REVIEW ARTICLE

Botanical Nootropics in Ayurveda: Potential Leads for Pharmacological Neurocognitive Enhancement and Drug Development

[1]Narayanam Srikanth, [2]Devesh Tewari, [3]Narayanam Haripriya, [4]Shruti Khanduri, [5]Chinmay Rath
[6]Anupam K Mangal, [7]Sudesh N Gaidhani

ABSTRACT

Aim: This study focuses on the documentation and critical evaluation of the presence of botanical nootropics in Ayurveda based on the available classical literature in Ayurveda. The study also entails the terminology used for different memory and cognitive functions in the classical texts of Ayurveda.

Background: The process of memory (*smriti*) and neurocognitive functions (*medha*) has been well documented by Indians since ancient times, and comprehensive portrayal concerning different diseases interfering neurocognitive functions and their management are embodied in ancient medical literatures. A detailed account of medicinal plants for enhancement of neurocognitive functions, such as *medhya rasayanas, smritikara, buddhivivardhaka, buddhimatiprada* drugs, etc. (nootropics and mental health promoters) can be traced from over nine codified texts of Ayurveda.

Review results: Exposition of the uncharted knowledge about plant drugs ascribed with nootropic effect is scattered elsewhere in archaic medical literatures and is pivotal for further research and drug development. For rational, evidence-based use and development of safe, effective, and acceptable pharmacological dosage forms, it is vital to comprehend the mode of action of these plant drugs based on their traditional use, principles mentioned in Ayurveda texts, and also applying modern pharmacological thoughts.

Conclusion: Documentation and critical evaluation of the presence of botanical nootropics in Ayurveda based on the available classical literature in Ayurveda was done. Mental health is one among the important health concerns in the emerging scenario, owing to the paradigm shift of the disease burden from communicable disease to noncommunicable disease in developed and developing countries. The potential leads from Ayurveda texts may be taken forward for further development of safe, effective, and user-friendly dosage forms through systematic preclinical and clinical studies. Further, the diverse terminology was found in different Ayurvedic text.

Keywords: Ayurveda, Medicinal plants, Memory enhancement, Neurocognitive improvement, Nootropics.

BACKGROUND

Nootropics also called smart drugs, memory enhancers, neuroenhancers, cognitive enhancers, and intelligence enhancers comprises drugs, supplements, nutraceuticals, and functional foods that improve one or more aspects of mental function.[1,2] The term "Nootropic" was coined by Giurgea in 1972 who was a Romanian psychologist and chemist.[3,4] The word is derived from the Greek words *nous* or "mind", and *trepein* meaning to bend or turn.[5] Further, memory can be defined as the normal consequence of learning which reflects the continuing changes in the nervous system that result from transient experiences.[6] *Ayurveda* (the ancient medical system of India) recounts about the physiology and mechanism of memory and associated neurocognitive functions. The core biological forces, viz. *vata, pitta,* and *kapha,* and their subfactors are attributed as different physiological components responsible for memory, understanding intelligence, and associated cognitive functions. Further, different disorders associated with memory and cognition, several medicinal plant drugs and compounds like polyherbal, metal, and mineral-based formulations are vividly described for their management. Most of these interventions possess memory-enhancing and nootropic actions, viz. *medhya, smritikara, buddhivardhak, buddhimatiprada,* as cited in Ayurvedic texts.

Neurocognitive Functions: An Interdisciplinary Understanding

Medha represents "mental vigor or power, intelligence prudence wisdom and intelligence personified".[7] In

[1]Deputy Director General, [2]Senior Research Fellow (Pharmacognosy), [3]Former Lecturer (Botany), [4]Research Officer (Ayurveda), [5]Research Officer (Botany), [6]Assistant Director (Pharmacognosy), [7]Assistant Director (Pharmacology)

[1,2,4-7]Central Council for Research in Ayurvedic Sciences Ministry of AYUSH, Government of India, New Delhi, India

[3]Krishnaveni Junior College, Narasaraopet, Andhra Pradesh India

Corresponding Author: Devesh Tewari, Senior Research Fellow (Pharmacognosy), Central Council for Research in Ayurvedic Sciences, Ministry of AYUSH Government of India New Delhi, India, e-mail: dtewari3@gmail.com

