Section A-Research paper

ROLE OF POTENTIAL MEDICINAL PLANTS TO TREAT NEURODEGENERATIVE DISEASES: A COMPREHENSIVE REVIEW

Mir Shahid[1], Rajiv Sharma[1*], Paramjeet Kaur[1], Hema Rani[1,3], Puneet Kaur[2]

1. **Faculty of Pharmacy, Desh Bhagat University, Mandi Gobindgarh, Punjab**
2. **College of Pharmacy, Chandigarh Group of Colleges, Landran, Mohali, Punjab**
3. **Research Scholar, Career Point University, Hamirpur, Himachal Pradesh**

For Correspondence: drrajeev.rs@gmail.com

Abstract

The majority of diseases are treated by drugs having chemical origin due to their quick effects and immediate relief to the patients .Allopathic drugs are becoming increasingly popular for the treatment of most of the diseases.However, these medications have major unwanted side effectsfor patients, and cause deaths at higher rates. As a result, researchers' interest among in medicinal plants for the treatment of various diseases is growing day by day. Some herbal plants have also beenproven to have substantial pharmacologicalas well as healing outcomes in the treatment of various neurodegenerative diseases. Preliminary studies conducted by various scientific communityyielded extremely valuable results, shedding light on a sign of hope for the therapy of these diseases.Therefore, this review emphasis on detailed overview of various medicinal plants having neuroprotective properties.

Keywords: Neurodegenerative, medicinal plants, herbal plants, allopathic drugs.

Introduction

The term "neurodegenerative diseases" (ND) refers to a group of conditions that cause a specific neuronal damage and pose a serious risk to the life of people. Difficulties based on age like these are getting more and more common.Alzheimer's disease, dementia, Huntington's disease,schizophrenia, Parkinson's disease, spinocerebellar ataxia, amyotrophic lateral sclerosis and epilepsy are a few examples of neurodegenerative disorders[1].It is generally recognized from brain pathology that cerebral and neurodegenerationillnesses is the main cause of death worldwide. A condition known as neurodegeneration occurs when the alterations in the neuropathologyand brain ageing[2]. A frequent pathogenesis of neurodegeneration, a protein buildup is accompanied with alterations in the physical and molecular makeup of the brain.Protein miscoding or misfolding, such as accumulation, are the pathogenic alterations that

cause these symptoms in the case of AD, the accumulation of amyloid (A) andneurological tangles(NTFs) [3].Synuclein is associated with amyotrophic lateral sclerosis (ALS), Parkinson's disease (PD) and frontotemporal dementia (FTD) have been linked to Huntington's disease have been linked to Huntington's disease and TDP-43[4].

Plant components such as stems,seeds,flowers,roots,leaves and fruits have been used in complementary and alternative medicine.The active ingredients or phytochemicals found in medicinal herbs include a variety of flavonoids, alkaloids, isoprenoids, polyphenols, and tannins, among others. Antioxidant-rich herbs have neuroprotective qualities as well. This study provides an overview of treatment options for treating neurodegenerative diseases as well as several significant and well-known medicinal plants that function as neuroprotective agents [5].

Many disorders have a complex aetiology that is influenced by both hereditary and environmental factors.Together with cellular and molecular causes such increased generation of inflammation, mitochondrial DNA alterations, oxidative stress, improper control of apoptosis, and other variables such as brain ageing is the primary cause of neurodegenerative disorders[6]. Cells often use defence mechanisms and repair processes to counteract strong oxidative stress.However, the antioxidant defence system is unable to entirely counteract ROS-mediated effects because neurodegenerative diseases like AD cause superoxide dismutase (SOD), catalases (CAT) and peroxiredoxins (Prxs) are examples of antioxidant enzymes to function less efficientlyto function less efficiently [7].

