

Medhya Rasayanas in Brain Function and Disease

Suman Ray^{1*} and Asim Ray²

¹CSIR-National Institute of Science Technology and Development Studies (CSIR-NISTADS), Pusa Gate, KS Krishnan Marg, New Delhi, India

²SRM University, NCR Campus, Delhi, India

Abstract

Ayurveda (Sanskrit word meaning “the scripture for longevity”) represents an ancient system of traditional medicine prevalent in India about 5000 years old. Rasayana concept of Ayurveda is believed to be useful to overcome challenging diseases to modern medicine i.e., regeneration of tissues after the disease condition like osteoarthritis, age related macular degeneration (AMD), Alzheimer's and Parkinsons disease, injuries, trauma, heart attack, stroke etc. Neurological and psychiatric disorders are generally associated with loss of memory, cognitive deficits, impaired mental function etc. The 'medhya rasayanas' are known to be beneficial to improve the intellectual e.g., *mandukparni swaras*, *yashtimadhu churna* with *ksheer*, *guduchi swaras*, and *shankhapushpi kalka*. Medhya Rasayana drugs are used for prevention and treatment of mental disorders of all the age groups. These drugs promote the Intellect (Dhi) Retention power (Dhriti), memory (Smriti). Mood disorders are known to be associated with considerable burden of disease, suicides, physical comorbidities, high economic costs, and poor quality of life. Therefore, it has become a major public health problem today. Unfortunately modern medicine based psychoactive drugs have met with limited success in treatment of various neurological and psychiatric disorders due to multi-factorial nature of these diseases. This review discusses about Medhya Rasayanas as a great player for prevention and management of age related cognitive decline.

Keywords: Ayurveda; Medhya rasayanas; Cognition; Degeneration; Mental disorders

Ayurvedic Approach of Disease Prevention

Ayurveda is considered the Upaveda of Atharva Veda, being the oldest recorded wisdom of the earth. Rasayana has been considered as a form of rejuvenative recipes, dietary regimen and a special health promoting conduct and behaviour i.e., Achara-Rasayana Arvid This therapy helps the individual to attain longevity, memory, intelligence, freedom from disorder, youthful age, excellence of luster, complexion and voice, optimum strength of physique and sense organs, successful words, respectability and brilliance. Ayurveda is believed to cure human diseases through establishment of equilibrium in the different elements of human life, the body, the mind, the intellect and the soul [1]. Ancient Ayurvedic approach of disease prevention involves therapeutic measures to arrest/delay ageing and rejuvenating whole functional dynamics of the body system. According to Ayurveda, the homeostasis of the body is maintained by Doshas that regulate all the metabolic processes-(a) Vata-regulates the catabolic activity (tissue wear and tear) (b) Kapha-stimulates synthesis of newer tissues (c) Pitta-governs the process of nutrients assimilation into tissues [2]. The revitalization and rejuvenation approach in Ayurveda is known as the 'Rasayan chikitsa' (rejuvenation therapy), one of the eight specialized branches of Ayurveda. It aims enhancement in strength, immunity, ojus, vitality, will power and determination of the body, longevity, memory, intelligence, excellence of luster, complexion and voice, optimum strength of physique and sense organs. Ayurvedic approach of treatment schedule of psychiatric disease is divided into three main categories as described in Figure 1.

Ayurveda has described various kinds of mental Disorders [3]:

1. Unmada (Insanity)
2. Apasmara (Epilepsy)
3. Atattvaabhinivesha (Obsessive Disorders)
4. Bhaya (Fear)
5. Harsha (Excitation)
6. Shoka (Grief)
7. Udvega (Anxiety)
8. Avasada (Depression)

Considering the effects of drugs on body and how to maintain proper health, acharya Charaka has classified all the drugs into three groups [3]:

1. Dosha Prashamana- which pacifies the vitiated doshas
2. Dhatu Pradushana- which vitiates Dhatus
3. Svasthavrittakara- which maintains the proper health

According to Ayurvedic approach, Rasayana agents are considered to promote nutrition through the following modes [4]:

1. Direct enrichment of the nutritional quality of Rasa (nutritional plasma)- Satavari, milk and Ghee.
2. Promoting nutrition through improving Agni (digestion and metabolism) as Bhallataka, Pippali.
3. Promoting the competence of Srotas (microcirculatory channels in the body) as Guggulu etc.

