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## Search for a perfect Nootropic supplement combination – Can we increase human intelligence by nutritional supplements?

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### Abstract

Human intelligence has always intrigued society in general and scientists in particular. So much so that there has been a large interest in drugs and supplements that have a tendency to even show a modicum of activity to enhance intelligence or in some cases, inhibit the stress that comes in with a high functioning brain. This review is a small addition to that line of thought and builds on scientific facts and studies that have been conducted to evaluate and even scientifically establish the use of some of the most commonly used neuroenhancers. These drugs or supplements can sometimes be used alone or in combination to enhance their overall effectivity and this article is an attempt to collect all the research data that supports the use of these supplements for increased cognition, comprehension, memory which invariably leads to better intelligence.

**Keywords:** Intelligence, Cognition, Nutritional supplements, Nootropics, Neuropsychopharmacology, Mental Performance, Mental Efficiency, Brain Power.

### Introduction

The word *nootropic* was coined in 1972 by a Romanian psychologist and chemist, Corneliu E. Giurgea, from the Greek words *nous* or mind and *trepein* meaning to bend or turn.

Nootropics also called smart drugs or cognitive enhancers-are drugs, supplements, or other substances that improve cognitive function, particularly executive functions, memory, creativity, or motivation, in healthy individuals. The use of cognition-enhancing drugs by healthy individuals in the absence of a medical indication is one of the most debated topics among neuroscientists, psychiatrists, and physicians which span a number of issues, including the ethics and fairness of their use, concerns over adverse effects, and the diversion of prescription drugs for nonmedical uses, among others.

Nonetheless, the international sales of cognition-enhancing supplements exceeded US\$1 billion in 2015 and the global demand for these supplements is still growing rapidly<sup>[1]</sup>.

We reviewed some of the widely known Nootropic drugs and their role in cognition & enhancement of memory. This paper is an attempt to search for a perfect Nootropic supplement combination that can improve human memory, cognitive ability and hence the over-all intelligence in healthy individuals.

### 1. Bacopa monnieri

*Bacopa monnieri* (also known as water Hyssop, Brahmi, thyme-leaved Gratiola, Indian Pennywort) is a perennial creeping herb native to the wetlands of Southern India, Australia, Europe, Africa, Asia, and North and South America. *An average person with a relaxed mind is a more efficient performer than a stressed-out genius!* That is why you should consume Bacopa monnieri, yet another powerful brain wellness supplement. It is one of the best nutrients for having a relaxed and positive outlook, promoting brain wellness, and have a calming effect on your brain while at the same time push the cognitive abilities to the limit. Thus, it helps in lowering your anxiety or nervousness too.

A lot of scientific studies<sup>[2, 3]</sup> have found that Bacopa monnieri:

- Is proven to support neurotransmitters in the brain.
- Fortifies a protein that is required to replace the worn-out neurons.
- Enhances consolidation of memory and recall
- Improves sensory perception, performance and reaction times.
- Known for increasing the speed and accuracy of solving puzzles
- Enhances visual information processing

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- Decreases anxiety and provides a calming effect
- Increases connections between brain cells, and repairs damaged neurons.

## 2. Acetyl L-Carnitine

Acetyl L-carnitine is naturally produced in the body and is present in food items rich in protein such as beef, lamb, chicken, fish and dairy products that contain significant amounts of carnitine.

Acetyl L-Carnitine converts fatty acids into energy within the nerve cells. Thus, your nerve cells (or neurons) get highly loaded with energy. This has been confirmed in human studies using NMR (Nuclear Magnetic Resonance) indicating that Acetyl L-Carnitine helps your brain and nerves maintain a round-the-clock supply of energy needed for efficient productivity [4]. Once Acetyl L-Carnitine reaches your brain, it gets converted into Acetyl-CoA. It then binds with a compound already present in the brain - Choline to become acetylcholine. Acetylcholine is a neurotransmitter which is strongly associated with important cognitive functions, like learning, and formation of memory. In a study, it was seen that daily consumption of 1.5 grams of acetyl-L-carnitine by 236 older adults for just 45 days led to a significant increase in the effectiveness of performance on all the measures of memorization power and other cognitive functions [5]. There are more than thirty scientific studies that show the potential of Acetyl L-Carnitine to prevent or slow the age related deterioration in mental function [6]. In such a study, 20 adults were given 1.5 g of acetyl-L-carnitine. It was found that many of their signs of the brain aging were reversed [7]. Consuming Acetyl-l-carnitine as a dietary supplement may thus prove beneficial for maintaining your brain health in case you have crossed that young and energetic age of 20's -30's.

