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Review Paper

Neuroprotective And Nootropic Potential of Shankhpushpi (Convolvulus Pluricaulis) And Its Polyherbal Formulations in Stress-Induced Cognitive Impairment: A Review

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ABSTRACT

Cognitive impairment, often known as cognitive decline, can occur gradually or suddenly, and it may be temporary or more permanent. It is a growing public health problem and may rely on normal age or be linked to other neurological conditions like Alzheimer's disease (AD). It is now commonly acknowledged that lifestyle variables, including eating habits, have a significant role in supporting good aging and minimizing cognitive impairment in later life. Among the natural substances that have gained a lot of interest recently are dietary polyphenols, which comprise phenolic acids. Improved cognitive function and the avoidance of cognitive deterioration have been associated with their supplementation. Despite their therapeutic potential, there is a dearth of human studies investigating the connection between phenolic acid ingestion and cognitive outcomes. In this review, we provide preclinical evidence that a variety of dietary polyphenols, such as ellagic acid, rosmarinic acid, and cinnamic aldehyde, can have pro-cognitive and neuroprotective effects through a variety of molecular mechanisms, including the control of inflammatory status and pro-oxidant and antioxidant machinery. To support the promising preclinical results, more thorough in vivo study is needed. Although phenolic acids have good pharmacokinetic qualities and can accumulate in the brain at pharmacologically relevant levels, future research should identify which of the different metabolites produced because of phenolic acid consumption may oversee the potential neuroprotective effects of this subgroup of polyphenols.

INTRODUCTION

Nootropics, often known as smart medications, are well-known substances or supplements that improve cognitive function. They function by improving mental abilities like motivation, creativity, memory, and concentration.[1] They function by improving mental abilities like

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motivation, creativity, memory, and focus. The goal of recent studies was to identify a novel possible nootropic made from both natural and manmade materials. Numerous studies have been conducted on the impact of nootropics on the brain. The dopaminergic pathway is one of the processes or paths via which the nootropic influences brain function. Nootropics have been shown to have an impact on the treatment of memory disorders, including Parkinson's, Alzheimer's, and Huntington's illnesses. It has been noted that those illnesses affect the same nootropic pathways. There are two types of nootropics: natural and herbal nootropics like Panax quinquefolia's (American ginseng) and Ginkgo biloba, and synthetic nootropics like piracetam. It has been demonstrated that using natural nootropics can improve brain health and function. Nootropics work against the brain's tiny arteries and veins by acting as vasodilators.[2] Incorporating natural nootropics into the system will improve blood flow to the brain while also supplying vital nutrients, energy, and oxygen.[3] The brain receives about 15% of the body's total blood flow and oxygen, although making up only 3% of the body weight. In actuality, the brain can only produce energy by burning glucose, demonstrating that neurons require a steady flow of nutrients and oxygen.[4] Unlike most other bodily cells, neurons are unique and cannot be replicated. The converted energy is continuously being used by the neuron cells to keep the cell compartments repaired. The energy produced by the glucose is essential for neurotransmitter, electrical, and maintenance functions.[5] It has also been demonstrated that natural nootropics could lessen brain inflammation. Nootropics will minimize the consequences of brain aging and shield the brain from poisons. The activation of new neuron cells is another way that natural nootropics improve brain function. The brain becomes more active because of the new neural cell's motivation, which improves thinking and memory skills and increases neuroplasticity.[6] Acetylcholine is the primary neurotransmitter in the peripheral, autonomic, and enteric nervous systems and was the first neurotransmitter discovered in the history of neuroscience.[7] The "cholinergic hypothesis of cognitive dysfunction" was developed as a result of preclinical and clinical evidence, as well as the observation of a decrease in choline acetyltransferase, an enzyme involved in the biosynthesis of acetylcholine, in the cerebral cortex of Alzheimer's disease patients. Different classes of medications, including acetylcholinesterase/cholinesterase inhibitors, cholinergic antagonists of muscarinic receptors, muscarinic cholinergic inhibitors, and acetylcholine precursors, were developed based on this hypothesis and the relationship between brain levels of acetylcholine and cognitive performance.

Cognitive Impairment or Neuro-degradation:

Cognitive impairment is a symptom or description of thinking problems (memory, focus, judgment), whereas neuro-degradation refers to the underlying physical breakdown of brain cells or tissue, which is often the cause of severe cognitive decline (neurocognitive diseases, dementia, Alzheimer's). Mild impairment (MCI) is less severe than significant neurocognitive illnesses, but it might increase the risk of dementia. In essence, cognitive impairment (difficult thinking) is produced by neuro-degradation (such as neuron loss). Neurodegenerative illnesses, such as Parkinson's disease, Alzheimer's disease, Lewy-body dementia, and cerebrovascular dementia, cause a gradual decline in behavior and cognition that ultimately results in severe dementia. By 2050, there will be 1.1 billion persons over 65 worldwide, according to current demographic projections, which will result in 37 million cases of dementia. Given the enormous public health and

