Nootropics – The herbal memory boosters

Abstract- Nootropic drugs are those that are claimed to improve cognitive abilities. Memory encodes, decodes, and stores information. Neuropsychiatric conditions that cause cognitive deficits or memory impairment necessitate the use of nootropics to improve cognitive abilities. Due to their minimal side effects, there is a huge push right now to study medicinal plants over the world in order to improve cognitive behavior. This paper is a review to refresh knowledge of the therapeutic and pharmacological actions, as well as major chemical constituents, safety, and potential mechanisms of action also their preclinical studies of herbs which chosen from the ayurvedic pharmacopoeia. Simultaneously, it raises the possibility of more research and standardization on nootropic herbs. Memory neurobiology, nootropic herbs, cognitive deficit, dementia are some of the terms used Memory-improving nootropic drugs can help people with Alzheimer's disease and other brain diseases improve their thinking, memory, and alertness. However, memory can fail for a variety of reasons, preventing one from reaching their full potential. 4 million people are thought to be affected by the problems which are age-related memory loss and an increased risk of Alzheimer's disease. Although there are several nootropic drugs which are available to treat memory related complications.
Keywords- dementia, Alzheimer disease, Memory, Cognitive dysfunction, nootropic, ayurveda.

I. INTRODUCTION

Ayurveda mentions three main aspects of mental abilities, i.e., Dhi (process of acquisition/understanding/learning), Dhuti (process of retention) and Smriti (process of recall) Dementia is defined as a malfunction in the acquisition/learning, retention, or recall processes. Ayurveda is a traditional Indian medicine system that has developed therapeutic measures for a good range of diseases and ailments. Agents have been developed to slow down the ageing process while also rejuvenating the body's overall functional dynamics. This type of rejuvenation therapy is known as, and natural remedies have been prescribed to improve memories and prevent memory loss in the brain in the treatment of dementia. Herbs which improve memory and blood circulation in the brain are known as memory enhancers. With some success, nootropics have been used to treat degenerative brain disorders like Alzheimer's and Parkinson's disease. Finding substances that may help to improve brain function is a difficult task. In light of the foregoing, we attempted to compile a list of medicinal plants having nootropic activity from the literature. Nootropics, also known as the smart drugs, cognitive enhancers and memory enhancers, also drugs, supplements, nutraceuticals, nutritional foods that claim to improve cognitive, memory, intelligence, attention, and concentration. Nootropics are thought to work by modify the availability of neurochemicals (enzymes, neurotransmitters, and hormones) in the brain, improving the oxygen supply to the brain, or stimulating nerve growth. Memory refers to a person's ability to analyze and record sensory stimuli, events, information, and so on, and store them for a period of time, and then recall them when needed. In today's exhausting and competitive world, poor memory, low retention, and slow recalling are all common issues Memory loss, amnesia, anxiety, high blood pressure, dementia, and more serious threats disease like dementia, schizophrenia and Alzheimer's disease can all be caused by age, stress, and emotions.

This review is concentrated on the potential of ayurvedic herbal medicine as nootropic activities since they are responsible for more than two-thirds of all dementia cases.

Memory, executive functioning, language, visuospatial functioning, and attention are the cognitive functions that are most affected in Alzheimer's patients. Several theories have been proposed to figure out what causes Alzheimer's disease. The cholinergic hypothesis, which is the oldest theory, claims that acetylcholine (ACh) deficiency is the cause. The currently available therapies for Alzheimer's disease management are based on this hypothesis. The most compelling

hypothesis, the beta-amyloid hypothesis, lays the groundwork for the development of new Alzheimer's disease therapeutic strategies. Alzheimer's disease is labeled by the formation of neuritic plaque and neurofibrillary tangles (NFTs) in the brain. Other factors that may contribute to neurodegeneration in Alzheimer's disease include elevated levels of advanced glycation end products, oxidative damage, and neuroinflammation. Because free radicals and inflammation play a role in Alzheimer's disease pathogenesis, antioxidant and anti-inflammatory drugs may be useful therapeutic tools. In studies, antioxidants were found to protect against A-induced neurotoxicity. The A (25–35)-induced activation of cyclin-dependent kinase 5, calcium influx, calpain activation, and tau hyperphosphorylation were all inhibited by the herbal drug Fuzhisan (FZS), resulting in a neuroprotective effect. Its ability to recall information, also known as "memory, "is one of its most impressive qualities. We must first understand what memory is before we can begin this review. 'Memory' are often defined during a sort of ways. "Memory is that the ability of a private to record the sensory stimuli, events, pieces of data, then on and retain them for brief or long periods of your time so as to recall them when needed later." during a nutshell, memory is one among the foremost important aspects of human survival.

However, when it involves memory. But once we discuss memory, it's not only the retention of data, alongside it we also consider some associated terms like- cognition, intelligence, attention, concentration, quality of life (QOL) etc. Intelligence is consistent with Ayurveda the mixture of three capabilities of mind:
Acquisition: Capacity to understand any information and to analyze it.
Retention: Retain the knowledge inside the brain.
Recollection: Recall the knowledge later.
Based on the various mechanisms and kinds, memory are often classified into 3 types:
i) Short term memory –rapidly formed memory that's retained for a brief time (minutes to hours).
ii) Long term memory –a memory that's retained for long periods, e.g.-from hours to days, weeks, months, even years ..
iii) Iconic Memory-the potential to remember temporarily the large amounts of data that folks experience a day
The up mentioned 'retention' and 'recollection' affect STM and LTM respectively .