Ayurveda, *Medha* or intelligence of an individual depends upon the correlation of different biological, genetic, environmental, and dietetic factors, such as *jaati* (race), *prakriti* (inherent morphological, physiological, and psychological attributes of individual), *abhyaasa* (practice), *aahaara* (food), *swarupa* (configuration of the skull and brain), etc. Capacity to recollect the past is called *smriti* or memory (*smriti bhutaardha vijnaanam*).[8] The mental registration of past experience, knowledge, ideas, sensations, and thoughts is called memory.[8] Registration of experience is favored by clear comprehension during intense consciousness, but it may occur during catatonic stupor (*mattavastha*). Retention of memory differs greatly with individuals as well as with structural and psychological variations. Memory recall means its intentional recollection and reproduction in consciousness, while clear comprehension greatly favors retention. Recall may fail because the memory has been obliterated or functionally became the stream of ideas that one does not want to remember. *Prasstapaada* in his commentary on "*Vaisheshik darshana*" defines *smriti* as union or coordinated function of soul (*aatma*) and mind (*manas*). According to his text, seeing, hearing, or experiencing anything evokes the past incidence. However, memory depends on one's desire to recollect (*Ichcha*) and effort to recollect (*anusmarana*).[9]

Cognition is the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses. It encompasses processes, such as knowledge, attention, memory and working memory, judgment and evaluation, reasoning and computation, problem-solving and decision-making, comprehension and production of language, etc. Ayurvedic texts, viz. *Bhela Samhita* and *Astang hridya*, clearly stand for the

above process of cognition and attributed to the functions of biological factors, viz. *buddhi vaishesika aalochakapitta,* and *sadhak pitta*[10] (Table 1).

Safe and Effective Pharmacological Approaches for Neurocognitive Enhancement: Need of the Hour

The most commonly used class of drug is stimulants, such as caffeine for cognitive enhancement, which are used primarily to treat cognitive or motor function difficulties attributable to disorders, such as Alzheimer's disease, Parkinson's disease, and Huntington's disease.[12] Certain studies reported common use of these agents despite concern for further research. Scientific studies support the beneficial effects of some compounds. Several factors positively and negatively influence the use of drugs to increase cognitive performance.[12] Considering the limitation of certain synthetic agents, it is imperative to develop safe and effective agents preferably from plant source. Ayurveda enumerates a number of such medicinal plants for neurocognitive enhancement.

Botanical Nootropics in Ayurveda

Classical literatures of Ayurveda describe the utilization of several drugs as nootropics with their diverse properties. A critical appraisal of these literatures revealed that about 31 medicinal plants are attributed with nootropic, actions, such as *medhya, smritikara, buddhivivardhaka, buddhimatiprada,* and some of them are frequently used in clinical practice by Ayurvedic physicians as single ingredient drugs or polyherbal formulations. The details of the plants which are attributed to different nootropic actions cited in

Table 1: Neurocognitive factors and their functional attributes: Ayurveda perspective

Mental faculties associated with memory and cognition as cited in Ayurveda texts	Possible interpretation with contemporary thoughts	Biological functional attributes (doshas) as cited in Ayurveda texts	Textual references and citations
Buddhi	Cognitive functions/ higher mental functions (reception, articulation, interpretation, assessment, reasoning and computation, judgment, understanding, etc.)	*Prana Vata*—a sub variety of *vata dosha*	[11]Astang Hridya, Sutra Sthan 12/4
		Sadhaka Pitta—a sub variety of *pitta dosha*	[11]Astang Hridya, Sutra Sthan 12/13
		Buddhi vaishesika Aalochaka Pitta—a sub variety of *pitta dosha*	[10]Bhela Samhita Chikitsa Sthana
		Kapha (in general)	[8]Charak Samhita Sutra Sthan 12/12
Smriti	Memory (ability to recall)	*Udana Vata*—a sub variety of *vata dosha*	[11]Astang Hridya Sutra Sthana 12/5
		Pitta (in general)	
Medha	Intelligence (capacity to understand)	*Sadhaka Pitta*—a sub variety of *pitta dosha*	[11]Astang Hridya Sutra Sthan 12/13
		Pitta (in general)	[8]Charak Samhita Sutra Sthana 18/50

various Ayurvedic texts are presented in Table 1. The details are presented according to their Sanskrit name along with botanical name followed by Ayurvedic pharmacodynamic profile and specific terminologies mentioned in Ayurveda texts,[13] thereby indicating nootropic effect/neurocognitive enhancement and classical citations. Various terminologies have been found in the classical texts of Ayurveda for nootropics; some of them are *Medhya*, *Medhavi/Medhyani*, *Medhkrit*, *Buddhiatriprada*, *chetoroghrit*, *chetovikarinam*, *Budhivivardhna*, *Manovikaresu*, etc.[11,14,15,8] The complete details of the terminologies are presented in Table 2.