Rasayana Chikitsa

According to Acharya Charak, equilibrium of Agni of Dhatu, Vayu, and Srotas are essential factors for maintaining normal strength, color and longevity of the body. In Ayurveda, Medhya is described in broad way. Medhya comprises of all the three mental faculties- Dhee, Dhriti and Smriti and these are interrelated with each other [3]. Medhya can also be subdivided into the following faculties:

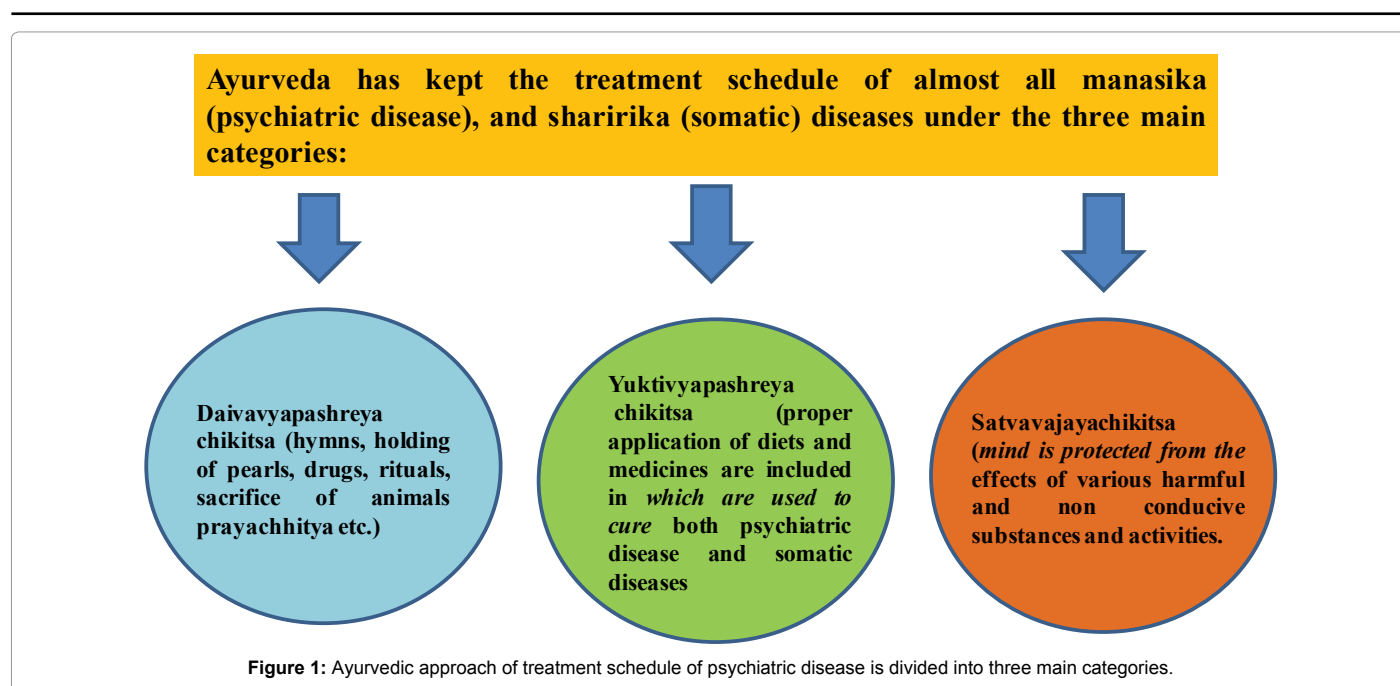
1. Grahanshakti (Power of Grasping)