NEUROBIOLOGY OF MEMORY

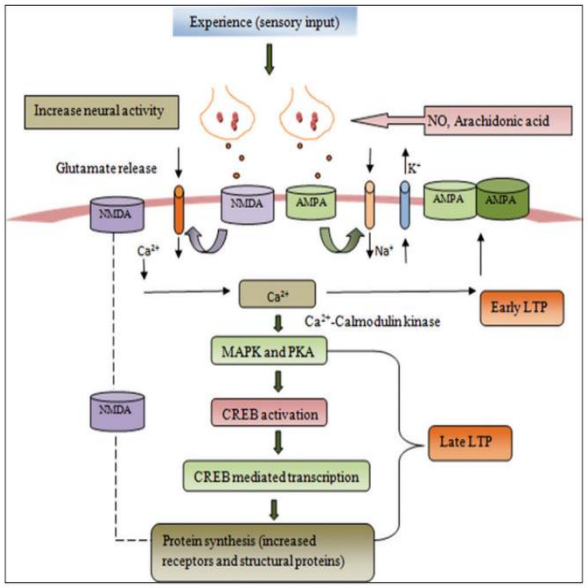

Fig. 1: Neurobiology of memory

formation process Synaptic plasticity refers to the changes in the physically and chemically that occur in the brain during learning and memory formation. It depicts the involvement of various signal transduction pathways, as well as the induction of gene expression, which leads to the formation of new synapses between nerve cells. This method is constantly being updated as time and new experiences pass. Short-term memory (lasts seconds or minutes at most), intermediate long-term memory (lasts days to weeks), and long-term memory (lasts months or years) are the three types of memory (once gathered, can be recollected up to years or even a lifetime later) The binding of neurotransmitters to the N-methyl D-aspartate (NMDA) and amino-3-hydroxy-5-methyl-4-isoxazole propionic acid (AMPA) receptors triggers a cascade of molecular events that activate the CREB and PKC pathways, resulting in the development of new proteins, such as receptors and structural proteins, that cement the synaptic connection between two frequently communicating neurons, ultimately leading to memory formation. A number of studies have shown that the NF-kB/Rel pathway is involved in the regulation of synaptic plasticity and that inhibiting

NF-kB activity in neurons results in improved cognitive functions. Calcium influx into the NMDA receptor channel during the initial stage of long-term potentiation (LTP) causes activation of Ca2+/calmodulindependent protein kinase and phosphorylation of previously existing AMPA glutamate receptor subtypes, as well as glutamate infusion into the postsynaptic membrane of newly formed AMPA receptors. Ampa receptors respond quickly by opening Na2+ and K+ ion channels, causing the cell membrane to depolarize. Adjuvant membrane depolarization, which opens the Ca2+ ion channel, is required for NMDA receptors to respond to glutamate alone. LTP is promoted by an increase in the postsynaptic response to glutamate release, which is mediated by an NMDA receptor-dependent influx of Ca2+. Arachidonic acid and NO are retrograde messengers that work presynaptically to nurture synaptic activity, and they are activated by Ca2+ influx.Cognitive dysfunction is a large-scale health issue in the twenty-first century, with cognitive dysfunction being one of the most functionally debilitating features of various neuropsychiatric and neurodegenerative disorders, such as Alzheimer's disease (AD), dementia, schizophrenia, depression, seizure, cerebrovascular impairment, Parkinsonism, and head injury. Because ageing causes a decline in LTP induction and synaptic plasticity, it is a major factor in cognitive dysfunction, such as age-related memory loss.

Cognitive enhancement

To improve cognition, various schemes are being pro posed. The majority of interventions are aimed at dis ease pathologies or procedures that obscure fundame ntal cognition, especially synaptic plasticity.

The following are treatment options for improving m emory and cognition: • Exercising and caring for the environment • Minerals and vitamins • Pharmaceutical plants and herbs; Medicinal plants and herbs; Medicinal plants and herbs in this article. The role of herbal drugs in memory and cognition en hancement has been thoroughly examined in this artic le using an evidence-based approach.

Herbal remedies for impaired memory and cognition:

Mechanisms and pharmacological actions

Herbal remedies are traditional herbs used over the world to enhance poor memory and related ailments. Several herbal medicinal plants and their extracts have shown nootropic properties or memory-enhancing properties by suitable character of their medicinal components.

Because herbal compounds have fewer or no side effects than any other chemical compound, herbal remedies are becoming increasingly popular around the world. Ayurveda, or Indian medicine, has a plethora of medicinal plants that improve memory, cognition, and intelligence. These Ayurvedic herbs are now widely used throughout the world. A large number of medicinal plants are used in Indian Ayurveda, Traditional Chinese Medicine (TCM), Japanese, Korean, African, American, and European medicines to help reverse memory loss.

The herbs acting upon brain cells are termed ‘nootropic drugs and their isolated compounds are called as ‘smart drugs’ or ‘cognitive enhancers’ or ‘brain booster’. Herbs The herbs which promote intelligence are referred to as 'Medhya herbs/ Rasayana' in Ayurveda, and which include Jatamansi, Ashwagandha, Vacha, Jyotishmati, Shankhapushpi, Amalaki, Yashtimadhu, Kavach Beej, Bramhi, and Mandukparni. By inhibiting excess AChE activity, all of these medicinal herbs increase neurotransmitter levels (especially acetylcholine) in the brain and improve blood circulation inside the brain, providing adequate oxygen to brain cells.