Over View Of Neuroprotective Disorder: A Mechanistic Approach

Alzheimer Disease (AD)

The hallmark of cognitive performance gradually declines as a result of Alzheimer's disease (AD)brought on by brain's hippocampus region, where senile plaques are present.Condition, a kind of dementia that affects five million plus Americansand is anticipated to impact 7.7 million people by 2030is the most prevalent form of dementia in middle-aged and older individuals. The bulk of the disease's early-onset variants are linked to a particular genetic flaw, and symptoms often start to manifest after the age of 60. In 10% to 15% of instances, genetic factors unquestionably contribute, even though the etiology is unknown[8]. A treatment for AD has not yet been found, and the medications that are now used to treat the illness only partially and ineffectively alleviate its symptoms.

The primary cause is a neuronal loss in the hippocampus, cortex, and subcortical areas [9]. A number of solutions are available in herbal medicine to slow the progression and symptoms of AD. The development and sale of medications derived from medicinal plants has become increasingly popular, and their scientific and economic significance in fields of health appear to be growing. These plant-derived products are meticulously standardised, and it has been shown that they are effective and safe for a particular use [10,11]. The use of nutritious plants and their components is advised in conventional medical proceduresto improve cognitive performance as

well as to treat other AD symptoms such depression, memory loss, and poor cognition. Depending on the complexity of the ailment, a solitary herb or a group of herbs is typically advised. The reasoning behind this is that the herb's bioactive components may not only work in concert but also control the action of other compounds from a different plant species or the same plant [12]. According to the study, protein aggregates that accumulate to produce neurofibrillary tangles(NFTs) and senile plaque are two of the disease's primary pathologies.

The composition of fibrillar amyloid (A) is caused by amyloid cleavage.However, in the case of NFTs, the tau protein that is connected to microtubules (APP) is hyperphosphorylated[13]. Since acetylcholine is produced by the enzyme choline acetyltransferase (ChAT), acetylcholine insufficiency played a role in the emergence of the "cholinergic theory of AD." According to reports of severe neocortical ChAT deficiencies, the nucleus basalis of Meynert loses cholinergic perikarya, which lowers choline absorption, Ach release, and has an impact on Ach functions like memory and learning[14].By employing a strict, individualised strategy that includes identifying the most likely causes of the cognitive decline, we provided the first evidence of cognitive decline in AD and pre-AD disorders, including moderate cognitive impairment (MCI) and subjective cognitive impairment(SCI).Finding healing the gut, gastrointestinal hyper permeability and enhancing the microbiome are some examples of how to handle these possible factors, identifying and treating diseases like Babesia, Borrelia, or Herpes family viruses,as well as identifying and treating pathogens that cause insulin resistance and restoring insulin sensitivity, inadequate amounts of trophic molecules, hormones, and minerals. This individualized, precision treatment programme has a sustained benefit over monotherapies[15]. Pathologically, AD is characterised by the development of senile amyloid plaques, a form of protein aggregate generated by tau-protein-based neurofibrillary tangles and amyloid-(A) peptides. Senile plaques for a long time had been considered the main pathogenic component from this perspective, AD and recent findings indicating protein aggregates are correlated with protection against AD seem counterintuitive. Recent studies, however, revealed that plaques might serve as an extracellular repository for cells that secrete too much A peptide, which then diffuses across the brain parenchyma and enters synaptic clefts where it causes synaptic dysfunction. The dispersing oligomers and insoluble deposits could consist of several monomers that can cause amyloid, including peptide, hunting tin, various prions, synucleins, and tau proteins, yetthe processes by which these oligomers appear to cause neurodegenerative diseases are remarkably similar[16].