Table 2: Medicinal plants specified for neurocognitive enhancement and their pharmacological attributes as cited in Ayurvedic texts

Sl. no.	Sanskrit name/botanical source and family	Ayurvedic pharmacodynamic profile				Specific terminologies mentioned in Ayurveda texts indicating nootropic effect/ neurocognitive enhancement and classical citations
		Rasa	*Guna*	*Veerya*	*Vipaka*	
1	Mandukparni *Centella asiatica* (L.) Urb. Umbellifere (Apiceae)	Tikta	Laghu	Sheeta	*Madhura*	Medhya ([14]Bhava prakasha Nighntu)
						Medhya ([8]Charaka Samhita Chikitsa Sthana 1-3/31)
2	Brahmi *Bacopa monnieri* (L.) Wettst. Scrophulariaceae	Tikta	Laghu	Ushna	*Katu*	Medhya ([13]Dravya Guna Vignanam)
3	Sankhpusphi *Convolvulus prostratus* Forssk. Convolvulaceae	Tikta	Snigdha Pichhila	Sheeta	*Madhura*	Medhakrit ([16]Raja Nighantu-133)
						Medhya ([8]Charaka Samhita Chikitsa Sthana 1-3/31)
4	Jyotishmati *Celastrus paniculatus* Willd. (CP). Celastraceae	*Katu Tikta*	*Tikshna*	*Ushna*	*Katu*	Budhismritiprada ([14]Bhava parkasha Nighntu)
						Medha ([16]Raja Nighantu 8)
5	Kushmanda *Benincasa hispida* (Thunb.) Cogn. Cucurbitaceae	*Madhura*	*Laghu, Snigdha*	Sheeta	*Madhura*	Chetoroghrit ([14]Bhav parkasha Nighntu)
						Chetovikarinam ([15]Susruta Samhita Sutra Sthana 46/24)
6	Vacha *Acorus calamus* L. Acoraceae	*Katu Tikta*	*Laghu, Tikshna*	*Ushna*	*Katu*	Medhya ([17]Dhanvantari Nighantu 7)
						Buddhivivardhana ([15]Susrut Samhita, Sareera Sthana)
7	Jatamansi *Nardostachys jatamansi* (D.Don) DC. Caprifoliaceae	*Madhura, Kashaya*	*Laghu, Snigdha*	*Sheeta*	*Madhura*	Medhya ([14]Bhav parkash Nighntu)
8	Choraka *Angelica glauca* Edgew. Apiaceae	*Tikta, Katu*	*Laghu Tikshna*	*Ushna*	*Katu*	Manovikaresu ([8]Charak Samhita Kalp Sthan)
9	Eranda *Ricinus communis* L. Euphorbiaceae	*Madhura kashay*	*Snigdha, Tikshna Sukshma*	*Ushna*	*Madhura*	Medhya ([15]Susruta Sutra Sthana 45/100)
10	Palandu *Allium cepa* L. Amaryllidaceae	*Katu, Madhur*	*Tikshna, Guru Snigdha*	*Ishat Ushna*	*Madhura*	Medha ([15]Susrut Sutra Sthana 46/247)
11	Rasona *Allium sativum* L. Amaryllidaceae	*Madhura Lavan, Katu Tikta, Kashaya*	*Snigdha, Tikshna Pichhila, Guru*	*Ushna*	*Katu*	Medha ([15]Susruta Samhita Sutrsthana 46/244 and [14]Bhava parkash Nighntu)
12	Tila *Sesamum indicum* L. Pedaliaceae	*Madhura*	*Guru, Snigdha*	*Ushna*	*Madhura*	Medha ([15]Susrut Samhita Sutra Sthan 46/40)
						Matiparda ([14]Bhava parkasha Nighntu)
						Medha ([8]Charaka *Samhita Sutra Sthan* 27/287)
13	Bhallatak *Semecarpus anacardium* L.f. Anacardiaceae	*Katu Tikta Kashaya*	*Snigdha, Laghu Tikshna*	*Ushna*	*Madhura*	Medha ([8]Charaka *Samhita* Chikitsa Sthana 1-2/19)
14	Karpoor *Cinnamomum camphora* (L.) J.Presl Lauraceae	*Tikta, Katu Madhur*	*Tikshna, Laghu*	*Sheeta*	*Katu*	Medhaya ([16]Raja nighatu -69)
15	Rudraksh *Elaeocarpus sphericus* L. Elaeocarpaceae	*Madhura*	*Guru, Snigdha*	*Sheeta*	*Madhura*	Manovikarsamn ([13]Dravya Guna Vignanam)
16	Gambhari *Gmelina arborea* Roxb. Verbenaceae	*Tikta, Kashaya Madhur*	*Guru*	*Ushna*	*Katu*	Medhya ([15]Susruta Samhita Sutra Sthan 46/24)