Some home remedies against poor memory are found in commonly known food plants, which we can have as oils and vegetables. The World Health Organization (WHO) states that at present date 80% of the world populations are using herbal remedies for the improvement of health.

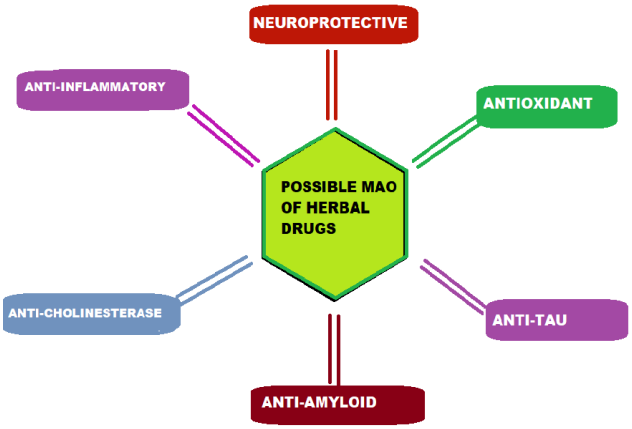

FIG.2 Multiple approach of herbal drug in AD

Memory enhancers

Functional foods, supplements and drugs that are able to improve memory, cognition intelligence and other mental functions are known as memory and cognitive enhancers. There is another term that can be used to describe memory and cognitive enhancers: ‘Nootropics’ Nootropics. The word ‘nootropic’

(Greek: noos-mind, tropein-to bend/turn or montor) was first coined in 1972 by Dr Corneliu E Giurgea. Nootropics are referred to as 'smart drugs' that act upon our brain cells. A nootropic is extremely non-toxic neuroprotective substance and can be used as memory and cognitive enhancer and in AD treatment. The functions of nootropics are: (a) Improving Acetylcholine level in the brain, (b) Improving O2 supply to the brain, (c) Supplying neurochemicals (e.g.-neurotransmitters, enzymes, hormones) to the brain. To improve memory and mood several nootropic agents are generally used such as Aniracetam, Oxiracetam, Pramiracetam, Piracetam and Choline esterase inhibitors like Donepezil, but the side effects of these agents have made their applicability limited.

Sanskrit name	Botanical name
Apāmarga	*Achyranthes aspera* L.
Brāhmī	*Bacopa monnieri* (L.) Wettst.
Guḍūci	*Tinospora cordifolia* (Willd.) Miers
Harītaki	*Terminalia chebula* Retz.
Kūṣmāṇḍa	*Benincasa hispida* (Thunb.) cognitive
Kuṣṭha	*Saussurea lappa* (Decne.) Sch. Bip.
Maṇḍūkaparṇī	*Centella asiatica* (L.) Urb.
Śatāvarī	*Asparagus racemosus* Willd.
Śankhapuṣpī	*Convolvulus pluricaulis* Choisy
Śaṅkhinī	*Clitoria ternatea* L.
Vacha	*Acorus calamus* L.
Viḍaṅga	*Embelia ribes* Burm.f.
Yaṣṭhimadhu	*Glycyrrhiza glabra* L.

History of memory enhancers in Ayurveda

Ayurveda The science of life is an alternative medicine system with roots in the Indian subcontinent that has been around for a long time. This branch of natural science combines basic natural laws with a therapeutic approach to treat a wide range of human ailments. The brain is the most vulnerable organ to this process because it represents a systematic involution of the human body. As a result, the Rasayana therapy, an Ayurvedic rejuvenation branch, was created to prevent this damage. Some natural medications which act as a brain tonic, promote brain health, alleviate behavioral disorders, or cure memory impairment are used in the Rasayana approach. Rasayana therapies include the use of memory-enhancing and rejuvenating plants such as Acorus calamus, Bacopa monniera, Clitoria , Withania somnifera, Asparagus racemosus, and others.The balance of health and disease is the foundation of Traditional Chinese Medicine (TCM). A healthy body, according to TCM theory, is one that is in balance; disharmony, on the other hand, does not cause disease. A combination of factors, including lifestyle, pathogen influence, and various negative effects, cause the disease. Herbal therapy, on the other hand, can aid in the restoration of balance. Thousands of years of experience in treatment, diagnosis, and disease prevention have allowed the Chinese to develop a comprehensive theoretical system of medical therapy. Herbal medicines with memory-enhancing properties are also included in TCM.

Nootropic activity in polyherbal formulations

Polyherbal formulations with nootropic activity are available on the market. BR-16A (Mentat) tablets, Brahmi Plus Capsules, Brahmivita Granules, Brain tab Tablets, Saraswatharishtham Syrup, Gingcopa Tablets, Mind Power Tablets, and Bramhi Grita Tablets are just a few examples. Withania somnifera, Ginkgo biloba, Ocimum sanctum, Asparagus racemosus Wild., Emblica officinalis Gaertn., Panax ginseng, Nardostachys jatamansi DC., Evolvulus alsinoides Linn.,

Valeriana jatamansi Jones, Valeriana jatamansi Jones, Valeriana jatamansi Jones, Acorus calamus Linn., Tinospora cordifolia Miers, Celastrus paniculatus Wild., Saussurealappa Linn., Acorus calamus Linn., Acorus calamus Linn., Acorus calamus Linn., Acorus calamus Linn Terminalia chebula Retz., Terminalia bellirica Roxb., Sasakurinensis Makino et Sibata, Pinusdensiflora Sieb.et Zucc., Tribulus terrestris Linn., and Piper nigrum The purpose of this study is to assess the nootropic effect of a polyherbal formulation containing brahmi, ashwagandha, and shatawari.