Parkinson’s Disease(PD)

Parkinson's disease (PD), the most prevalent form of the disease, affects more than 10 million individuals worldwide It is progressive neurological movement disorder whose prevalence increases with advancing age (Parkinson data can be found at www.pdf.org.). According to estimates, 4% of cases of PD are discovered before the age of 50, and men are more likely than women to get PD[17,18].Pathologically, PD patients' brain tissues primarily exhibit Lewy bodies, aggregation ofloss of dopaminergic neurons and cytoplasmic aggregates harbouring

insoluble –synucleinthe substantianigra pars compacta (SNpc) in the midbrain)[19]. It has been well established over the past few decades that oxidative stress, diminished powerhouse cell activity, swelling ,apoptosis, abnormaldepletion of neurotrophic factors and proteolysis are all involvedParkinson's disease (PD) progression[20].Injections of stem cells into the striatum, surgically inserted electrodes for deep brain stimulation of the subthalamic nucleus and globuspallidus and oral preparations of levodopa (L-DOPA), dopamine (DA), and monoamine oxidase-B are all used to treat Parkinson's disease (PD) (MAO-B)receptor agonists and inhibitors. Experimental and clinical studies using stem cells to treat Parkinson's disease (PD) have gained more interest now a days [21,22]. Although these treatments have shown to have some benefit,however, there is no treatment for Parkinson's disease.Although neuroprotective therapy does not directly address the cause of Parkinson's disease (PD), it can prevent the disease from progressing by intervening in some early stages of the disease's pathogenesis. Several trials have suggested that traditional Chinese medications may be clinically effective in slowing PD development. According to mounting evidence, several herbs include neuroprotective substances such as bacopamonnieritriptolide, ginsenoside, resveratrol, curcumin, gingko biloba ,withaniasomnifera ,or green tea polyphenols or catechins[23,24].

Huntington's Disease(HD)

A progressive decline of brain and muscular function is the hallmark of Huntington's disease (HD), a fatal genetic and familial disorder.It happens as a result of neurons' genetically predetermined neuronal degeneration, which results in uncontrollable movement, a decline in intelligence, and emotional disorderstheHuntingtin (HTT) gene's first exon, which is located on chromosome 4, (4p63), has a CAG trinucleotide expansion that contributes to HD[25].6-35 CAG repeats are present in healthy individuals, whereas more than 36 repetitions are present in those with the disease.Mutant Huntingtin proteins accumulate and form a long polyglutamine region that damages brain neuronal networkscauses neuronal death.Chorea, cognitive deficits, and early death are caused by the degenerative alterations in the cerebral cortex and striatum. Children who have parents with HD have a 50% chance of inheriting the condition. When HD first occurs between the fourth and fifth decade of life, it affects both each gender equally.Aged between 35 or 55 is when the symptoms typically start to show up when it varies from person to person[26].Among populations of Western European ancestry, the mutation is present in 4–10 occurrences per 100,000 people, with many more having a chance of acquiring the defective gene. AsevereBasal ganglia (caudate region and putamen) loss of efferent medium spiny neurons causes brain neurodegeneration. Over time as a result of having the HD mutation is what causes the classic HD symptom[27].The clinical course of HD normally proceeds from a presymptomatic state to total impairment and death over a period of 10 to 20 years. Tumbling, lack of concentration, problems with movement and concentration, clumsiness, short-term memory lapses, and depression are some of the early symptoms. The main signs of the condition include difficulty speaking, weight loss, feeding issues, swallowing issues, excessive facial movements, itching, and stumbling. According to estimates, HD affects between 6000 and

30,000 persons in the UK and the USA, respectively[28].Although each person's symptoms are unique, mental instability or abnormal behaviour is a common signof the condition Huntington's. A recent study found that HD cells have much higher CA2? loading in their mitochondria even when they are at rest. Since mitochondrial DNA damage results from this high CA2? loading, HD cells' mitochondria become dysfunctional [29]