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Sl. no.	Sanskrit name/botanical source and family	Ayurvedic pharmacodynamic profile				Specific terminologies mentioned in Ayurveda texts indicating nootropic effect/ neurocognitive enhancement and classical citations
		Rasa	*Guna*	*Veerya*	*Vipaka*	
17	Pippali *Piper longum* L Piperaceae	*Katu*	*Snigdha, Laghu, Tikshna*	*Anushan Sheeta*	*Madhura*	Medha (14Bhav parkash Nighntu)
18	Agastya *Sesbania grandiflora* (L.) *Pers.* Fabaceae	*Tikta*	*Ruksha, Laghu*	*Sheeta*	*Katu*	Buddhi (18Nighantu Ratnakar)
19	Dadima *Punica granatum* L. Punicaceae	*Kashaya, Madhura, Amla*	*Laghu, Snigdha*	*Anushna*	*Madhura*	Medha (14Bhava parkasha Nighntu)
20	Chitraka *Plumbago zeylanica* L. Plumbaginaceae	*Katu*	*Ruksha, Laghu, Tikshna*	*Ushna*	*Katu*	Medhavi (11Astang Hridaym Uttar Tantra 39/63)
21	Krishan jeerak *Cuminum cyminum* L. Apiaceae	*Katu*	*Laghu, Ruksha*	*Ushna*	*Katu*	Medhya (14Bhav parkash Nighantu)
22	Satpuspa *Anethum sowa* Roxb. ex Fleming Apiaceae	*Katu, Tikta*	*Laghu, Ruksha, Tikshna*	*Ushna*	*Katu*	Medhya (19Kaidev Nighantu shaloka1191)
23	Sunnishanka *Marsilea minuta* L. Marsileaceae.	*Madhura, Kashaya*	*Laghu, Snigdha*	*Sheeta*	*Katu*	Medhya (13Dravya Guna Vigyanam P.V. Sharma)
24	Shatavari *Asparagus racemosus Willd.* Asparagaceae	*Madhura, Tikta*	*Guru, Snigdha*	*Sheeta*	*Madhura*	Medhya (14Bhav parkash Nighntu) Medhya (15Susruta Samhita Sutra Sthan)
25	Kalajaji *Nigella sativa* L. Ranunculaceae	*Katu, Tikta*	*Laghu, Ruksha, Tikshna*	*Ushna*	*Katu*	Medhya (14Bhav parkash Nighntu)
26	Bimbi *Coccinia grandis* (L.) Voigt Cucurbitaceae	*Tikta*	*Laghu, Ruksha, Tikshna*	*Ushna*	*Katu*	Medhya (19Kaidev Nighatu shaloka 587)
27	Haritaki *Terminalia chebula* Retz. Combretaceae	*Madhura, Amla, Tikta, Katu, Kashaya*	*Laghu, Ruksha*	*Ushna*	*Madhura*	Medhya (15Susruta Samhita Sutra Sthan) Medhya, Buddhi (14Bhava Prakasha Nighantu) Smriti, Buddhi (8Charaka Samhita chikitsa Sthana 1/34) Medhya (20Dhanvantri Nighantu -205)
28	Vridhdaruka *Argyreia nervosa* (Burm. f.) Bojer Convolvulaceae	*Katu, Tikta, Kashaya*	*Laghu, Snigdha*	*Ushna*	*Madhura*	Medha (14Bhav parkash Nighantu) Medhavi, Smritikara (21Bhaisjay Ratnavali)
29	Mundi *Sphaeranthus indicus* L. Asteraceae	*Katu, Tikta*	*Laghu, Ruksha*	*Ushna*	*Katu*	Medhya (14Bhava Prakash Nighantu)
30	Sadanpuspa *Catharanthus roseus* (L.) G.Don Apocynaceae	*Tikta, Kashaya*	*Laghu, Ruksha*	*Ushna*	*Katu*	Chittodveghari (14Bhava Prakasha Nighantu)
31	Guduchi *Tinospora cordifolia* (Lour.) Merr. Menispermaceae	*Tikta, Kashaya*	*Guru, Snigdha*	*Ushna*	*Madhura*	Medhya (8Charaka Samhita Chikitsa Sthan 1-3/31)

In spite of great advancement in the science of psychiatry for decades, the problems with the management of a certain mental problems like cognitive dysfunction, memory disorders, anxiety, stress, mental retardation, etc., have remained unsolved. In addition, adverse effects of antipsychotic medication are creating considerable amount of discomfort to the patient. At this juncture, there is a need for exposition and adaptation of such therapies that could effectively tackle such conditions without any adverse events. The entire Ayurvedic management is more health-oriented than disease-oriented, and as such, there is a big scope of utilizing Ayurvedic approach and therapeutics as an adjunct to the disease-oriented therapy of modern psychiatry to provide a full treatment. Various treatment modalities are described in the Ayurvedic classics which include the following.