socioeconomic burden, it is evident that the need of therapeutic intervention aimed at either finding a cure or preventing sickness onset cannot be stressed. Nowadays, the human population is aging faster. This leads to increased dependence rates, and social and health services need to adapt to this aging population. One of the changes this group has experienced is frailty. It is characterized as a syndrome that is clinically detectable and linked to the aging of many physiological systems that result in a state of vulnerability. The pathophysiology of frailty, which seems to have a complicated genesis, is determined by a number of interrelated elements. The four main causes of frailty, according to Morley et al., are atherosclerosis, sarcopenia, cognitive decline, and malnutrition, together with the associated metabolic alterations. Malnutrition is associated with cognitive impairment or functional loss, while inadequate nutrition is known to predispose to cognitive fragility. Additionally, dietary factors that may impact vascular risk factors may worsen dementia in people with cognitive fragility. This study aims to provide an overview of the nutritional components that have been investigated thus far and that may be involved in the development of frailty, namely cognitive impairment. The progressive dysfunction of specific neuronal groups determines the clinical manifestation of neurodegenerative illnesses. Misfolded proteins accumulate both intracellularly and extracellularly in many neurodegenerative protein-pathies, which is associated with neuronal death. Some of the main fundamental processes include deficiencies in the ubiquitin-proteosome-autophagy system, oxidative stress and free radical production,mitochondrial dysfunction, impaired bioenergetics, neurotrophin dysfunction, "neuroinflammatory" processes, and (secondary) disruptions of neuronal Golgi apparatus and axonal transport. Over an extended period of time, a number of interrelated events culminate in programmed cell death. Current study has shown both intraindividual variances and overlap across diverse symptoms, despite the fact that neurodegenerative disorders are classified using major components of protein deposits or established genetic mechanisms. Synergistic mechanisms between sick proteins reveal common pathogenic pathways. The basic mechanisms of neurodegeneration and cell death have been clarified by animal models and other research, creating new opportunities for preventative and therapeutic strategies.

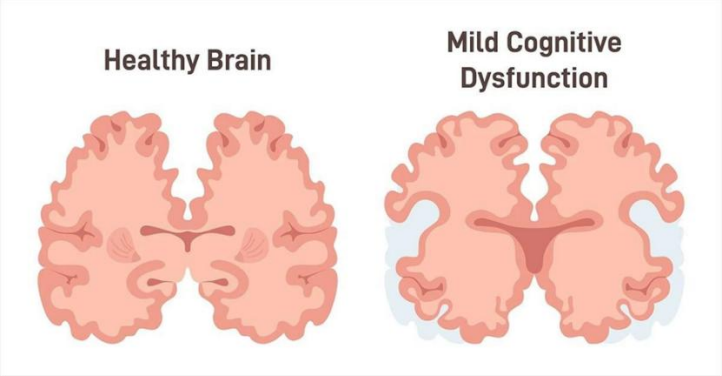


Fig: 1.1Difference between Normal Brain and Damaged Brain

The greatest consistent risk factor for developing a neurodegenerative disease, especially AD or PD, is becoming older. Over the past century, the number of people in developed countries who are 65 years of age or older has increased far more quickly than the total population. Consequently, it

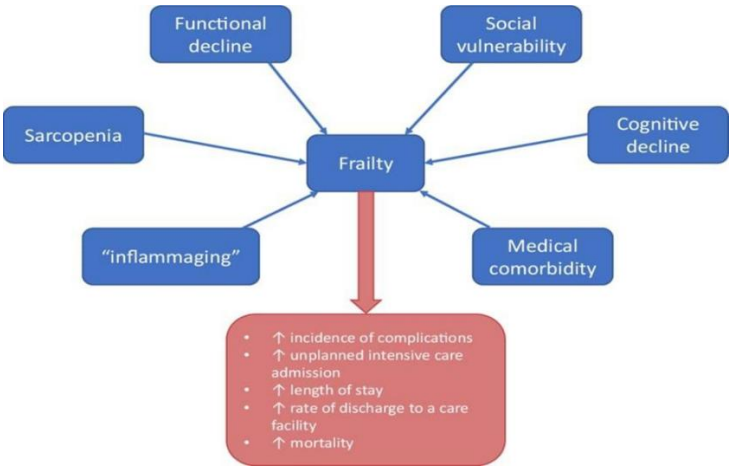
is anticipated that over the next few generations, the number of elderly people would double, which could lead to an increase in the number of persons suffering from neurodegenerative disorders.Management of Alzheimer's disease

The Frailty Concept:

The world's population is quickly aging, which leads to the development of illnesses connected to aging. Neurological disorders were the primary cause of DALYs (disability-adjusted life-years), the second most prevalent cause of mortality (90 million), and the sum of years of life lost (YLLs) and years lived with disability (YLDs) (276 million), according to recent reports.

One of them that geriatric medicine has recently concentrated on is frailty. A person's heightened vulnerability to stressors resulting from deterioration in several physiological systems is a clinical condition known as frailty. Frailty is a physical, social, and cognitive illness that is a condition of reversible pre-disability. A standard definition of frailty was sought by Fried et al.