***Corresponding author:** Dr. Suman Ray, Scientist, CSIR-National Institute of Science Technology and Development Studies (CSIR-NISTADS), Pusa Gate, K.S. Krishnan Marg, New Delhi-110012, India, Tel: +911125843127; Fax: +911125846640; E-mail: sumanitr@gmail.com

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2. Dharana shakti (Power of Retention)
3. Vivekshakti (Power of Discrimination)
4. Smriti (Power of recollection)

The aim of Rasayana Chikitsa is to nourish blood, lymph, flesh, adipose tissue and semen. This prevents the individual from chronic degenerative diseases. The therapy influences the fundamental aspect of body viz., Dhatus, Agni, Srotansi and Ojus [4]. In Rasayana therapy, the Bheshja (medicine) is divided into two types:

- α. Swasthasyaurjaskara-toning up the health of a healthy person
- β. Kinchit Artasya Rognut-treating the ailments of the patients

Rasayana Drugs

As per Acharya Charak, *Rasayanais defined as* the means of achieving the finest quality of rasadidhatus (body tissues) where it increases life span, improves medhya (intelligence), cures disease, stabilizes youthfulness, improves luster, complexion, voice and makes body and senses strong and healthy etc. Rasayana drugs acts as-

- a. **Immunomodulator**- By augmenting or reducing the ability of the immune system.
- b. **Adaptogen**- Increases the ability of an organism to adapt to environmental factors e.g., Ashwagandha, Tulsi, haridra, Pippali, Amalaki, Guduchi, shatavari.
- c. **Antioxidant**- Circumvent the damage caused by oxygen free radical.
- d. **Nootropic**- Promote intelligence and functions of brain e.g., Medhya Rasayana drugs (namely-Mandookparni, Guduchi, Yashtimadhu and Shankhpushpi).

Types of Rasayana (Rejuvenation) therapy [5]

According to achievable outcome- Rasayana is of three types:

1. **Naimittika rasayana** (nimitt-Sanskrit for “cause”) is also known as Rogapaharan or Curative type of Rasayan. It is used to combat

or balance a specific cause responsible for the disease in the body. Few examples include Dhatri rasayana, Mandookaparni rasayana, Brahmi rasayana, and Triphala rasayana.

2. **Ajasrika rasayana** is used to maintain good health and improve the quality of life through a healthy lifestyle, diet, or exercise. It is also called as **Vayasthapan Rasayan**.
3. **Kamyra rasayana**- This is described as to fulfill a wish or desire or to serve a special purpose (kama - desire). It is of four types:
 - α. Prana Kamyra- best quality of prana (life energy) in the body.
 - β. Medhya Kamyra- enhancing the memory and intellect. e.g., Shankhpushpi Rasayan.
 - γ. Ayush Kamyra- increasing longevity.
 - δ. Chakshu Kamyra- maintaining healthy eyes.

According to mode of Administration- It is of two types:

1. **Kutipraveshika** (kuti-cottage, pravesha-enter)- It is an indoor management in which the person lives in a specially prepared cottage for a long period while taking various rasayana herbs.
2. **Vatatapika**- Where “vata” means air, and “atapa” means heat or sun (good for people who are engaged in everyday life activities). It is an outdoor management and involves taking rasayana, while a person remains exposed to air and heat. It includes Chyavanaprasha, Brahma rasayana Shilajitu rasayana, Amalaki rasayana, Haritaki rasayana, Pippali rasayana, Lohadi rasayana and Loha shilajitu rasayana. A total of 63 combinations of various rejuvenation formulae are described in the Charaka samhita.

According to modalities- It is of three types:

1. **Achar Rasayan** (Behavioural modalities)- describes a type of rasayana for psychological and spiritual health. It focuses on the body, mind, and soul, Ayurveda also.
2. **Ahar Rasayan** (Dietary modalities)- includes rules relating to eating, sleeping, and celibacy create rejuvenation in a person,

following a sattvik diet and life style, speaking the truth, practicing non-violence, living in harmony with the nature, following social ethics and conducts, are all included under this category of rasayana.