Daiv Vyapashraya: Spiritual therapy that includes the use of prayers, religious activities, wearing of precious stones, etc.

Satvavjaya: Psychobehavioral therapy incorporating the principles of assurance therapy (aashvasan), replacement of emotions, and psychoshock therapy.

Yukti Vypashraya Chikitsa: Pharmacological therapy includes *samshodhan* (cleansing therapy/panchkarma) and *shaman* therapy (pacification). The patient is subjected to biocleansing therapy in order to cleanse the channels

of the body followed by *shaman* therapy or palliative treatment with the help of drug, dietetics, and lifestyle. A number of single and compound *medhya* (promoters of intellectual faculties) formulations are used in Ayurveda for the treatment of mental diseases. These are believed to act as brain tonics and adaptogens. The *medhya* drugs are considered as specific molecular nutrients for the brain providing a better mental health, leading in turn to alleviation of behavioral alterations.

Overview of Some Research Contributions

The contributions of the Central Council for Research in Ayurvedic Sciences are significant in the scientific exploration of this branch of Ayurveda. The Council through extensive multicentric clinical trials has evaluated the efficacy of certain single drugs and compound formulations on various mental problems and developed formulations like Ayushman-8 for mental retardation, Brahmyadi Yoga for schizophrenia. Clinical trials are being conducted to evaluate the effect of *Dhara Chikitsa* in the management of anxiety neurosis, clinical studies on *Manas Mandata* (mental retardation), *chittodvega* (anxiety neurosis).[22]

Manas Mandata (Mental Retardation)

- A double-blind study was conducted with *Mandukparni* (*Centella asiatica* L. Urb.) whole plant on 30 mentally retarded children in the age group of 7 to 18 years. Children with a history of epilepsy and other neurological problems were excluded. The children were assessed on Binet–Kamat test and on a behavioral schedule. Children were given 0.5 gm tablets twice a day for 6 months. Placebo group was given starch tablet. All the children were reassessed after 3 and 6 months. The results indicated that there is an improvement in the intelligence quotient (IQ) level of the children treated with Mandukparni as compared with placebo, and the data were found to be significant at the end of 3 months; however, it was observed that there was no significant difference in improvement in the IQ level after 3 and 6 months.[23]

- The Council has formulated Ayushman-8 for the treatment of *Manas Mandata* (mental retardation). The preparation of Ayushman-8 consists of (i) *Brahmi* (*C. asiatica* L. Urb.); (ii) *Shankhapushpi* (*Convolvulus pluricaulis* Choisy); (iii) *Vacha* (*Acorus calamus* L.) in different ratios. The evaluation was carried out on 51 confirmed cases of *Manas Mandata* in the age group of 5 to 16 years. They were classified into study group and placebo group. Study group was given Ayushman-8, at the dose of 700 mg twice a day with honey,

whereas placebo group 700 mg of plain sugar for 1 year. Out of 51 children enrolled, 26 patients were put under study group and 25 in placebo group, 12 children left the study (7 in trial group and 5 in placebo group), and rest completed 1-year duration. Results showed that there was numerical increase in the mental age in both the groups. However, the increase shown by the drug was greater than that of placebo.[24]

Unmada (Schizophrenia)

- *Brahmyadiyoga*, a herbal compound consisting of fine powder of *Brahmi* (*C. asiatica* L. Urb), Vacha (*Acorus calamus* L.), *Sarpgandha* (*Rauvolfia serpentina* (L.) Benth. ex Kurz), *Kustha* (*Saussurea lappa* (Decne.) Sch. Bip.), *Tagar* (*Nymphoides macrospermum* Vasud.Nair), and *Jatamansi* (*Nardostachys jatamansi* (D.Don) DC.) was administered in the dose of 8 to 16 gm a day for 90 days to the 14 confirmed cases of *Unmaada*. The patients selected for the study were between the age group of 18 and 40 years with chronicity of 2 to 6 years. Psychological assessment was done on the symptoms rating score, like positive score, negative score, and total score. Out of 14 patients enrolled for the study, 10 completed the study. Out of 10 patients, 6 improved according to all the three assessments, but 4 did not show any improvement.[25]