Herbal plants :

Plant description: Bacopa monnieri (brahmi)

Bacopa monnieri (B. monniera) is a small, perennial creep herb with numerous branches, small oblong leaves, and purple flowers that belongs to the Scrophulariaceae family. It's known as Brahmi in India, and it's used for its energising, Medhya rasayana, and nootropic properties, which help with memory and intellect (Medhya). Bacopa used to treat a variety of ailments by practitioners of India's traditional ayurvedic system of medicine for thousands of years.

Main chemical constituents: The main chemical compounds of B. monniera contains triterpenoid saponins known as bacosides. It also contains alkaloids brahmine, nicotine and herpestine. The saponins bacopasides I–XII have also been identified.

Pharmacological activities: Anticonvulsant, antidepressant, anxiolytic, analgesic, anti-inflammatory, antioxidant, antimicrobial, antiulcerogenic, anti-Helicobacter pylori, adaptogenic, antineoplastic, bronchodilatory, hepatoprotective, and immunostimulatory are some of the biological activities of this medicinal herb. Since ancient times, Bacopa monnieri (Brahmi) used as a nerve tonic for memory enhancement. The chemical ingredient responsible for the action of brahmion learning regimens has been identified as a combination of two saponins known as bacosides A and B. In the hippocampus, they also improve activity of protein kinase and protein levels. Bacosides have also been found to be safe in FDA-sponsored pharmacological and toxicological studies. Bacopa monnieri (Bacopa monnieri) is a plant that grows in the Bacopa monnieri family (Brahmi) Brahmi is the most widely used nootropic (Scrophulariaceae). The plant extract improves cognition and memory while also scavenging reactive oxygen species (ROS) and acting as a sedative. The saponin and bacoside content of brahmi extract (alcoholic) is what gives it its nootropic properties. Novel components (bacopasaponin G, bacopasides III, IV, and V, as well as phenyl-ethyl alcohol) were extracted, according to the researchers. The cholinergic system, which affects the neurotransmitter acetylcholine and the nervous system areas that use acetylcholine as a memory coordinator, is influenced by Brahmi. This neurotransmitter's availability is improved, which improves cognitive activities in the brain. In rats, the plant extract (alcoholic) improves cognition and retention, reduces retrograde amnesia, and protects against phenytoin-induced cognit+ive decline. Bacoside antioxidant effects against chronic toxin-induced oxidative catastrophe in the rat brain were discovered in a recent study, as well as thyroid T4 hormone attractive actions in animals at high doses. In the treatment of amnesia, brahmi extract has the potential to be a powerful memory enhancer. Brahmi lowers the likelihood of forgetting what you've learned.

Preclinical studies: The extract of B. monniera has been found to contain alkaloids, flavonoids, glycosides, triterpenoids, saponins, and alcohols, among other beneficial bioactive components. In the foot shock motivated brightness discrimination test, active conditioned avoidance test, and Sidman continuous avoidance responses in rats, the alcoholic extract of B. monniera improved acquisition, consolidation, and retention of memory. Bacosides A and B (a mixture of two saponins) may be responsible for its learning and memory facilitation. Bacosides have also been shown to have antioxidant and anti-inflammatory properties.. Bacosides also attenuate the reverse amnesia produced by immobilization-induced stress, electroconvulsive shock, and scopolamine. They improve protein kinase activity and increased the protein content in the hippocampus, which may also contribute to their memory-enhancing effect. Administration of bacosides (200 mg/kg) for 3 months in middle-aged and aged rats exerted a protective

effect against age-associated alterations in the neurotransmission system, behavioral paradigms, hippocampal neuronal loss, and oxidative stress markers. The involvement of the microRNA 124-CREB pathway and serotonergic receptor in the memory enhancing mechanism of standardized extract of B. monniera (BESEB CDRI-08) has also been reported. The effect of alcoholic extract of Bacopa has been evaluated at the doses of 20, 40, and 80 mg/kg on cognitive functions and neurodegeneration in the animal model of AD induced by bilateral intracerebroventricular administration of AF64A. They found that Bacopa improved the escape latency in the Morris water maze test and prevented the reduction in cholinergic neuron density. Besides, oral administration of 40 mg/kg/day of the Bacopa extract for 5 weeks prevented neurotoxicity in rats exposed to aluminum chloride. The cognitive deficit induced by intracerebroventricular (ICV) injection of colchicine and ibotenic acid into the nucleus basalis magnocellularis was attenuated by standardized Bacopa extract by reversing the depletion of ACh level, reduction in choline acetyl transferase (ChAT) activity and decrease in muscarinic cholinergic receptor binding in the frontal cortex and hippocampus. Holcomb et al. reported that administration of ethanolic extract of Bacopa leaves at doses of 40 and 160 mg/kg for 2 and 8 months reduced A 1–40 and 1–42 levels in the cortex of PSAPP mice. Bacopa, at a dose of 50 mg/kg, demonstrated a neuroprotective effect in the colchicine model of dementia through its antioxidant effect and restored the activity of Na+K+ATPase and AChE. The neuronal dendritic growth stimulating property of Bacopa has also been reported, which may be responsible for its memory enhancing property.