3. Dravya (Aushadha) Rasayan- includes some herb and food types that are indeed beneficial for the optimum functioning of the body as well as the brain.

What is Medhya Rasayanas?

The word 'medhya rasayanas', have been derived from the Sanskrit words 'medhya', meaning intellect or cognition, and 'rasayana', meaning 'rejuvenation'. The medicinal plants in the Ayurvedic system are classed as brain tonics or rejuvenators. Earlier reports indicate that these plants are used both in herbal and conventional medicine and offer benefits that pharmaceutical drugs lack [6]. Neurological and psychiatric disorders are generally associated with loss of memory, cognitive deficits, impaired mental function etc. The 'medhya rasayanas' are known to be beneficial to improve the intellectual e.g., *mandukaparni swaras*, *yasthimadhu churna* with *ksheer*, *guduchi swaras*, and *shankhapushpi kalka*. Table 1 describes about drugs having the *Medhya Rasayana* property.

Medhya Rasayana is a group of 4 medicinal plants (Figure 2) that can be used singly or in combinations [7]:

1. *Mandukaparni (Centella asiatica* Linn.)-act on behaviour besides being neuroprotectives brain growth promoter, inhibits the memory impairment induced by scopolamine through the inhibition of AChE.
2. *Yasthimadhu (Glycyrrhiza glabra* Linn.)-it increases the circulation into the CNS system, improves learning and memory on scopolamine induced dementia.
3. *Guduchi (Tinospora cordifolia* (Wild) Miers)- possess learning and memory enhancing, antioxidant, and anti-stress action, enhances the cognition in normal and cognition deficits animals in behavioural test. It is useful for treatment of *bhrama* (Vertigo), in improving behavior disorders, mental deficit and IQ levels [8].
4. *Shankhapushpi (Convolvulus leuroides* Choisy)-effective in *hittodvega* (anxiety disorders), reverses the social isolation stress-

induced prolongation of onset and decrease in pentobarbitone-induced sleep, increased total motor activity and stress-induced antinociception in experimental model.

The formulation of *Medhya Rasayana* drugs are of two types:

1. *Shita Virya* and *Madhura Vipaka*- it promotes kapha and enhances "Dharana Karma" (i.e., retention of cognition) e.g., *Yasthimadhu*, *Bramhi*, *Sankhpushpi* etc.
2. *Ushna Virya* and *Tikta Rasa*- it promotes pitta and enhances *Grahana* and *Smarana* (i.e., grasping power and Memory) e.g., *Guduchi*, *Vacha*, *Jyotishmati* etc.

Medhya drugs act at different levels [4]-

- α. at level of *Rasa*
- β. act by stimulating and improving the function of *Agni*
- γ. improve circulation of *Rasa* by opening and cleaning the micro channel and thus improving *Medhya* function.

Medhya rasayanas in neuroprotection

Medhyarasayana drugs play an essential role in the treatment of psychiatric and psychosomatic diseases. The mode of this therapy involves the individual to attain sedation, calmness, tranquility or a stimulation of activities of brain [3]. Based on the experimental and clinical research, it is known that these drugs have varying degree of psychotropic action and are known to possess antidepressant, sedative and tranquilizing action. *Medhya Rasayana* drugs are used for prevention and treatment of mental disorders of all the age groups. These drugs promote the Intellect (*Dhi*) Retention power (*Dhriti*), memory (*Smriti*). In fact they produce Neuronutrient effect by improving cerebral metabolism [9]. *Medhya Rasayana* drugs are known to have specific effect on mental performance by promoting the functions of "Buddhi" and "Manas" by correcting the disturbances of "Rajas" and "Tamas" [9]. This helps the mental patient to get relieve from stress, anxiety and depression. *Medhya Rasayana* in aging brain is described in Table 2.