- Double-blind controlled study of *Brahmyadi Yoga* and *Tagara* in the management of various types of *Unmada* (Schizophrenia): The study was conducted on 136 patients of either sex suffering from various types of *Unmada* (schizophrenia) in the age group of 16 to 45 years. A diagnostic criterion for schizophrenia was in accordance with the National Institute of Mental Health and Neuro Sciences. Ayurvedic diagnosis was made based on the symptomology. Stupors and excessively withdrawn patients were not included in the study. Duration of illness varied from 2 months to 2 years. The patients were admitted and randomly allocated into four treatment groups, viz. (i) *Tagara*, (ii) *Brahmyadiyoga*, (iii) Placebo, and (iv) chlorpromazine. Out of 136 patients, 28 patients dropped out; 108 patients who completed the treatment for a period of 2 months were taken for final assessment. The route of administration was oral, 2 gm four times a day, i.e., *Tagar, Brahmyadi Yoga,* placebo and 50 mg chlorpromazine four times a day dose of the medicine given for the first month. The dose of medicine was increased to 3 gm four times a day in the case of first three groups and 75 mg four times a day in the case of chlorpromazine group. Results of four treatments were compared simultaneously for their mean improvement in the

mental states by analysis of variance. The results showed that chlorpromazine was found to be superior to *Tagara* and placebo. However, overall effect of chlorpromazine was found to be better than *Brahmyadi Yoga* but difference is not statistically significant. It was observed that improvement in mental condition of patient treated with *Brahmyadi Yoga* was found to be significantly more than that obtained with single drug Tagara and placebo.[25]

Another study with 36 patients of both the genders in the age group of 16 to 45 years suffering from Schizophrenia with active psychotic symptoms of a minimum duration of 1 month was conducted. Patients suffering from epilepsy or mental retardation were excluded. Out of 36 patients, 18 were managed on Ayurvedic line and the other 18 patients were given chlorpromazine therapy. In Ayurvedic treatment, it was intended to examine the combined effect of the general line of Ayurvedic treatment, comprising *Shodhana, Shamana,* and *Satvavajaya Chikitsa* followed by medicinal therapy; *Kalyanakaghrita* in case of *Vataja, Pittaja Unmada,* and *Panchgavyghrita* in *Kaphja unmada* 10 mL once a day. Results revealed that the scheduled Ayurvedic regimen is effective in 85% of cases of *Unmada*. This suggested that the Ayurvedic treatment is efficacious comparable to standard drug chlorpromazine.[26]

Chittodvega (Anxiety neurosis)

- A pilot study on 10 patients of either sex suffering from uncomplicated anxiety neurosis (*Chittodvega*) of 6 months chronicity was conducted with *Kshirodhara* (pouring of milk on forehead) in supine position. Assessment was done based on the Max Hamilton's Anxiety Rating Scale, Manifest Anxiety Scale and Symptoms. Results revealed that 8 patients showed clinically significant improvement.[27]

Evidence Based and Scientific Studies on Some Botanical Nootropics

Though several plants have been used as nootropic, here we describe some of the well-known plants. Experimental and clinical studies have demonstrated efficacy, mode of action of some medicinal plants mentioned in Ayurvedic text for their nootropic and neurocognitive enhancing effects, and brief description on five most important plants.

Mandukparni (C. asiatica L. Urb.)

The utilization of this herb in the central nervous system (CNS)-related disorders is evident from the appearance of this herb in the ancient Ayurvedic texts. The herb is used in different purposes, such as a memory enhancer, immune booster, strength promoting, antiepileptic, antianxiety, and adaptogen.[28,29] The aqueous extracts of *C. asiatica* were evaluated in intracerebroventricular streptozotocin-induced cognitive impairment and oxidative stress in rats, and it was found that the plant possessed cognitive-enhancing effect and also an involvement of antioxidant mechanism.[30] The use of this plant is also found clinically for the anxiety neurosis and for mentally retarded children[23] as well and showed improvement in the short-term memory and learning abilities in both animal models and humans.[23,31] The plant is also utilized in the traditional eastern cultures as sedative, which was assumed due to its phytoconstituents brahmoside and brahminoside. The plant also possesses anxiolytic properties which are associated due to binding to cholecystokinin receptors, which are G protein coupled-type receptors and bind the peptide hormones cholecystokinin or gastrin and were considered to play a significant role in modulation of anxiety, memory, and hunger and nociception in animals and humans.[29,32] The herb is also known to invigorate the nervous system and brain and increase concentration, attention span, and combat aging.[32,34]