Withania somnifera (ashwagandha)

Withania somnifera is a small woody shrub that is commonly cultivated in India and belongs to the Solanaceae family. Indian ginseng, winter cherry, and ashwagandha are some of the other names for the herb. It's a popular Ayurvedic herb with greenish or yellowish flowers that are about a centimeter long. It's used as a general tonic in a variety of formulations to boost energy, improve overall health, and extend life. Ashwagandha, also known as Withania somnifera, is a popular herb in Ayurvedic and traditional medicine. The plant is called "Medhya Rasayan," which means "mind rejuvenate," and it helps with memory and overall brain function. Sitoindosides VII-X and Withaferin A (glycowithanolides) from Withania somnifera have been shown to have an antioxidant effect in the brain, which could explain its diverse pharmacological properties. Withania somnifera is a plant that has been used to improve physical and mental health, protect against disease and harmful environmental elements, and slow down the ageing process. Withania somnifera has been shown to have antioxidant, anti-tumor, anti-stress, anti-inflammatory, immunomodulatory, hematopoetic, anxiolytic, anti-depressive, and rejuvenating properties, and to play a significant role in the prevention of various CNS illnesses, particularly stress and neurodegenerative diseases such as Parkinson's and Alzheimer's disorders, tardive dyskinesia, and cerebral ischemia, as well as in the treatment of drug addiction. It improves cognition and has been shown to help children with memory problems as well as elderly people suffering from memory loss. In a study, Schliebs et al. found that Withania somnifera improves brain cognitive abilities by increasing muscarinic receptor capacity. The goal of this research was to see how Withania somnifera extract influenced cognitive and psychomotor performance in healthy human volunteers.

Main chemical constituents: The major phytoconstituents of W. somnifera are isopellertierine, anferine, withanolides, withaferins, sitoindoside VII and VIII and withanoloides. Other chemical compounds are withanine, somniferine, somnine, somniferinine, withananine, pseudo-withanine, tropine, pseudo-tropine, 3-a-gloyloxytropane, choline and cuscohygrine.

Pharmacological activities: W. somnifera exhibits a broad range of biological activities like anti-inflammatory, antioxidant, neuroprotective, antischemic, anti-Parkinson's, antiepileptic, anxiolytic, antidepression, antiarthritic, cardioprotective, antidiabetic, anticancer, antistress, nephroprotective, hepatoprotective, antihypoxic, immunomodulatory, hypolipidemic and antimicrobial.

PRECLINICAL STUDIES

W. somnifera root total alkaloid extract (ashwagandholine, AG) has been studied for its effects on the CNS. W. somnifera root antioxidant mechanism. somnifera attenuated the memory loss induced by STZ. The root preparation has been shown to have neuroprotective effects in neurodegenerative disorders by reducing stress-induced hippocampus degeneration in rats The extract containing sitoindosides VII–X and withaferin A (50 mg/kg, p.o for two weeks) reversed ibotenic acid-induced cognitive deficit and reduction in cholinergic markers (e.g., ACh and ChAT) in rats. Sitoindosides VII-X and withaferin (40 mg/kg for 7 days) altered AChE activity and increased M1- and M2-muscarinic receptor binding in various brain regions .Withaferin A and Withanolide A are suggested to have a potent immunomodulatory effect in BV-2 microglial cells by triggering the Nrf2 pathway, leading to production of neuroprotective proteins such as heme oxygenase-1

Asparagus racemosus

Asparagus racemosus (satavar, shatavari, or shatamull, shatawari) is an asparagus species native to India, the Himalayas, and northern Australia. It grows to a height of 12–12 m (3 ft 3 in – 6 ft 7 in) and prefers to take root in gravelly, rocky soils high up in the piedmont plains, at an elevation of 1,300–1,400 m (4,300–4,600 ft). In 1799, it was botanically described. The demand for Asparagus racemosus is constantly increasing due to its many uses. The plant is now classified as "endangered" in its natural habitat due to destructive harvesting, habitat destruction, and deforestation. Asparagus racemosus (family: Asparagaceae), also known as "Shatavari," which means "woman who has a hundred husbands," implies that this plant is extremely beneficial in female reproductive system disorders. Charak Samhita by Charak and Ashtang Hridyam by Vagbhata, the two main sources on Ayurvedic remedies, both include Asparagus racemosus as part of the formulae to treat problems affecting women's health. In modern Ayurvedic medicine, the plant's roots are used as an antispasmodic, stomach tonic, aphrodisiac, galactogogue, astringent, antidiarrhoeal, antidysentery, laxative, anticancer, anti-inflammatory, blood purifier, antitubercular, antiepileptic, and in the treatment of night blindness, kidney problems, and throat complaints. It's also known as medhya, a term that refers to herbs that improve intelligence, learning, and memory. The rejuvenator herbs improve health by boosting immunity, vigour, and resistance, as well as promoting longevity and stress resistance. There are 22 species of asparagus recorded in India, with A. racemosus being the most often utilized as a medicinal herb in traditional medicine.