Described the situation of being more vulnerable to homeostatic resolution after a stressful experience as a clinical characteristic of frailty. For senior individuals living in the community, this increases the likelihood of unfavourable outcomes, such as falls, disability, fractures, hospitalization, and death. A secondary analysis of data from 5210 men and women over 65 who took part in a prospective cohort study known as the Cardiovascular Health report served as the basis for the initial report.



This concept has been widely used and mostly focuses on the physical features. A set of five criteria (weight loss, weariness, sedentary behaviour, sluggish walking, and low physical strength) are used to thoroughly assess the presence or absence of signs or symptoms. Pre-physical fragility is characterized by one or two of these traits, while physical frailty is characterized by three or more of these five prerequisites. Numerous factors impact the pathophysiology of frailty, and its genesis seems to be complex. The four main causes of frailty, according to Morley, are atherosclerosis, cognitive decline, malnutrition, and sarcopenia with associated metabolic issues.

Dementia is another common health problem among the elderly. Moreover, cognitive impairment is considered a component of frailty. Physical frailty and dementia or cognitive impairment have been demonstrated to be strongly correlated in a number of cross-sectional and longitudinal investigations.

Sign and Symptoms:

Language and problem-solving difficulties, memory loss, emotional or behavioral problems, and difficulty focusing are signs and symptoms of cognitive impairment. These problems can make everyday tasks more challenging and are more serious than typical age-related forgetfulness. Repeating the same stories or having difficulty following a recipe or handling money are examples of specific symptoms.

1. Learning, focus, and memory.
2. Language and Communication.
3. Making choices and using judgment.
4. Shifts in mood and behaviour.
5. Disorientation and confusion.
6. A visual issue.

Causes:

Aging, illnesses, lifestyle choices, and injuries are some of the factors that contribute to cognitive impairment. Age-related changes are the primary cause, but other contributing factors include diseases including Alzheimer's, Parkinson's, and stroke, infections, vitamin deficiencies, depression, long-term alcohol or drug misuse, and head injuries. To identify the specific cause of the right course of treatment, a proper diagnosis is essential.

- **Health issues:**

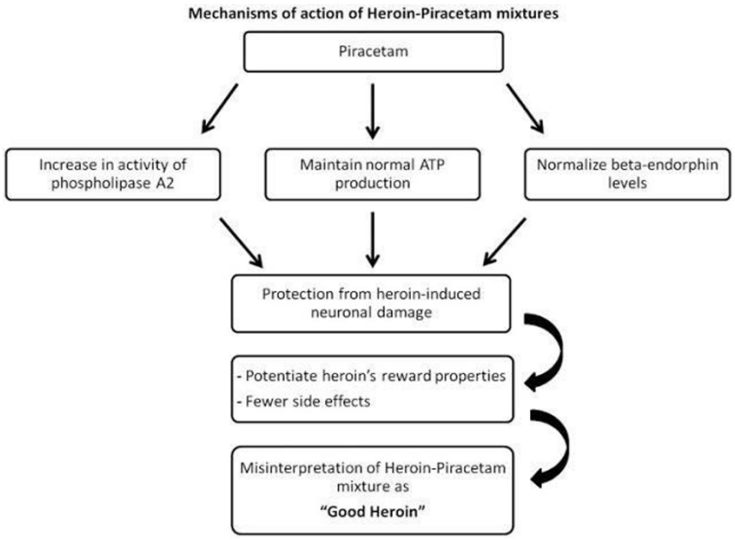
1. Neurodegenerative disorders, such as dementia, Parkinson's disease, and Alzheimer's disease.
2. Vascular issues: restricted brain blood vessels due to atherosclerosis and high blood pressure, brain bleeding, and stroke (including "silent" strokes).
3. Chronic and metabolic diseases: thyroid issues, diabetes, and high cholesterol.

- **Environmental and lifestyle factors**:

1. Substance abuse: Chronic alcohol and drug usage.
2. Head injuries: Traumatic brain injury brought on by accidents or falls.
3. Adverse drug reactions: Some tranquilizers, antidepressants, and other medications.
4. Nutritional deficiencies: A lack of certain vitamins, like vitamin B12 Poor health practices include things like smoking, inactivity, and unhealthy food.
5. Exposure to environmental toxins: pesticides and heavy metals.

Mechanism:

Neurotransmitters are not released by nootropics, nor do they function as receptor ligands. [8]
but enhance the brain's oxygen and glucose flow, have ant hypoxic properties, and shield brain cells from neurotoxicity. [9,10] Additionally, they improve the production of proteins and nucleic acids in neurons and promote the metabolism of phospholipids in neurohormonal membranes. [11,12] Certain nootropics have been shown to enhance erythrocyte flexibility, have an anti-aggregation impact, and influence the removal of oxygen free radicals. This enhances blood flow to the brain and improves the blood's rheological characteristics. [13,14,15] Although these drugs are metabolically active, most nootropics don't work right away after a single dose and need to be used for a long time to demonstrate any effects. To enhance brain metabolism, they must be able to cross the blood–brain barrier, and sustained use is required to have long-lasting effects. [16] example of piracetam as a nootropic effect-



Important neurotransmitter modes of action include:

The manipulation of neurotransmitter systems such acetylcholine, dopamine, serotonin, glutamate, and GABA is one of the main ways that nootropics improve cognition. They accomplish this via influencing cellular metabolism, receptor sensitivity, and neurotransmitter availability, among other mechanisms.