Schizophrenia

Schizophrenia is a psychological condition marked by psychotic symptoms, such as hallucinations and delusions, which have a major impact on emotions, behavior, and, most significantly, mental functions and contents. A person's perception of reality might be lost as a result of the mental disease known as psychosis. A psychotic condition known as schizophrenia, which literally means "split mind," is characterised by serious social or vocational dysfunction as well as impairments in reality perception or expression. People with this condition exhibit catatonic, delusional, hallucinatory, disorganised speech, and/or excessively disorganized behavior [30,31].Anhedonia, avolition, emotional flatness, and disorganised speech and behaviour are some of the negative symptoms of schizophrenia, which is a clinically diverse disorder. Positive symptoms include delusions and hallucinations. Severe social impairment.Contact and related disorders are additional important characteristics: For a diagnosis to be made, there must be proof of social or occupational impairment [32].The inability to maintain relationships with friends and family, as well as a lack of interest in socially significant activities like job and school, are examples of specific social function impairments, insufficient self-care and study. These behavioural and clinical anomalies are thought to be caused by a functional dysconnectivity condition, which affects how the brain's network of connections is organized [33].

One of the most significant indicators of a long-term prognosis for schizophrenia, social dysfunction is crucial to the early diagnosis of the illness [34].But clinical symptomatology and the results of typical cognition tests have little to no relationship with social functioning.Instead, it seems that comprehension of the poor social and occupational functioning that many people with schizophrenia display has everything to do with a patient's ability to infer what others are thinking and feeling and to reason about how those thoughts and feelings will influence their behavior [35].Regardless of the cause, antipsychotic medications are helpful in treating hallucinations, delusions, and mental abnormalities. They constitute the cornerstone of acute and maintenance treatment for schizophrenia. Herbal medicine has been used in recent decades by modern psychiatry to treat psychiatric diseases including schizophrenia.

A time of disappointment sets in as people come to terms with the truth that synthetic pharmaceuticals are not all-powerful following the advent of the pharmaceutical industry in the last century and substantial advancements in therapy.Because of this, there has been an increase in interest in recent years in using complementary and alternative therapies to treat psychiatric disorders, such as schizophrenia [36], and a study found that 44% of psychiatric patients with

schizophrenia had used herbal medicine in the previous year (primarily for psychiatric purposes) [37].

Dementia

The term "dementia" refers to a collection of clinical symptoms that impact one's memory, thinking, and social skills. It is characterised by a steady decline in memory retention and cognitive ability. It has become a significant social and medical issue that necessitates quick action to determine its pathophysiology and determine appropriate therapeutic methods. Old age, brain ischemia, toxicity exposure, and oxidative stress are a few of the factors that contribute to the development and progression of dementia. An estimated 50 million people worldwide are thought to have dementia, and 7.7 million new cases are reported year. They mostly come from low- and middle-income nations and have subpar diagnoses [38]**.**One of the leading causes of death in high-income nations is dementia [39]. Despite dementia typically being associated with the old, cases among those between the ages of 40 and 60 are increasing quickly [40].

Despite the quick development of synthetic medications that target memory loss, there is a growing global demand for complementary or alternative medicine, and this market deserves a lot of attention. Here, we examine the crucial function of typical medicinal plants, which are frequently employed in numerous traditional medical systems as prospective dementia prevention or treatment measures.Vascular dementias have a number of neurodegenerative diseases as common causes, including substance addiction, amyotrophic lateral sclerosis intracranial tumors, neuro-infection, subdural hematoma and other neurodegenerative diseases[41,42]**.**Alzheimer's disease (AD), the most prevalent form of dementia, is marked by beta-amyloid buildup (amyloid plaques) and progressive microtubule disintegration, which results in synaptic loss, impaired communication, and neuronal cell apoptosis**.**In addition, -amyloid plaques, which are insoluble proteins that accumulate in the gaps between neurons and interact with cell membranes to produce oxidative stress and a rise in free calcium levels, eventually cause the death of neuronal cells. Pesticides, air pollutants, and industrial hazardous compounds that easily pass through blood-brain barriers can cause oxidative stress, neuronal damage, and the progression of dementia [43,44].