Chemical constituents

Shatavari possesses a wide range of phytochemical constituent which are mentioned below. Shatavari roots contain 4 steroids saponin known as shatvarins. Shatvarin I to VI are present. Shatvarin I is the major glycoside with 3-glucose and rhamnose moieties attached to sarsapogenin, whereas in sahatvarin –IV two glucose & one rhamnose moieties attached Recently, Shatavarin V, Asparginins,curillins, Asparosides, Curillosides have also been reported. Oligospirostanoside referred to as Immunoside. (Polycyclic alkaloid- Aspargamine A, a cage type pyrrolizidine alkaloid . Isoflavones - 8-methoxy- 5, 6, 4-trihydroxy isoflavone-7-0-beta-D-glucopyranoside . A cyclic hydrocarbon-Racemosol .Furan compound-Racemofuran . Carbohydrates- Polysaccharides, mucilage . Flavanoids- Glycosides of quercitin, rutin and hyperoside are present in flower and fruits . Sterols- Roots also contain sitosterol, benzaldehyde and undecanyl cetanoate . Trace minerals - are found in roots-zinc, manganese, copper, cobalt along with calcium, magnesium, potassium zinc and selenium . Kaepfrol- Kaepfrol along with Sarsapogenin from woody portions of tuberous roots could be isolated . Miscellaneous- Essential fatty acids- Gamma Linoleinic acids, Vitamin A, Diosgenin, quercetin 3-glucourbn .

Pharmacological activities

Antidepressant activity, Antitussive activity , Antisecretory activity, Adaptogenic activity, Antiprotozoal activity , Antibacterial activity , Gastrointestinal activity , Aphrodisiac activity , Anti-hepatocarcinogenesis , Anti-stress activity , Galactogogue , Anti-inflammatory activity , protects against amnesia enhances memory activity :- In specific brain regions, Asparagus racemosus inhibited the acetylcholinesterase enzyme (at prefrontal cortex, hippocampus and hypothalamus). As a result, it exhibits nootropic and anti-amnesic properties in the models studied, and these effects may be mediated through augmentation of the cholinergic system due to its anti-cholinesterase activity. A. racemosus extract also demonstrated a significant reduction in latency time during retention trials. With A. racemosus, hippocampal regions associated with learning and memory show a dose-dependent increase in acetylcholinesterase activity in Carbonic anhydrase1. Involvement in neurodegenerative disorders:- Excitotoxicity and oxidative stress are the main mechanisms of neuronal cell death in Alzheimer's and Parkinson's diseases. As a result, a compound that can slow or reverse neuronal damage is needed to combat neurodegenerative disorders in mice. Intra-hippocampal and intra-striatal injections of KA to anesthetized mice resulted in the production of excitotoxic lesionsin the brain. After KA injection, impairment of hippocampus and striatal regions of brain was observed accompanied by increased lipid peroxidation, increased protein carbonyl content, decreased glutathione peroxidase (GPx) activity and reduced glutathione hormone (GSH) content. GSH is an important antioxidant which acts as a nucleophilic scavenger of toxic compounds and as a substrate in the GPx-mediated destruction of hydroperoxides which would otherwise accumulate to toxic levels in brain tissues. The mice treated with Asparagus racemosus extract showed an enhancement in GPx activity and GSH content, and reduction in membranal lipid peroxidation and protein carbonyl. They concluded that the plant extract plays the role of an antioxidant by attenuating free radical induced oxidative damage .

Preclinical studies :

Asparagus racemosus (AR) is an Ayurvedic rasayana possessing multiple neuropharmacological activities. The adpatogenic and antidepressant activities of AR are well documented. The present study was undertaken to assess the nootropic and anti-amnesic activities of MAR in rats. The Morris water maze (MWM) and elevated plus maze (EPM) models were employed to evaluate learning and memory activity. Subsequently, the anti-amnestic activity was evaluated in scopolamine and sodium nitrite ($NaNO_2$)-induced amnestic models in rats. Rats pre-treated with MAR (50, 100, and 200 mg/kg, p.o) for 7 days showed a significant decrease in escape latency in the MWM test, indicating nootropic activity. MAR also significantly reversed scopolamine and sodium nitrite-induced increases in transfer latency on EPM, indicating antiamnesic activity. Further, MAR dose-dependently inhibited the acetylcholinesterase enzyme in specific brain regions (prefrontal cortex, hippocampus, and hypothalamus). Thus, MAR showed nootropic and antiamnesic activities in the models tested, and these effects may probably be

mediated through augmentation of the cholinergic system due to its anti-cholinesterase activity. The various studies demonstrate that MAR possesses an outstanding source for natural nootropics and confirm the traditional uses of this plant, which could be industrialised for enhancing learning and memory impairment associated with neurodegenerative disorders, particularly AD.

Conclusion :
Ayurveda an integrated science arranges solutions for memory and cognitive disorders in a beneficial way. From the discussion, herbal nootropic drugs find beneficial usefulness in achieving adequate results in memory disorders. Thus, the effort has been made to consider rationally in the prospect of memory enhancement in a view to explore greener pastures.

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COMPETING INTERESTS, we declare that we have no conflicts of interest

References:

https://www.researchgate.net/profile/Rajiv-Gupta-17/publication/259291121_Role_of_Traditional_Medicine_in_Neuropsychopharmacology/links/555f48be08ae6f4dcc926b9d/Role-of-Traditional-Medicine-in-Neuropsychopharmacology.pdf

2 https://www.nature.com/articles/s41392-019-0063-8

3 2020 Alzheimer's disease facts and figures - PubMed (nih.gov)