Brahmi, Bacopa monnieri (L.) Wettst

Bacopa monnieri (L.) Wettst is used in traditional medicine for the treatment of various nervous disorders, for the enhancement of memory development, concentration, and learning performance. It is also useful for the anxiety and several other therapeutic purposes.[35,36] There are a large number of phytoconstituents that have been reported from *Bacopa monnieri,* which include alkaloid brahmine, herpestine, bacosides A[3-(α-L-arabinopyranosyl)-*O*-β-D-glucopyranoside-10,20-dihydroxy-16-keto-dammar-24-ene], nicotine; triterpenoid saponins, saponins A, B, and C, β-sitosterol, stigmastanol, D-mannitol, betulinic acid, and pseudojujubogenin glycoside.[8,37-41] A number of behavioral studies in animals have been carried out, including the antidepressant studies that showed *Bacopa* improved learning of motor functions, acquisition and retention, and delay extinction of newly acquired behavior.[42,43]

Jyotishmati, Celastrus paniculatus Willd. (CP)

Jyotishmati botanically identified as *Celastrus paniculatus* Willd. (CP) belongs to family Celastraceae.[44] The seed oil of the plant was reported to have sedative action in rats; however, no such effects were recorded when tested in rabbits. The seed oil was also found to have some tranquilizing effect on adrenaline and amphetamine-induced excitement when tested in mice.[45]

Shankhpushpi, *Convolvulus pluricaulis Choisy (Syn. Convolvulus prostratus* Forssk.)

This is one of the most popular plants used in various CNS-related disorders in different traditional medicine systems. The plant is used for the treatment of insomnia, fatigue, nervous debility, low energy level, and also as brain tonic. The plant is well recognized as a memory enhancer and is used as a psychostimulant and reduces mental tension as well.[46] The plant was studied in different *in vitro* and *in vivo* models for its various neuroprotective effects. Researchers from the India and USA investigated the potential of *Convolvulus pluricaulis* aqueous extract to attenuate scopolamine-induced amplified protein and messenger ribonucleic acid levels of tau, amyloid precursor protein, amyloid β levels, which are the biomarkers for Alzheimer's diseases. The extract reduced the biomarkers and also improved the histological changes that occur in Alzheimer's disease in rat brain.[47] The plant was also reported for the enhancement of memory as well as improvement in cognitive function in several behavioral studies and also found to reduce the plasma cortisol and urinary catecholamine levels in clinical study.[47,48]

Vacha, *Acorus calamus* L.

In Atharva Veda (3000 BC), *Vacha* was used in the *prashana karma* and as an amulet to be worn in *kantha pradesha* for well-being of a person (A.P.I./44/10, 5/1/5). Sayana explained that this drug improves the intelligence and speech of an individual (2/7/10–13). It was used as a *krimihara* and *sanjyasthapaka dravya* (2/31/2–5). In Charaka Samhita (1000 BC onward), Vacha is mentioned in eight mahakshayas and more than 106 references in different disease conditions have been noted. In Susruta Samhita (600 BC) around 101 verses describe its use in different disease conditions and medhya is mentioned as one of the actions as per classics. A dose-dependent reduction in spontaneous movement in different rodents, viz. rats, mice, dogs, cats, and monkeys was shown by *A. calamus* rhizome volatile oil. At 100 mg/kg dose, spontaneous motor activity was reduced by 95% compared with control. Further, the essential oil of *A. calamus* rhizome antagonized amphetamine-induced agitational symptoms and also inhibited the conditioned avoidance response in rats.[49,50] Different studies showed diverse effects of Acorus in various disease conditions including cardiovascular diseases.[51,52] Treatment of 50 cases of depression with *A. calamus* (500 mg in dose of two tablets three times a day) for 6 weeks showed reduction in the degree of severity of depression and better rehabilitation and also a significant improvement in assessment based on the rating of symptoms on the Hamilton Depression Rating Scale.[50,53]

CONCLUSION

Mental health is one among the important health concerns in the emerging scenario, owing to the paradigm shift of the disease burden from communicable disease to noncommunicable disease in developed and developing countries. Attributable to the lifestyle changes, utmost importance has been given to prevention of mental disorders besides promotion of mental health and management of psychiatric illness in Ayurveda. The causal relationship between the mind and its role in the causation of physical illness is clearly dealt in Ayurveda and other nonmedical literatures indigenous to India, which has been recently recognized by the modern world. Several lifestyle interventions (Sadvrita) and pharmacological interventions comprising single drugs and compound formulations have been vividly described for the management of disorders.

In view of the alarming increase of mental illness in recent times and unmet medical needs in the field of psychiatry, there is need felt to explore suitable safe and effective options and modalities from plant resources. With the rich background of Ayurveda literature embodied with enormous botanical resources attributed with diversified actions and potentials to combat psychotic illness and also promotion of mental health, the drug development process may be taken forward adopting Ayurveda approach or phytopharmaceutical approach suitably satisfying the requisite formalities to ensure quality, safety, and efficacy as deemed.