In over 20 years of scientific research, which includes a study on more than 600 patients suffering from Alzheimer's disease, it has been confirmed that Acetyl L-Carnitine is really beneficial for the patients with Alzheimer's [8]. Acetyl L-carnitine increases the energy of brain cells. This increased energy allows these cells to communicate better and this sort of social brain is indeed a happier brain. Thus, it is amongst the most valuable natural compounds for relieving depression [9]. In animal models of nerve injury, Acetyl-L-carnitine has shown a dramatic increase in the speed of nerve healing as well as preventing loss of nerve function [10]. Thus, you should consider Acetyl L-carnitine in case you have suffered from such an injury (like a car accident) where there has been damage to nerves and brain cells [11].

Not only this, Acetyl- L-carnitine has also the potential of helping in the repair process of neurons in case they are damaged by Diabetes mellitus (Diabetic Neuropathy) [12]. In a scientific study, 160 stroke patients were asked to consume 1.5 grams of acetyl-L-carnitine daily for 56 days (8 weeks). To their surprise, it not only led to the speedy recovery of their stroke symptoms, but it improved their mental energy, attention span and mood as well [13].

Studies have shown that Acetyl L-Carnitine has benefited Chronic Alcoholics with cognitive impairment to a significant degree [14].

## 3. Ginkgo

*Ginkgo biloba*, known as ginkgo or as the maidenhair tree, is the only living species in the division Ginkgophyta, all others being extinct. A study conducted in Germany in the year 2011 regarding the effect of Ginkgo on memory in healthy, middle-aged subjects indicated that, when administered daily, Ginkgo

improves various aspects of memory. The results of this study were published in a highly popular journal *Phytotherapy*. The study found that Ginkgo treated subjects significantly improved in a memory recall test after a six-week course [15]. About 10 years before this study, 3 other scientific studies were conducted in healthy individuals in Australia [16], USA [17] and Germany [18] suggesting that improvement of cognition, memory, or self-estimated mental health was strongly attributed to Ginkgo biloba. In the "brain function loss of old age", medically termed as Alzheimer's disease, the main mechanism of brain damage includes the deposition of harmful proteinaceous substances called Amyloid plaques and Neurofibrillary tangles. The researchers at the Department of Pharmaceutical Sciences, School of Pharmacy, University of Maryland, Baltimore, Maryland, USA have successfully proved that Ginkgo intake reduces amyloid- $\beta$  aggregation and toxicity [19]. Researchers have associated the formation of harmful substances called free-radicals in causing memory loss. In one study, it was proven that Ginkgo functions as a free radical scavenger suggest its use in the various memory loss disorders [20]. Chinese researchers have published a paper in *Journal of Alzheimer's disease*, in which they have shown how daily dose of Ginkgo extracts can stabilize or slow the decline in cognition, function and behavior [21]. Other papers strongly advocate the use of Ginkgo [22, 23, 24] for:

- *Improving blood circulation to brain*
- *Helping the brain, eyes, ears, and legs function better*
- *Reducing the symptoms of anxiety*
- *Improving memory, attention and speed of thinking in healthy adults*
- *Improving the symptoms of Vascular, Alzheimer's or mixed dementias (loss of cognition)*

## 4. Phosphatidylserine (PS)

Phosphatidylserine is an important phospholipid membrane component (i.e. component of the cell membrane) which plays a key role in cell cycle signaling, specifically in relationship to apoptosis.

The first question however, that might have come in your mind might be, how the memories form in the brain? When you are learning something new/ experiencing an event, a group of neurons (the brain cells) talk to (share the brain chemicals with) each other, the memories are formed. Same is the case with the process of recalling that memory.

If there is less or no PS, such a communication among your brain cells is very difficult. This is the reason why PS positively affects the memory, recall, as well as the overall functioning of your brain. As we age, most of us lose some memory function. PS may help to slow down or even reverse the process of losing some memory function as happens with the aging process [25].

In one study, 75 patients who were having age-related impairment in the memory function were asked to take 300 mg of PS every day for 3 months. PS markedly improved their performance tests of learning as well as the memorization tasks of their daily lives [26]. In yet another similar study, 33 dementia patients were given 300 mg of PS everyday over just 2 months. The results were significant and improved the overall brain wellness of those dementia patients [27]. While there is no total medical cure for the Alzheimer's, having nutrients like PS has shown the slowing of the progression of this disease. Even in few cases, reversal of some of the symptoms of Alzheimer's has been noticed [28, 29]. Two studies with 18 and 25 patients of Alzheimer's were given suitable doses of PS over 6 months and 3 months

respectively. Both the studies showed positive effects of PS on memorization power, recall and improvements in brain function [30, 31]. In a study on 10 elderly clinically depressed women, PS intake showed a remarkable improvement in the symptoms of depression, behaviour as well as memory [32]

### 5. St. John's Wort

*Hypericum perforatum*, known as St John's wort, is a flowering plant in the family *Hypericaceae*. St. John's Wort is even used as a prescription medicine for depression and relieving stress naturally. Two chemicals- Hypericin and Hyperforin, play a larger role in treating depression or elevating mood. St. John's Wort is thus very famous for clearing the mental fogginess and thus, giving a so called "neural clarity" for performing any task efficiently [33]. This herb has been found in research conducted in Poland to not only prevented stress induced memory impairments, but it significantly improves recognition memory as well [34].