- **Raising Acetylcholine (Ach) Levels**: Several nootropics, including acetylcholinesterase inhibitors (like Huperzine-A) and choline precursors (like citicoline), raise the amount of acetylcholine that is available in the brain. Acetylcholine is essential for learning, memory, and focus.
- **Adjusting Glutamate Receptors**: AMPA glutamate receptors are positively allosterically modulated by certain nootropics, especially racetams like piracetam and aniracetam. The main excitatory neurotransmitter, glutamate, is crucial for long-term potentiation and synaptic plasticity, two processes that are necessary for memory formation.
- **Inhibiting Neurotransmitter Breakdown:** Some drugs increase the amounts and duration of activity of neurotransmitters by inhibiting the enzymes that break them down in the synapse. For example, the enzyme that breaks down acetylcholine, acetylcholinesterase, is inhibited by Huperzine-A. The enzyme monoamine oxidase
- (MAO), which degrades dopamine, serotonin, and norepinephrine, may be inhibited by rhodiola rosea.
- **Controlling Synthesis and Release:** Nootropics can affect how neurotransmitters are synthesized and released. For instance, L-theanine can raise serotonin, dopamine, and GABA levels, encouraging a calm, alert state.
- **Neuroprotection and Blood Flow:** Many nootropics also have indirect benefits that enhance overall neurotransmitter function and neuronal health, such as increasing cerebral blood flow, offering antioxidant protection, and boosting cell membrane health.

Types Of Nootropic Drugs:

Nootropic medicines, also known as "smart drugs," are a broad family of drugs that can improve brain function and are typically grouped according to their source and purpose. They fall into three general categories: synthetic over-the-counter agents, natural chemicals, and prescription drugs.

1. **Supplemental (Natural Nootropics):** These substances come from organic sources including plants, herbs, and nutrition. Compared to prescription medications, they are freely accessible over the counter and typically have less potency but fewer negative effects.

Herbal Remedies:

a) **Bacopa monnieri (Brahmi):** Often known as Brahmi, may lessen anxiety and enhance memory and focus. Ginkgo biloba: Well-known for increasing blood flow to the brain, which can improve memory and brain function in general, particularly in elderly persons or those experiencing cognitive decline.
b) **Ginseng (Panax ginseng):** Has been demonstrated to enhance memory and mental function in addition to helping with stress management.
c) **Ashwagandha:** An adaptogen that helps reduce anxiety, enhance memory, and manage stress. Nutrients and Other Substances: Caffeine: A common stimulant that improves focus and alertness.
d) **L-theanine**: Frequently combined with coffee, it can elevate mood and encourage peaceful alertness.
e) Creatine is an energy metabolite that can improve short-term memory and cognitive function.
f) omega-3 fatty acids: Essential lipids that supply.

2. (OTC) investigational synthetic nootropics: These are substances made in laboratories, many of which don't need a prescription but aren't usually FDA-approved for use as cognitive enhancers in healthy people.

A. racetams: class of synthetic substances known as racetams, of which piracetam was the first nootropic to be produced. They function by influencing the glutamate and acetylcholine neurotransmitter systems. Examples consist of:
Piracetam Aniracetam
Pramiracetam
Oxiracetam Additional Synthetics
B. Noopept: Often marketed as a supplement, this peptide affects glutamatergic signaling, albeit it isn't accessible in the US.
B. Citicoline: A substance that helps with learning and memory, especially in elderly adults recovering from stroke or experiencing mild cognitive impairment.

3. (Pharmaceutical Prescription) Nootropics: These powerful, synthetic drugs are used to treat certain illnesses like dementia, narcolepsy, and ADHD. Although they are more likely to cause adverse effects and dependence, they often have bigger effects.

A. ADHD medications are stimulants that raise dopamine and norepinephrine levels in the brain to enhance concentration and focus.
B. Methylphenidate (Concerta, Ritalin) Adderall and other
C. Amphetamines Eugeroics
D. Wakefulness -promoting agents are used to treat sleep problems by encouraging alertness.
E. Armodafinil (Waklert)
F. Modafinil (Modalert) Dementia and Alzheimer's Drugs: Acetylcholinesterase inhibitors like donepezil raise acetylcholine levels.
G. Memantine: For mild to severe dementia, memantine is prescribed.