Earlier reports indicate that 'Rasayan drugs' could be used in stem cell therapy. This may be beneficial to overcome challenging diseases to modern medicine i.e., regeneration of tissues after the disease

Medhya drugs	Synonyms	Properties			
		Rasa	Guna	Virya	Vipaka
Mandukaparni (<i>Centella asiatica</i> Linn. Family – Umbelliferae)	Manduki, Twastri, Divya, Mahausadhi. Dasha karma – Kapha-Pitta shamak.	Tikta	Laghu	Sita	Madhur
Yasthimadhu (<i>Glycyrrhiza glabra</i> Linn., Family – Fabaceae)	Yas-timadhuk, Klitaka. Dasha karma – Vata- pitta shamak	Madhur	Guru, Snigdha	Sita	Madhur
Guduchi (<i>Tinospora cordifolia</i> Willd. Miers, Family – Menispermaceae)	Amrita, Madhuparni, Chinnamula, Cakra-lakshani, Amrita-valli, Chinna, Chin-nodhbhava, Vatsadani, Jivanti, Tantrika, Soma, Somavalli, Kundali, Dheera, Vi-shalya, Rasayani, Candrasasa, Vayastha, Mandali, Deva-nirmita, Dasha karma – Tri-dasha shamak	Tikta, Kasaya	Guru, Snigdha	Usna	Madhur
Shankhapushpi (<i>Convolvulus pleuricaulis</i> Choisy. Family – Convolvulaceae):	<i>Ksheerpushpi, Mangalyakusuma</i> . Dasha karma – Vata- pitta shamak	Tikta	Snigdha, Picchil	Sita	Madhur
Aindri (<i>Bacopa monniera</i> Linn. Family – Scrophulariaceae)		Tikta	Laghu	Usna	Katu
Jyotishmati (<i>Celastrus paniculata</i> Willd. Family – Celastraceae):	<i>Katabhi, Jyotishka, Kanguni, Paravatpadi, Pinya, Lata, Kakundani, Malkangani</i> . Dasha karma – Vata-kapha sha-mak	Katu, Tikta	Tikshna	Usna	Katu
Kushmanda (<i>Benincasa hispida</i> Thunb. Cogn. Family – Cucurbitaceae)	<i>Puspaphala, Pitapushpa, Brihatphala</i> . Dasha karma – Pitta shamak	Madhur	Laghu, Snigdha	Sita	Madhur
Vacha (<i>Acorus calamus</i> Linn., Family – Araceae)	<i>Vacha, Uragandha, Sadhgrantha, Golomi, Satparvika, Khudra-patri, Mangalya, Jatila, Ugra</i> and <i>Lomasha</i> , Dasha karma – Kapha-Vata shamak ⁸	Katu, Tikta	Laghu, Tikshna	Usna	Katu
Jatamansi (<i>Nardostachys jatamansi</i> DC., Family – Valerianaceae)	<i>Bhutjata, Jatila, Tapas-vini</i> and <i>Mansi</i> . Dasha karma – TriDasha shamak	Tikta, Kasaya Madhur	Laghu, Snigdha	Sita	Katu

Table 1: Drugs having the *Medhya Rasayana* property [34].



Figure 2: Medhya Rasayana is a group of 4 medicinal plants.