Considering the limitations of conventional management, need is felt to mainstream the Ayurvedic approaches with rich background and potential in the management of psychiatric illness that could affectively cater the unmet needs in this field. The potential leads from Ayurveda texts may be taken forward for further development of safe, effective, and user-friendly dosage forms through systematic preclinical and clinical studies.

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हिन्दी सारांश

आयुर्वेद में वानस्पतिक नूट्रोपिक्सः औषधीय तंत्रिका संज्ञानात्मक वृद्धि एवं औषधि विकास

¹नारायणम श्रीकांत, ²देवेश तिवारी, ³नारायणम हरिप्रिया, ⁴श्रुति खंडूड़ी, ⁵चिन्मय रथ
⁶अनुपम के. मंगल, ⁷सुदेश एन. गायधनी

उद्देश्यः यह दस्तावेज आयुर्वेद में उपलब्ध ऐतिहासिक ग्रंथ पर आधारित आयुर्वेद में वानस्पतिक नूट्रोपिक्स की उपस्थिति से संबंधित उसके प्रलेखन तथा आलोचनात्मक मूल्यांकन पर आधारित है। यह दस्तावेज आयुर्वेद के ऐतिहासिक ग्रंथों में विभिन्न प्रकार के स्मरणों तथा ज्ञान संबंधी कार्यों में प्रयोग किए जाने वाले शब्दकोश का संग्रहण है।

पृष्ठभूमि: प्राचीन काल से ही स्मृति की प्रक्रिया तथा तंत्रिका संबंधित ज्ञान प्रणाली का उचित प्रलेखन भारतीयों द्वारा किया जा चुका है तथा प्राचीन चिकित्सकीय साहित्यों में तंत्रिका ज्ञान से संबंधित विभिन्न प्रकार के रोगों एवं उनके प्रबंधन का विस्तृत चित्रण उपस्थित है। तंत्रिका ज्ञान संबंधी प्रणाली जैसे मेधा (प्रचारकर्ता) के प्रगति हेतु चिकित्सीय पादप औषधियों का विस्तृत विवरण आयुर्वेद के नौ संहिताबद्धों से प्राप्त किया है।

समीक्षा का परिणामः नूट्रोपिक प्रभाव से संबंधित पादप औषधियों के विषय का अनसुलझे ज्ञान की प्रदर्शनी प्राचीन चिकित्सीय साहित्य में यत्र–तत्र रूप में उपस्थित हैं तथा आगामी अनुसंधान एवं औषधि विकास हेतु यह आवश्यक है। तार्किक रूप से साक्ष्य आधारित प्रयोग एवं सुरक्षित प्रभावशाली तथा स्वीकार्य फार्माकोलॉजिकल मात्रा का प्रारूप के विकास हेतु यह आवश्यक है कि इन पादप औषधियों के कार्यप्रणाली को उनके पारंपरिक प्रयोग, आयुर्वेद के ग्रंथों में उल्लेखित सिद्धांतों तथा आधुनिक फार्माकॉलोजिक प्रयोगों के आधार पर समझने की आवश्यकता है।

निष्कर्ष: आयुर्वेद में उपलब्ध ऐतिहासिक ग्रंथ पर आधारित आयुर्वेद में वानस्पतिक नूट्रोपिक्स की उपस्थिति से संबंधित उसके प्रलेखन तथा आलोचनात्मक मूल्यांकन किया जा चुका है। विभिन्न आयुर्वेदिक ग्रंथों में विभिन्न प्रकार के शब्दकोश पाए जाते थे। वर्तमान परिदृश्य में महत्वपूर्ण स्वास्थ्य संबंधी विषयों मे मानसिक स्वास्थ्य उनमें से एक है जो कि विकसित एवं विकासशील देशों में इस रोग का स्थानांतरण संचारी रोग से गैर संचारी रोग की ओर बढते रोगो के कारण हुआ है। आयुर्वेद के ग्रंथों से प्राप्त जानकारियों को आगामी सुरक्षित प्रभावशाली तथा उपयोगकर्ता हितकर मात्रा के रूप में ग्रहण करने के लिए समुचित पूर्व नैदानिक एवं नैदानिक अध्ययन के द्वारा विकास किया जा सकता है।

शब्द कूंजी: स्मृति में वद्धि, तंत्रिका ज्ञान प्रणाली में सुधार, नूट्रोपिक्स, आयुर्वेद, चिकित्सीय पादप।