Indications:

Nootropics are used to treat memory, consciousness, and learning impairments in acute or subacute circumstances.[17] They are advised for early brain injury, which shows up as mental retardation, memory loss, and qualitative

alterations in consciousness. Acute psychoorganic syndrome (POS) is the term used to describe this disease. Although it is typically curable, in certain instances it may develop into dementia. Brain injury, infection, stroke, or intoxication (alcohol, medications with central anticholinergic action, or carbon monoxide) can all result in acute POS. The POS category also includes delirium tremens.[18] Chronic cognitive issues including mental retardation or memory impairment could be further signs. In these situations, nootropics are used somewhat often, but their usefulness is debatable, particularly in cases of more severe dementia. When there is merely a slowing down of brain function without the development of dementia, such as in people with minor cognitive impairments or "benign senescent forgetting," they appear to be more beneficial. [19,20] Fatigue and exhaustion-related attention and memory problems can occasionally be treated using nootropics.[21,22] Children with mild brain dysfunction syndrome also utilize them.[23,24]

Nootropic Treatments:

In general, nootropics are quite well tolerated. The dosage determines their effectiveness, and in reality, giving too little of a dose is a frequent error. After the disruption of consciousness has subsided, treatment should continue for a minimum of two to three weeks [25]. To measure the extent and duration of impaired consciousness, a clinical scale has been created. Eye-opening, verbal performance, and motor responsiveness are three behavioral elements that are tested separately. These are noted and regularly assessed in accordance with the chart [26]. Nootropic side effects are rare and seldom dangerous. In addition to individual intolerance, there may occasionally be an increase in libido, a sleep disturbance, or an increase in activity in the undesired direction.

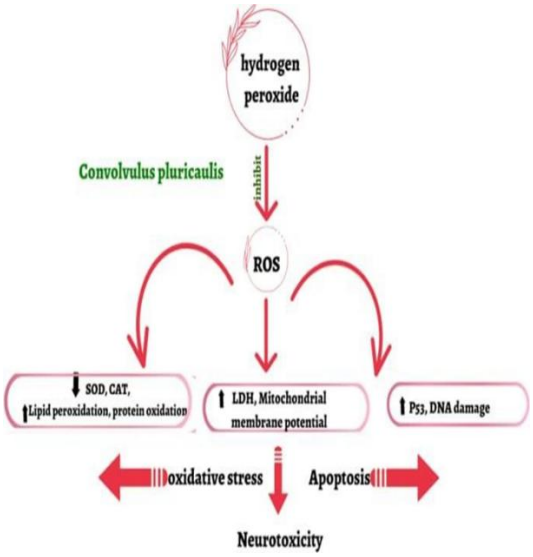
Advantages and Disadvantages of Natural Vs Synthetic Nootropics:

Natural origin medications derived from various plant parts (flower, leaf, root, etc.) have the undeniable advantage of having a wider range of potentially advantageous pharmacological effects. This is because a herbal medication contains a variety of compounds that can have additive or synergistic effects.[27] Additionally, natural nootropics are typically less toxic, which lowers the risk of overdose injury. Certain substances, however, could lessen the pharmacological activity of other substances.[28] Plant extracts are frequently utilized since higher doses of such a herbal medication are required to provide the intended effect. Additionally, there are issues with storage, potential falsification, and authenticity verification. [29,30] The pharmaceutical purity, specificity of action, and potential for increased effect through chemical structural alteration are the benefits of synthetic substances.[31] Although they are typically active at lower dosages, there is a higher chance of overdosing.[32]

Herbal Drug Plant Collection for the Treatment of Impairments:

Shankhpushpi:

Shankh-pushpi, a popular Ayurvedic drug, is used for a number of CNS effects, most notably memory enhancement. It is unclear where the term "shankhpushpi" originated because it is used to refer to a number of plants in different locations of India. Plants commonly referred to as shankhpushpi include Convolvulus pluricaulis Chois., Evolvulus alsinoides Linn., and Clitoria ternatea Linn. (Leguminosae).[33]



Shankhpushpi (Convolvulus pluricaulis) is an Ayurvedic cognitive enhancer (nootropic) that regulates neurotransmitters, shields brain cells, and enhances learning, memory, focus, and stress/anxiety. It is applied as a "brain tonic" to improve overall mental clarity and cognitive function



(Fig. – 3.1 Flowers of Shankhpushpi)

Botanical Description:

Shankhpushpi, mostly Convolvulus pluricaulis, is a prostrate, perennial herb belonging to the Convolvulaceae family. It is distinguished by its hairy, spreading branches, short, arrowhead-shaped leaves, and characteristic conch-shaped blooms that appear in the morning. Its slender roots, bitter taste, and cold strength make it an Ayurvedic brain tonic. The entire plant is used as a natural sedative and for memory, stress alleviation, and Pitta/Kapha dosha balance.