S No	Example	Role in aging brain
1.	Yashtimadhu (<i>Glycyrrhiza glabra</i>)	Spatial learning and passive avoidance, preliminary free radical scavenging, cerebral ischemia and antioxidant capacity towards LDL oxidation.
2.	Guduchi (<i>Tinospora cordifolia</i>)	Strong free radical scavenging properties against reactive oxygen and nitrogen species diminishing the expression of iNOS gene, reduction in thiobarbituric acid reactive substances and an increase in reduced glutathione catalase and superoxide dismutase (anti-oxidant)
3.	Shankhapushpi (<i>Convolvulus pluricaulis</i>)	Anxiolytic, memory enhancing and mood elevating effect, retard brain aging, help in regeneration of brain cells and in Dendritic arborization which is the neuronal basis for improved learning and memory, increase in AGHe activity in CA1 with AS and CA3
4.	Mandukaparni (<i>Centella asiatica</i>)	Neuronal dendritic growth stimulating property, effective in reducing brain regional lipidperoxidation (LPO) and protein carbonyl (PCO) levels and in increasing anti-oxidant status, improve the altered levels of neurotransmitters such as 5HT, acetylcholine, epinephrine, norepinephrine, GABA (gamma-aminobutyric acid) and Glutamate, improve the mental ability and fatigability of subjects under stress, inhibit the formation of beta amyloid plaques owing to the oxidative stress and activation of glial cells and thereby delay neuronal apoptosis.
5.	Brahmi (<i>Bacopa monnieri</i>)	Positive implications for improved neurotransmission and repair of damaged neurons via enhanced regeneration of nerve synapses via changes in the hippocampus, cerebral cortex (areas critical to memory function) and hypothalamus regions of the brain.
6.	Ashwagandha (<i>Withania Somnifera</i>)	GABA-like activity, owing to its anxiolytic effect, increase in the levels of three natural antioxidants superoxide dismutase, catalase and glutathione peroxidase.
7.	Kapikachu (<i>Mucuna Pruriens</i>)	Contain significant quantity of L-Dopa which could be the basis for its anti-Parkinsonism effect.
8.	Jyotishmati (<i>Celastrus paniculata</i>) and Tagara (<i>Valeriana wallichii</i>)	Role in brain and memory disorders in the elderly.

Table 2: Medhya Rasayana in aging brain [35].

condition like osteoarthritis, age related macular degeneration (AMD), Alzheimer's and Parkinsons disease, injuries, trauma, heart attack, stroke etc [10]. Rasayana concept of Ayurveda has been correlated with

tissue regeneration and cell renewal and specific rasayana is known to stimulate and nourish respective dhatus or tissues [2]. For example, *Medhya* Rasayana for the brain, *Hridya* Rasayana for the heart, *Twachya* Rasayana for the skin, and *Chakshusya* Rasayana for the eyes. Role of 'medhya drugs' in neuronal stem cells differentiation is also described earlier [2]. Ayurveda have been described to provide a list of herbs known for nootropic activity having multi-dimensional utility in various conditions [7]. Medhya Rasayana drugs and its mode of action is described in Table 3.

Mandukaparni (*Centella asiatica* Linn.)

Earlier studies have reported ameliorating effect of CE on learning and memory impairment induced by either transient bilateral common carotid arteries occlusion (T2 VO) in mice [11]. *Centella asiatica* plays a significant role in improving cognition and memory. One of the major etiological factors implicated in Parkinson's disease (PD) is α -Synuclein aggregation. Interestingly evidences also indicate that the aqueous extract of *Centella asiatica* (CA) inhibit the formation of oligomer to aggregates and stimulate the disintegration of the preformed fibrils [12]. Other investigators have shown the relevance of *Centella asiatica* to its anti-oxidant and anti-apoptotic mechanisms. Exploration of the neuroprotective effect of *Centella asiatica* on chronic aluminum exposure induced mitochondrial enzyme alteration, oxidative stress, apoptosis and cognitive dysfunction in rat have shown its multiprotective effect against aluminium induced neurotoxicity [13]. Administration of *Centella asiatica* showed improved memory performance, oxidative defense decreased aluminum concentration, caspase-3, acetylcholinestrase activity and reversal of mitochondrial enzyme activity as compared to aluminum-treated animals [13]. The significance of *Centella asiatica* as a neuroprotective agent have already been used traditionally since decades in ayurvedic medicine [14]. Various evidences have reported its neuroprotective potential by different modes of action such as enzyme inhibition, prevention of amyloid plaque formation in Alzheimer's disease, dopamine neurotoxicity in Parkinson's disease, and decreasing oxidative stress [14]. Asiatic acid (AA), a pentacyclic triterpene in *Centella asiatica*, possess neuroprotective effects both *in vitro* and *in vivo*. This was shown to attenuate glutamate-induced cognitive deficits of mice and protects SH-SY5Y cells against glutamate-induced apoptosis *in vitro* [15].