Amyloid protein buildup and deficiencies in cholinergic neurotransmission in the brain are hallmarks of ageing or cognitive disorders. Unfortunately, existing dementia medications, such ascalcium channel blockers, N-methyl-D-aspartate (NMDA) antagonists (memantine), and choline esterase inhibitors, only temporarily ease symptoms without addressing the primary underlying aetiology [45].

Table-: list of medicinal plants for the management of Alzheimer disease, Parkinson disease ,Huntingtons disease, Schizophrenia And Dementia

no				Constituents			
1	*Withania Somnifera*	Solonaceae	Root	withasomidienone,withaferin-A, withanone ashwagandha	anti-inflammatory,n, inhibits neural cell death,memory and cognitive function improvement	500mg/day	[46-48]
2	*Bacopa monnieri*	Scrophulariaceae	Leaves and stem	alkaloids, saponins and sterols	memory loss,improves memory intention, cardiovascular health and slows down brain ageing	50mg/day	[54-57]
3	*Gingko biloba*	Ginkgoaceae	Leaves and seeds	Quercetin, Isorhamnetin, Kaemferol, and Ginkgolides A–C	antioxidant, anti-dementia and anti-Alzheimer‘s	240mg/day	[61-63]
4	*Crocus Sativus*	Iridaceae	Dried red stigma	carotenoids, α-crocetin, picrocrocin and glycoside crocin	sedative, antispasmodic, stimulant, stomachic, eupeptic and aphrodisiac	30mg/day	[69-71]
5	*Curcuma* Longa	Zingiberaceae	Roots,bulbs rhizomas	curcuminoids Turmenenone oil Demethoxycurcumin	Anti-inflammatory Anti-septic Anti-bacterial	200mg/day	[73-75]

				Cyclocurcumin Bisdemethoxy curcucumin			
6	*Coriandrum sativum*	Apiaceae	Fresh leaves and dried seeds	aliphatic aldehydeslinalool, linoleic and linoleic acid	Memory improvement, sedative ,anti-alzheimers activity	100mg/day 200mg/day	[79-81]
7	*Convolvulus Pluricaulis*	Convolvulaceae	Whole Plant	Triterpenoidsflavonol glycosides, anthocyanins, and steroids	Antioxidant Anti-inflammatory Improve memory Slows brain aging	250mg-2g dose per day	[84-86]
8	*Centella Asiatica*	Apiaceae	Leaves and stem	triterpenes,Asiaticoside, adecassoside, sapogenins, glycosides	Prevention of amyloid formation ,dopamine toxicity in parkinon's disease	250,500 and 750 mg/day	[89]

Neuroprotective EffectsOf Medicinal Plants

1.1 *Ashwagandha (WithaniaSomniferia)*

As a brain rejuvenator for AD, ashwagandha is one of the most popular drugs that is commonly recommended. Winter cherry and ginseng from India are other names for it. It is recommended as a stimulant of the nerves, an energy and a way to increase overall health and lifespan [46].According to studies, ashwagandha has the capability to maintaina strong immune system, operate as an antioxidant, and scavenge free radicals [47]. Many highly interesting bioactive substances, including components of ashwagandhais steroidal lactones of the ergostane class. Among otherswithasomniferin-A, withanonewithasomidienone, with-asomniferols A–C, dehydrowithanolide-R,withaferin-A withanolides A through Y compounds are also present. other components consist of the beta-sitosterol, alkaloid and Sitoindosides VII–X are phytosterols [46,48].

A dose- and time-dependent stimulation of neurite outgrowth was seen in humans after treatment with ashwagandha methanol extract. In a study utilising cultured rat cortical neurons [29] and neuroblastoma cells, the A peptide treatment resulted inPre- and postsynaptic stimuli are lost, along with axonal and dendritic atrophy [49]. Axons, dendrites, and pre- and post-synapse regeneration were all significantly promoted by further withanolideA treatment in the cultured cortical neurons.Withanolide A prevented the axonal, dendritic, and neurite degeneration brought on by *A(25-35) in vivo*.Reversing the memory deficits brought on by A-peptide in mice and bridging connections between the cerebral cortex and hippocampus[50].