Plant Characteristics:

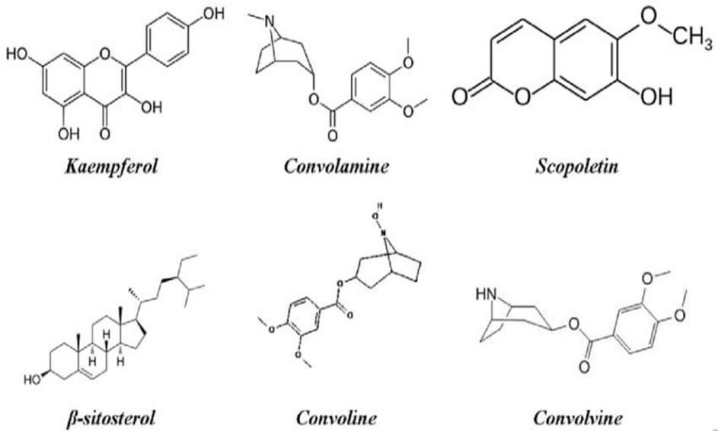
- **Botanical name:** Convolvulus pluricaulis (occasionally Convolvulus prostratus).
- **Family:** Morning Glory family, Convolvulaceae.
- **Habit:** A dispersed, prostrate (spreading) herb that spreads by creeping along the ground with slightly elevated branches.
- **Roots:** Usually woody, thin, and branching.
- **Leaves:** Ovate to elliptic, little (0.5–1.5 inches long), with an acute or truncate base (abruptly cut).
- **Flowers:** solitary, pale blue or white, funnel-shaped (trumpet-like), morning-opening.
- **Fruit:** Round in form, Typically, flowers bloom from May to December (during and after the wet season).

Chemical Constituents:

The mystical herbal remedy has a number of active substances, including alkaloids like convolvuline, convolidine, convolvine, convolamine, convoline, confoline, and convozine.

Additionally found are volatile oils, fatty acids, fatty alcohols, hydrocarbons, palmitic acids, linoleic acids, myristic acids, flavonoids, steroids-

phytosterols, D-glucose, maltose, sucrose, starch, rhamnose, and other carbs, proteins, and amino acids.



- **Alkaloids:** Convolvine, convolamine, confoline, convoline, convosine, subhirsine, phyllabine, and convolvidine are among the most prominent tropane alkaloids. These substances are especially linked to the plant's anxiolytic and neuroprotective qualities. As potent antioxidants, flavonoids and phenolics help shield brain cells from oxidative damage.

- **Lipids and Steroids:** Ceryl alcohol and β-sitosterol are important sterols. Along with hydrocarbons and waxy components, the plant also includes a variety of fatty acids, including linoleic acid, myristic acid, and palmitic acid.

- **Carbohydrates and Other Compounds:** In addition to proteins and amino acids, Shankhpushpi is high in a variety of carbohydrates, including as D-glucose, rhamnose, maltose, sucrose, and starch.

Therapeutical Uses:

- Shankhpushpi for Depression: Shankhapushpi is very important for treating a range of psychotic problems, such as depression, dementia, restlessness, etc., due to its potent anti-stress, anti-depressive, and anti-anxiety properties.
- Prevents Headaches: Shankhpushpi is crucial for reducing stress, chronic headaches, etc. Anxiety, worry, and a heavy workload are common causes of headaches. It improves nerve function, soothes agitated nerves, and calms the brain.
- Enhance Cognitive Function: Shankhpushpi is a traditional treatment for enhancing brain function. Its powerful antioxidants and flavonoids improve memory, focus, concentration, calmness, and alertness. Shankhpushpi is a tonic and brain stimulant that improves cognitive abilities like reasoning, memory, and problem-solving.
- Lessens Mental Fatigue: Mental tiredness can result from prolonged and excessive cognitive effort. It typically results from excessive computer use, excessive television viewing, learning or memorization of chores, etc.

Mentha:

Mentha, or mint, primarily enhances attention, memory, and alertness while reducing mental fatigue through its effects on neurotransmitter systems (cholinergic, GABAergic) and increased

brain wave activity. Studies have demonstrated that peppermint (Mentha piperita) and spearmint (Mentha spicata) extracts or essential oils improve mood and vigor as well as performance on challenging tasks.The main chemical groups responsible for Mentha's diverse range of bioactivities are believed to be polyphenols and essential oils (EO). The EO of Mentha includes terpenoids, menthol, menthone, neomenthol, menthyl acetate, isomenthone, 1,8-cineole, linalool, α-pinene, β-pinene, limonene, carvone, and pulegone, as well as monoterpenes and sesquiterpenes, the quantity of which varies from species to species.[34]



(Fig. – 3.2 Leaves of Mentha)

Botanical Description:

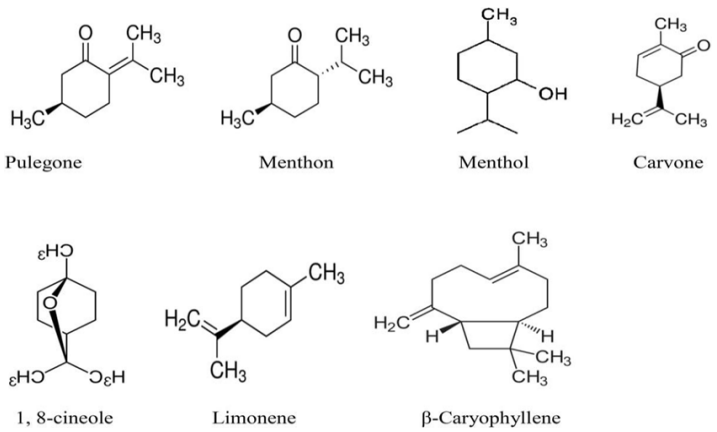
Mint (Genus Mentha) is a fragrant, square-stemmed perennial herb belonging to the Lamiaceae family. It spreads quickly through underground rhizomes and stolons (runners) and is characterized by opposing, serrated leaves with tiny oil glands and small, frequently purplish flowers in whorled clusters (verticillasters). Its various varieties and hybrids differ in height (4-120 cm), leaf form (oblong to lanceolate), and blossom color (white to purple). Other important characteristics are fragrant leaves, square stems, and opposing leaves.

Plant Characteristics:

- **Lamiaceae:** (Mint Family) is the family.
- **Growth Habit:** Perennial, rapidly proliferating both above and below ground through runners (stolons).
- **Stems:** clearly four-angled (square), erect, and branching.
- **Leaves:** Opposite, simple, fragrant, frequently soft and hairy, with serrated (toothed) margins; when exposed to light, small oil glands appear as dots.
- **Flowers:** Two-lipped (bilabiate) and frequently pale purple, pink, or white, they are grouped in dense whorls (verticillasters) in the leaf axils or at the tips of stems.
- **Fruit:** Hard, little nutlets that are frequently not noticeable.

Chemical Constituents:

It belongs to the Lamiaceae family. Menthol demonstrated its antioxidant activity by raising the activities of the GSH antioxidant and the enzymes GSH-Px and GR in the menthol-treated group compared to the vehicle-treated group. Menthol showed immunomodulatory properties; in stomach tissue, it reduced the pro-inflammatory cytokines TNF and IL-6 and elevated the anti-inflammatory cytokine IL-1.[35]



- Menthol: The main ingredient of peppermint (Mentha piperita), which gives it its distinctive cooling effect and many of its therapeutic benefits, such as its analgesic and anti-inflammatory qualities.
- Menthone: Alongside menthol, this important ketone is present. The primary ingredient that gives spearmint (Mentha spicata) its distinct flavor profile is carvone.
- Additional Elements of Essential Oil: Menthyl acetate, pulegone, limonene, 1,8-cineole (eucalyptol), menthofuran, and beta-caryophyllene are additional significant volatile chemicals that add to the overall aroma and biological activities.

The capacity of mentha, often known as mint, to enhance cognitive performance is supported by a variety of chemical components. Among the crucial materials are:

1. Monoterpenes, such as carvone, menthol, and menthone, are responsible for the unique aroma and medicinal properties of mint.
2. Luteolin, rosmarinic acid, and other flavonoids with antioxidant and antibacterial qualities are examples of phenolic compounds.
3. Sesquiterpenes: β-caryophyllene has anti-inflammatory properties.
4. Essential Oils: It has been shown that peppermint oil improves alertness and cognitive performance, particularly in tasks requiring sustained attention.
5. A flavonoid with potential neuroprotective qualities is luteolin.
6. Caffeic acid is a phenolic acid that has antioxidant properties.

Therapeutical Uses:

1. Improves Alertness: Peppermint oil can improve cognitive function and alertness, particularly when engaging in activities that require extended concentration.
2. Enhances Memory: Mentha's anti-inflammatory and antioxidant properties may help to improve cognitive function and memory.
3. Reduces tension and Anxiety: Mentha's calming qualities help promote mental clarity while reducing tension and anxiety.
4. Neuroprotective Effects: Compounds with neuroprotective properties, such rosmarinic acid and luteolin, may be able to stop age-related cognitive decline.
5. Improves Focus: Mentha's invigorating aroma can improve focus and concentration.

Liquorice:

Licorice (Glycyrrhiza glabra) contains anti-inflammatory and antioxidant chemicals called glycyrrhizin, which may improve memory and

learning while protecting against oxidative stress and neuroinflammation linked to conditions including depression, Alzheimer's, and stroke. It may enhance memory by reducing inflammatory cytokines and raising brain-derived neurotrophic factor (BDNF); nevertheless, high dosages may have negative consequences that warrant caution.

1. Memory & Learning: Research on animals has demonstrated that licorice extracts improve memory and learning. By boosting cholinergic transmission, they may even be able to cure amnesia caused by some drugs.
2. Neuroprotection: It protects neurons from damage (such as glutamate or ischemia) and reduces neuroinflammation, which is a factor in cognitive diseases like Alzheimer's.
3. Antidepressant-like Effects: Research has shown that licorice components can alleviate depression, reduce stress-related behaviors, and elevate mood.
4. Antioxidant Action: Bioactive compounds reduce oxidative stress in the brain, which is linked to aging and cognitive decline, by scavenging free radicals.