Yastimadhu (*Glycyrrhiza glabra* Linn.)

Glycyrrhizin (GL) is a triterpene present in the roots and rhizomes of licorice (*Glycyrrhiza glabra*) [16]. It is found to have neuroprotective effect in the kainic acid induced neuronal cell death in mouse [16]. This is mediated via suppression of gliosis and induction of proinflammatory markers (COX-2, iNOS, and TNF- α). The anti-convulsant potential of aqueous and ethanol extract of *Glycyrrhiza glabra* (AEGG and EEGG) and its action on markers of oxidant stress is shown in pentylenetetrazole (PTZ)-induced seizure in albino rats [17]. Similarly others have also shown neuroprotective effects of glycyrrhizin (GL) in the postschemic rat brain after middle cerebral artery occlusion (MCAO). This mechanism involves its anti-inflammatory, anti-excitotoxic, and anti-oxidative effects and in particular, it exerts anti-inflammatory effect [18]. In addition, 2,2',4'-trihydroxychalcone from *Glycyrrhiza glabra* has been shown as a new specific beta-site amyloid precursor protein (APP)-cleaving enzyme 1 (BACE1) inhibitor that efficiently ameliorates memory impairment in mice [19]. Glabridin, isolated from the roots of *Glycyrrhiza glabra* is also a promising candidate on learning and memory in mice [20]. Other findings indicate that glabridin, a major flavonoid of *Glycyrrhiza glabra* (licorice) has a neuroprotective effect via modulation of multiple pathways associated with apoptosis [21]. Antidepressant-like activity of *Glycyrrhiza glabra* is demonstrated in

S No	Medhya Rasayana drugs	Mode of action	Reference
1	Withanolide-A isolated from root of Ashwagandha (<i>withania somnifera</i>)	Neuritic regeneration, synaptic reconstruction, axon extension dendrite extension synaptogenesis memory improvement	[36,37]
2	Withanolide IV (<i>Withania somnifera</i>)	Axon extension dendrite extension synaptogenesis memory improvement	[37]
3	Withanolide IV	Axon extension dendrite extension synaptogenesis memory improvement	[37]
4	Bramhi (<i>Bacopa monnieri</i> Linn)	Memory enhancement, cognitive function, Reduce amyloid levels in PSAPP mice, effect on cholinergic system, prevent aluminium neurotoxicity i.e., protect brain from oxidative damage resulting from aluminium toxicity.	[38-40]
5	Sankhapushpi (<i>Convolvulus pluricaulis</i>)	Anxiolytic and memory enhancing, mood elevating, retard brain aging	[41]
6	Mandukaparni (<i>Centella asiatica</i>)	Useful in treating mental retardation (improvement in performance IQ), Social Quotient, immediate memory span and reaction time, asiatic acid (AA), a pentacyclic triterpene in <i>Centella asiatica</i> - attenuates glutamate-induced cognitive deficits of mice and protects SH-SY5Y cells against glutamate-induced apoptosis <i>in-vitro</i> , influence the neuronal morphology and promote the higher brain function of juvenile and young adult mice, cognitive enhancement, prevent oxidative stress, enhance neuronal dendrites, dendritic growth in the hippocampal CA3 neurons in adult rats. antidepressant activity.	[1,42-45]
7	Guduchi (<i>Tinospora cordifolia</i>)	Enhanced verbal learning and memory and logical memory (of immediate and short term type), enhances cognition (learning and memory) in normal rats and cyclosporine induced memory deficit, anti-stress, anti-depressant and anxiolytic properties, improvement in sensile memory impairment	[46-48]
8	Ashwagandha (<i>Withania somnifera</i>)	Mood stabilizer in clinical conditions of anxiety and depression., clearance and reverses the behavioral deficits and pathology seen in Alzheimer's disease models.	[49,50]
9	Jyothismati (<i>Celastrus paniculatus</i>)	Affects learning and recall of memory, significant decrease in the AChE activity assayed from hypothalamus, frontal cortex and hippocampus of the rat brain treated with 400 mg/kg body weight. With CP oil i.e., Jyothismati oil from seeds of <i>Celastrus paniculatus</i> (CP))	[51,52]
10	Vidanga (<i>Embelia ribes</i>)	Defence against MCAO- induced focal cerebral ischemia in rats and exhibits neuroprotective activity, useful adjunct in the treatment of stroke.	[53,54]
11	Kushmanda Ghrita (<i>Benincasa hispida</i>)	Increased immediate memory, possess antidepressant activity	[55]