4Shaji: Alzheimer's and related disorders society of India - Google Scholar

5 Kumar: StatPearls [internet] - Google Scholar

6 Alzheimer's disease and Parkinson's disease - PubMed (nih.gov)

7 Davies: Selective loss of central cholinergic neurons... - Google Scholar

8 A review on cholinesterase inhibitors for Alzheimer's disease | SpringerLink

9 Beyreuther: Amyloid Precursor Protein (APP) and BZA4... - Google Scholar

10 Amyloid deposition as the central event in the aetiology of Alzheimer's disease - ScienceDirect

11 Alzheimer's Disease: The Amyloid Cascade Hypothesis (science.org)

12The molecular pathology of Alzheimer's disease: Neuron (cell.com)

13 The amyloid hypothesis of Alzheimer's disease at 25 years - PMC (nih.gov)

14 Effects of a Standardized Bacopa monnieri Extract on Cognitive Performance, Anxiety, and Depression in the Elderly: A Randomized, Double-Blind, Placebo-Controlled Trial - PMC (nih.gov)

15 Amelioration of intracerebroventricular streptozotocin induced cognitive impairment by Evolvulus alsinoides in rats: In vitro and in vivo evidence - ScienceDirect

16 beta-Amyloid toxicity in organotypic hippocampal cultures: protection by EUK-8, a synthetic catalytic free radical scavenger. | PNAS

17 Melatonin Prevents Death of Neuroblastoma Cells Exposed to the Alzheimer Amyloid Peptide | Journal of Neuroscience (jneurosci.org)

18 https://search.proquest.com/openview/4082300c6958cd1ab08ebded78fa85c1/1?pq-origsite=gscholar&cbl=37979

19 (PDF) MEDICINAL PLANTS WITH NOOTROPIC EFFECT: A REVIEW (researchgate.net)

20 Brain Sciences | Free Full-Text | Indian Medicinal Herbs and Formulations for Alzheimer's Disease, from Traditional Knowledge to Scientific Assessment | HTML (mdpi.com)

21 Neuropharmacological Review of the Nootropic Herb Bacopa monnieri | Rejuvenation Research (liebertpub.com)

22 Neurocognitive Effect of Nootropic Drug Brahmi (Bacopa monnieri) in Alzheimer's Disease - FullText - Annals of Neurosciences 2017, Vol. 24, No. 2 - Karger Publishers

23 Kishore: Effect of bacosides, alcoholic extract of... - Google Scholar

24 Singh: Modulation of hydrogen peroxide and acrolein-induc... - Google Scholar

25 Joshi: Brahmi rasayana improves learning and memory in mice - Google Scholar

26 Kishore: Effect of bacosides, alcoholic extract of... - Google Scholar

27 Singh: Neuropsychopharmacological effects of the... - Google Scholar

28 Srinath: Memory enhancing medicinal herbs - Google Scholar

29 Prevention of age-associated neurodegeneration and promotion of healthy brain ageing in female Wistar rats by long term use of bacosides | SpringerLink

30 Participation of microRNA 124-CREB pathway: a parallel memory enhancing mechanism of standardised extract of Bacopa monniera (BESEB CDRI-08) | SpringerLink

31 Attenuation of 1-(m-Chlorophenyl)-Biguanide Induced Hippocampus-Dependent Memory Impairment by a Standardised Extract of Bacopa monniera (BESEB CDRI-08) | SpringerLink

32 https://linkinghub.elsevier.com/retrieve/pii/S0378874106005745

33 Bhattacharya: Molecular Aspects of Asian Medicines - Google Scholar

34 Neuroprotective Effects of Bacopa monnieri in Experimental Model of Dementia | SpringerLink

35 Vollala: Enhanced dendritic arborization of hippocampal... - Google Scholar

36 The acute effects of an extract of Bacopa monniera (Brahmi) on cognitive function in healthy normal subjects - Nathan - 2001 - Human Psychopharmacology: Clinical and Experimental - Wiley Online Library

37 Chronic Effects of Brahmi (Bacopa monnieri) on Human Memory | Neuropsychopharmacology (nature.com)

38 Erratum to: The chronic effects of an extract of Bacopa monniera (Brahmi) on cognitive function in healthy human subjects | SpringerLink

39 Effects of a Standardized Bacopa monnieri Extract on Cognitive Performance, Anxiety, and Depression in the Elderly: A Randomized, Double-Blind, Placebo-Controlled Trial | The Journal of Alternative and Complementary Medicine (liebertpub.com)

40 Raghav: Randomized controlled trial of standardized... - Google Scholar

41 Singh: Neuropsychopharmacological effects of the... - Google Scholar

42 Negi: Clinical evaluation of memory enhancing properties... - Google Scholar

43 Bacopa monniera, a reputed nootropic plant: an overview - ScienceDirect

44 Neurocognitive Effect of Nootropic Drug Brahmi (Bacopa monnieri) in Alzheimer's Disease - Abstract - Annals of Neurosciences 2017, Vol. 24, No. 2 - Karger Publishers

45 https://iijls.com/currentissue/IJLSSR-1034-10-2015.pdf

46 1917-ArticleText-4341-1-10-20210701.pdf

47 Bone: Clinical applications of Ayurvedic and Chinese herbs - Google Scholar

48 Chatterjee: Treatise on Indian medicinal plants - Google Scholar

49 Chatterjee: Treatise on Indian medicinal plants - Google Scholar

50 Pharmacologic overview of Withania somnifera, the Indian Ginseng | SpringerLink

51 Molecules | Free Full-Text | Steroidal Lactones from Withania somnifera, an Ancient Plant for Novel Medicine (mdpi.com)

52 Mishra: Scientific basis for the therapeutic use... - Google Scholar

53Chemistry and pharmacology of withania somnifera: An update -CELLMED | Korea Science