(Fig. – 3.3 Dried root of Liquorice)

Botanical Description:

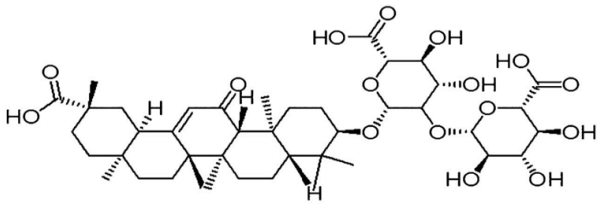
Growing up to 1-2 meters tall, licorice (Glycyrrhiza glabra) is a perennial herb in the pea family (Leguminosae) that is distinguished by its large root system and sweet, woody root with a bright yellow interior. It produces spikes of tiny, pea-like blooms that are white, pale blue, or purple, followed by flattened seed pods. Its pinnate leaves have nine to seventeen leaflets. The root, which is harvested after a number of years for its sweet extract used in food and medicinal, is the main beneficial part

Plant Characteristics:

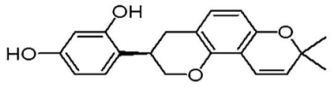
- **Habit:** Herbaceous perennial that grows into a big herb or tall bush.
- **Height:** up to five feet, or 1.5 meters.
- **Roots:** Often harvested for its delicious extract, roots are a deep, woody taproot with horizontal runners (stolon's)s that can grow widely. Woody, occasionally reddish stems, Flowers and Leaves.
- **Leaves:** 7–15 cm long, alternating, pinnate (feather-like), with 9–17 ovate, yellow-green leaflets.
- **Flowers:** Purple to whitish-blue, little (0.8–1.2 cm), grouped in long, dense clusters (racemes or spikes).
- **Fruit:** An oblong pod with several seeds that is two to three centimeters long.

Phyto-Chemical Constituents:

The sweet triterpenoid saponin glycyrrhizin (also called glycyrrhizic acid) and several flavonoids are the main active compounds found in liquorice root, along with sugars, polysaccharides, starches, and minerals. These compounds give liquorice root its sweet flavor and a range of pharmacological effects, such as anti-inflammatory and antioxidant properties. There are more than 400 known phytochemicals.



Glycyrrhizic acid



Glabridin

- Saponins: The most important is glycyrrhizin (also known as glycyrrhizic acid), a triterpenoid saponin that gives it its strong sweetness (50–60 times sweeter than sugar) and expectorant qualities.
- Flavonoids: These give it its yellow hue and include liquiritin, isoliquiritin, glabridin, and licuraside, which have estrogen-like and antioxidant properties. Liquiritin, isoliquiritin, and isoprenoid-substituted flavonoids such as glabridin and glabrene are examples of phenolic compounds.
- Polysaccharides & Mucilage: Its texture and calming qualities are attributed to water-soluble polysaccharides and mucilage.

Therapeutical Uses:

Licorice, or Glycyrrhiza glabra, has a number of therapeutic uses that can enhance cognitive performance. Here are some of its primary benefits:

1. Improves Memory: Licorice increases acetylcholine activity, a neurotransmitter necessary for memory and learning, by inhibiting acetylcholinesterase, the enzyme that breaks down acetylcholine.
2. Reduces Stress and Anxiety: By modulating the HPA axis, licorice reduces cortisol levels, which has a calming effect.
3. Enhances Mood: Dopamine and serotonin, two neurotransmitters associated with pleasure, reward, and emotional well-being, are elevated by licorice.
4. Neuroprotection: Licorice's antioxidant and anti-inflammatory properties protect brain tissue from damage and improve cognitive function.
5. Encourages Concentration and Focus: Licorice may improve concentration and reduce symptoms of ADHD.

CONCLUSION

The nootropic mixture made with Shankhpushpi, mint, and licorice has encouraging potential for enhancing cognitive abilities like learning, memory, and mental alertness. Mint helps to promote focus and mental clarity, while Shankhpushpi is well known for its neuroprotective and memory-boosting qualities. Licorice has antioxidant and adaptogenic properties that enhance general brain health and lessen mental stress. The combination formulation may work in concert to preserve normal neuronal function and improve cognitive performance. Compared to synthetic nootropic drugs, this formulation is anticipated to provide superior safety and tolerability due to its herbal composition. However, additional pharmacological testing, standardization, and clinical research are needed to confirm its safety

and effectiveness. The results support the traditional usage of Shankhpushpi for its neuropharmacological activity and offer significant implications for its application in the treatment and prevention of memory and CNS-related disorders. E. alsinoides is a promising agent for controlled clinical trials to determine its safety and efficacy as an antioxidant, NSAID-like prophylactic agent, NMDA down-regulator, and acetylcholinesterase enhancer for protection against AD and possibly other neurodegenerative age-related diseases due to its comparative multiple beneficial effects over other Shankhpushpi botanicals. Neuropharmacological activity data indicate that while the other three plants can be utilized as Shankhpushpi substitutes, E. alsinoides should be the actual source

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