### 6. Oral/Inhaled Rosemary oil

*Rosmarinus officinalis*, commonly known as rosemary, is a woody, perennial herb with fragrant, evergreen, needle-like leaves, native to the Mediterranean region. It is a member of the mint family *Lamiaceae*. Rosemary oil is essentially the extract of a small light blue flower along with an extract from the leaves to yield the fragrance of the essential oil, which is sometimes used as an ingredient in perfumes as well as for a food flavoring. Rosemary oil has a powerful and refreshing herbal smell.

The performance on cognitive tasks is significantly related to the concentration of absorbed 1,8-cineole following exposure to rosemary aroma, with improved performance at higher concentrations of it. [35]. Study has proven significant increases in blood pressure, heart rate, and respiratory rate after rosemary oil inhalation treatment. Subjects were found to have become more active and stated that they felt "fresher" after its inhalation. [36]. It has also been shown to possess excellent brain-stimulating properties as well as an aid for memory improvement. [37]

### 7. Dimethylaminoethanol Bitartrate

IUPAC name 2-(Dimethylamino) ethanol Dimethylaminoethanol Bitartrate (DMAE) is a powerful natural nootropic that has been proved to enhance not only the mental but also the physical efficiency required for executing any complex or tough task. By abolishing that early morning "fogginess," it helps attain a clear mental focus and also allows one to remain concentrated for longer periods of time [38]. DMAE helps to increase the levels of Choline in the brain which is important for mental focus, attention, and concentration [38]. There are scientific studies in which Dimethylaminoethanol Bitartrate was able to improve the recall, attention, mental focus, as well as other higher mental functions in the subjects [38]. DMAE also plays a role in the induction of lucid dreams [39].

### 8. Vinpocetine

IUPAC name- (3 $\alpha$ , 16 $\alpha$ )-Eburnamenine-14-carboxylic acid ethyl ester. Vinpocetine is a semi synthetic derivative of the vinca alkaloid vincamine & is an extract from the periwinkle plant. Vinpocetine was first isolated from the plant in 1975 by the Hungarian chemist Csaba Szántay.

There are two popular research papers [40, 41] that have shown how Vinpocetine activates brain metabolism, causes an improvement in the blood flow to brain, enhances the use of

oxygen by brain and increases the energy of the brain cells as well as doubles the memorizing power.

### 9. L-Glutamin hydrochloride

IUPAC name- (2S)-2,5-diamino-5-oxopentanoic acid;

L-Glutamine hydrochloride increases the level of glutamine in the brain, helps in elevating the energy levels of brain cells. It thus makes a person taking it mentally alert, focussed, less tired and more vigorous during longer mental task like an examination, late night study or meeting a deadline for a project in hand. It is known to enhance the problem solving skills as well. Various studies [42, 43] have shown that Glutamine intake:

- Plays a major role in fighting stress
- Elevating the energy levels of our brain
- Helps increase mental alertness
- Improves concentration
- Enhances problem-solving skills
- Makes students less angry, more vigorous, and less tired during tests.

### 10. Glycero Phospho Choline (GPC)

Glycerophosphocholine (GPC) is an important nutrient present in all body cells; but primarily in liver, brain and nerve tissue. GPC is a metabolic precursor of phospholipids.

#### GPC improves Memory/mental focus function in young as well as elderly

There are scientific studies in which GPC was able to improve the recall, attention, mental focus, as well as other higher mental functions in the subjects [44]

#### Improves your Reaction time

It was found that the GPC supplementation in the middle-aged as well as elderly volunteers improves their reaction time. It does so by supporting electric coordination and energy generation in the brain. [45]

#### Growth Hormone Production

GPC is known to revitalize the functions of the hormone release from the master gland – the pituitary (like the Growth Hormone) in the elderly population [46]

#### Brain recovery from stroke or injury or anesthesia

There have been researches proving the effectiveness of GPC in brain recovery after the patients had stroke or any other such circulatory injuries [47].

#### Cognition defects and social behavioural problems due to Alzheimer's disease or vascular dementia

When the effectiveness of GPC for Alzheimer's dementia was compared to that of the common prescription drugs, the former proved out to be way better than Oxiracetam [48].

### Conclusion

A wide range of studies have taken place in the last decade, that have proved the role of various Nootropic supplements in improving cognitive function, memory and creativity in healthy individuals. These supplements can also be used to relieve stress and elevate mood, which in turn improves the overall mental well being especially for individuals leading a stressful lifestyle.

Hence, supervised regular intake of Nootropic supplements in prescribed doses, (along with nutrition and exercise) can gradually increase the overall intelligence in healthy

individuals by improving memory, creativity and cognitive function.

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