Table 3: Medhya Rasayana drugs and its mode of action.

mouse models of immobility tests. This is mediated by increase of brain norepinephrine and dopamine, but not by increase of serotonin [22]. Memory-strengthening activity of *Glycyrrhiza glabra* in exteroceptive and interoceptive behavioural models of memory is also shown by other investigators [23]. The beneficial effect on learning and memory by *Glycyrrhiza glabra* (popularly known as liquorice) in mouse brain is due to facilitation of cholinergic-transmission also known [24].

Guduchi (*Tinospora cordifolia* (Wild) Miers)

The neuroprotective activity of ethanol extract of *Tinospora cordifolia* aerial parts have been shown in a study involving 6-hydroxy dopamine (6-OHDA) lesion rat model of Parkinson's disease (PD) [25]. Evidence also exists for aqueous ethanolic extract of *Tinospora cordifolia* playing a role for differentiation based therapy of glioblastomas [26]. Involvement of Monoaminergic and GABAergic Systems in Antidepressant-like Activity of *Tinospora cordifolia* is shown in a study involving mouse model of depression using tail suspension test and forced swim test [27]. Another study showed the neuroprotective activity of *Tinospora cordifolia* involves modulation of the antioxidant system in rat hippocampal slices subjected to oxygen glucose deprivation [28]. *Tinospora cordifolia* may also play an effective role against ischemic brain damage as it attenuate oxidative stress mediated cell injury during oxygen-glucose deprivation (OGD) in rat hippocampal slices [28].

Shankhapushpi (*Convolvulus pluricaulis* Choisy)

This drug is known for its action on boosting memory and improving intellect and beneficial for brain disorders like epilepsy. It consists of whole plant of *Convolvulus pluricaulis* choisy (CP, Convolvulaceae). Shankhapushpi is found to be effective in anxiety, neurosis and used in cerebral abnormalities, insomnia, and serve as wonderful nervine tonic and memory invigorator [29]. Shankhapushpi enhances memory function due to its Antioxidant and Acetylcholinesterase Inhibitory

Properties [30]. Investigators have shown neuroprotective effects of aqueous extract from *Convolvulus pluricaulis* (CP) against aluminium chloride induced neurotoxicity in rat cerebral cortex [31]. Evidences of antioxidant and anticonvulsant activity of Shankhapushpi is also demonstrated by earlier studies [32]. Earlier evidences have demonstrated the potential of *Convolvulus pluricaulis* (CP) to attenuate scopolamine (2 mg/kg, i.p.) induced increased protein and mRNA levels of tau, amyloid precursor protein (A β PP), amyloid β (A β) levels and histopathological changes in rat cerebral cortex [33-55].

Concluding Remarks

It is very unfortunate that in spite of advancements in modern medicine today its success is very limited in context with neurological and psychiatric disorders due to multi-factorial nature of these diseases. Therefore, the concept of modern medicine based therapy for treatment of such patients may be more effective when based on psychoactive drugs. Hence, the need to explore medicinal plants globally for improving cognitive function owing to their less adverse effects is must today so as to overcome the cognitive deficit diseases.

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