54 Malhotra: Studies on Withania-ashwagandha, Kaul.... - Google Scholar

55 Susceptibility of hippocampus and cerebral cortex to oxidative damage in streptozotocin treated mice: prevention by extracts of Withania somnifera and Aloe vera - Journal of Clinical Neuroscience (jocn-journal.com)

56 Neuroprotective Effects of Withania somnifera Dunn. in Hippocampal Sub-regions of Female Albino Rat - Jain - 2001 - Phytotherapy Research - Wiley Online Library

57Effects of glycowithanolides from Withania somnifera on an animal model of Alzheimer's disease and perturbed central cholinergic markers of cognition in rats - Bhattacharya - 1995 - Phytotherapy Research - Wiley Online Library

58 Withania somnifera and Its Withanolides Attenuate Oxidative and Inflammatory Responses and Up-Regulate Antioxidant Responses in BV-2 Microglial Cells | SpringerLink

59Withanoside IV and its active metabolite, sominone, attenuate Aβ(25–35)-induced neurodegeneration - Kuboyama - 2006 - European Journal of Neuroscience - Wiley Online Library

60 Sominone enhances neurite outgrowth and spatial memory mediated by the neurotrophic factor receptor, RET - Tohda - 2009 - British Journal of Pharmacology - Wiley Online Library

61 Sominone enhances neurite outgrowth and spatial memory mediated by the neurotrophic factor receptor, RET - Tohda - 2009 - British Journal of Pharmacology - Wiley Online Library

62Withanamides in Withania somnifera fruit protect PC-12 cells from β-amyloid responsible for Alzheimer's disease - Jayaprakasam - 2010 - Phytotherapy Research - Wiley Online Library

63 Withania somnifera reverses Alzheimer's disease pathology by enhancing low-density

lipoprotein receptor-related protein in liver | PNAS

64Protective Role of Ashwagandha Leaf Extract and Its Component Withanone on Scopolamine-Induced Changes in the Brain and Brain-Derived Cells (plos.org)

65 An Aqueous Extract of Withania somnifera Root Inhibits Amyloid β Fibril Formation In Vitro - Kumar - 2012 - Phytotherapy Research - Wiley Online Library

66 Effect of ashwagandha on lipid peroxidation in stress-induced animals - ScienceDirect

67 Withania somnifera showed neuroprotective effect and increase longevity in Drosophila Alzheimer's disease model | bioRxiv

68 Pandey: Multifunctional neuroprotective effect of... - Google Scholar

69https://www.biorxiv.org/content/10.1101/2020.04.27.063107.abstract

70 Efficacy and Safety of Ashwagandha (Withania somnifera (L.) Dunal) Root Extract in Improving Memory and Cognitive Functions: Journal of Dietary Supplements: Vol 14, No 6 (tandfonline.com)

71 A systematic review of the clinical use of Withania somnifera (Ashwagandha) to ameliorate cognitive dysfunction - Ng - 2020 - Phytotherapy Research - Wiley Online Library

72https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3897003/

73 pdf-141582-68402 (jpccr.eu)

74Efficacy and Safety of Ashwagandha (Withania somnifera (L.) Dunal) Root Extract in Improving Memory and Cognitive Functions: Journal of Dietary Supplements: Vol 14, No 6 (tandfonline.com)

75 Neurodegenerative diseases and Withania somnifera (L.): An update - ScienceDirect

76 Plant profile, phytochemistry and pharmacology of Asparagus racemosus (Shatavari): A review - PMC (nih.gov)

77https://www.researchgate.net/publication/8926957_Experimental_excitotoxicity_provokes_oxidative_damage_in_mice_brain_and_attenuation_by_extract_of_Asparagus_racemosus

78(PDF) CODEN(USA): PCJHBA Plant Representation, Phytochemistry and Medicinal Assets of Asparagus Racemosus (researchgate.net)

79(PDF) Neuro-nutraceutical potential of Asparagus racemosus: A review (researchgate.net)

80Neuroprotective Efficacy of Asparagus racemosus Root Extract on Hippocampal Neurons in Scopolamine Mouse Model of Alzheimer's Disease (researchgate.net)

81(PDF) Neuro-nutraceutical potential of Asparagus racemosus: A review (researchgate.net)

82 (PDF) Neuroprotective effect of Asparagus racemosus root extract via the enhancement of brain-derived neurotrophic factor and estrogen receptor in ovariectomized rats (researchgate.net)

83https://pubmed.ncbi.nlm.nih.gov/20594636/#:~:text=Asparagus%20recemosus%20enhances%20memory%20and%20protects%20against%20amnesia,and%20antidepressant%20activity%20of%20AR%20is%20well%20documented.

84 https://1library.net/document/z3nn86dq-updated-review-herbal-drugs-nootropic-activity-possible-mechanisms.html

85https://www.academia.edu/69456130/Neuroprotective_Activity_of_Asparagus_racemosus_Linn_Against_Ethanol_Induced_Cognitive_Impairment_and_Oxidative_Stress_in_Rats_Brain_Auspicious_for_Controlling_the_Risk_of_Alzheimer_s_Disease

86https://www.researchgate.net/publication/328914509_Plants_with_Nootropic_activity_A_Review

87https://www.researchgate.net/publication/317405228_Acute_and_Subacute_Toxicity_Profile_of_Asparagus_racemosus_root_extract_Isoprinosine_and_Shatvari_Syrup_in_Swiss_Albino_Mice