscript{26}. So in this sense, it would seem obvious - and studies also show, that glutamine as a precursor to glutamate, along with other nutrients, seems to improve cognitive function – especially in learning\textsuperscript{27}

References:
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