The part that is most usually utilised is the root of ashwagandha, whichbelongs to the *Solanaceae* family, which includes nightshades. It is categorised as a rasayana (rejuvenative), and its anti-inflammatory, immune-supporting, and free radical-scavenging effects are all believed to exist [51]. An ashwagandha root total alkaloid extract calms in a variety of ways, the central nervous system of mammalian species indicating that it would be possible to utilise this herb to promote calm. Recent studies regarding how Ashwagandha reduces stress were randomized, dual-blind, and placebo-controlled studies showed that it decreased the symptoms of stress and cognitive impairment.It improved concentration and amnesiain a way that depends on dose; 500 mg/day was more efficient[52].This plant's water-based study on extracts has indicated that promotes cholinergic activity, as shown by increases in acetylcholine content and choline-acetylrationale for transferase activity. This may assist in explaining some of the processes that improve memory and cognition [53].

1.2***BacopaMonnieri***

The plant Bacopamonnieri, often known as Brahmi, is a member of the *Scrophulariaceae* family. It is a traditional Ayurvedic treatment for nerve disorders and memory improvement. The inclusion of certain phytoconstituents, including as alkaloids, saponins, sterols, as well as Bacosides, which have memory-enhancing properties, is what causes the pharmacological benefits of Brahmi[54]. A crossover design was used to determine whether to provide 500 mg of Sideritis extract, 320 mg of Bacopamonnieriextract, or a combination to ten participants. Sideritis extract is abundant in various flavonoids and has been shown to been demonstrated to enhance cognition in AD animal models [55].A neuropsychological test of sustained, selective attention and visual scanning is called the Attention d2 Test, speed. Evaluation studies showed that combining a low-dose bacopamonnieri extract with a Sideritis extract improved the d2 concentration test score. Since Bacopamonnieri alone only had a similar effect after repeated doses, the improvements in long-term memory shown with serial bacopamonnieri delivery may be a potential therapeutic method for MCI patients[56]. The medication also revealed neuroprotective effect against glutamate- and -amyloid-induced neurotoxicity [57]. Bacopamonnieri is used as a memory enhancer, antioxidant, anti-stress, anti-inflammatory, and anti-microbial relaxant for smooth muscles [58]

1.3 GingkoBiloba

Ginkgo biloba L, one of the most significant medicinal plants in the Ginkgoceae family,Quercetin, Isorhamnetin, Kaemferol, Ginkgolides A–C, and Bilobalide make up the majority of the herb's chemical composition [59].In experimental rats, ginkgo biloba extract demonstrates neuroprotective properties against 6-hydroxydopamine (6-OHDA)-induced neurotoxicity in the nigrostriatal dopaminergic system, or Parkinson's disease [60].Ginkgo biloba has also been demonstrated to have antioxidant, anti-dementia, and anti-Alzheimer's effects as well as to enhance cognitive functions[61].Reduced expression of peripheral genes and prevention of -amyloid peptide aggregation in Alzheimer's disease, antioxidant effects, and anti-platelet activating factor activity for vascular illnesses are some of the hypothesised mechanisms of the plant extract that benzodiazepine receptor reduces stress[62,63].Terpenoids make up 6% of the standardised extract of Ginkgo biloba leaves (GBE), which is measured inwhich contain quercetin, kaempferol, isorhamnetin, and other flavonoids,3.1% ginkgolides A, B, C,24% flavonoid glycosides and J; and 2.9% bilobalide; and 5.0% to 10.0% organic acid. According to some theories, the pharmacologically active components of GBE are flavonoids and terpenoids[64,65].A wide variety of conditions and illnesses, such as multi-infarct dementia, low mood, cerebral insufficiency, which manifests as symptoms including memory loss, difficulty concentrating, worry and peripheral occlusive arterial disease, thrombosis,myocardial ischemia, confusion Stroke and (POAD). It also impacts on sexual dysfunction brought on by antidepressants[66].

1.4 Saffron (*CrocusSativus*)

C. sativus belongs to family*Iridaceae* that includes one of the most therapeutic plants.Crocus sativus L (c. sativus), sometimes known as saffron, is a tiny perennial herb or shrub native to Afghanistan, Turkey, and Spain. It was grown in numerous nations, with the majority of cultivation taking place in Iran [67]. The stigmas of this plant include the carotenoids -crocetin, picrocrocin, and glycoside crocin as well as the antioxidant lycopene,vitamin B2,carotenoidsandzeaxanthin. This herb has a long history of use as a eupeptic ,stimulant, antispasmodic,stomachic, sedative and aphrodisiac[68]. To evaluate saffron's effectivenessmild-to-moderate AD treatment, researchersincluded 46 individuals who were randomised to receive saffron30 mg once daily, or an inactive drug. Following sixteen weeks, saffron considerably improved the results on cognitive testsfthan placebo in terms of(ADAS-cog and CDR scores) performance. The randomised, dual-blinded,Saffron appearedto be advantageous and safe in mild to moderate AD, according to a controlled trial[69].Saffron extract and memantine comparison in lowering thinking impairments was done as part of a pilot study to determine their safety and effectiveness.There were 68 individuals in the study with moderate to severe AD casual, dual-masked trials, analogs, and similar trial. The participants received either saffron extract (30 mg/day) or memantine (20 mg/day) capsules for the duration of the study, which

lasted a full year.With regard to those who have mild to severe AD, the saffron extracthad little side effects and was equally effective as memantine at halting cognitive deterioration [70].

1.5 ***Turmeric* (*Curcumalonga*)**

The *Zingiberaceae* ginger family includes the flowering plant known as turmeric, which is native to Southeast Asia and the Indian subcontinent. This rhizome plant's vibrant yellow-orange color is mostly a result of the polyphenolic substances known as curcuminoids.Turmeric has been used for millennia to cure a variety of illnesses, such as liver detoxification, the prevention of infection, inflammation due to its anti-inflammatory, antiseptic, and antibacterial characteristics, the treatment of allergies, the stimulation of digestion, and the management of cholesterol levels to increase resistance [71]. Turmeric's active ingredients are water-solublecurcuminoids and turmerone oil. Demethoxycurcumin and curcumin are examples of turmerones (DMC), cyclocurcuminandbisdemethoxycurcumin[72].The main curcuminoid, curcumin, has anti-inflammatory properties andis related to a decreased risk of AD [73].In investigations carried out *in vitro*, curcumin was discovered to be significantly more effective than vitamin E at preventing lipid peroxidation and neutralising reactive oxygen species[74]. In several animal models of AD, curcumin also slows cognitive deterioration.Regardless of the method of administration, higher doses of curcumin are more effective than lower doses, and piperine, which has a number of pharmacological effects and several health benefits, especially against chronic diseases, enhanced the effects of curcumin on cognition [75]. The anti-aging and neuroprotective effects of curcumin administration in 6- and 24-month-old rats are demonstrated. As people age, their lipid peroxidation and lipofuscin concentrations often increase. In a similar way, as people age, their SOD, GPx, and Na+, K+ -ATPase activities decline. Chronic curcumin administration has shown to have anti-oxidative [76].

1.6 ***Coriander* (*Coriandrumsativum*)**

The annual herb coriander (Coriandrumsativum L) is a member of the *Apiaceae* family. This plant is indigenous to the Mediterranean region and is widely cultivated worldwide. Aliphatic aldehydes are found in the fresh herb oil, whereas linalool, oxygenated monoterpenes, and monoterpene hydrocarbons are found in the coriander fruit oil. The plant is also strong in Eos such linalool, linoleic, and linoleic acid, as well as lipids like petroselinic acid[77,78]. A preventive effect against tacrine-induced orofacial dyskinesia has been shown by ethanolseeds of Coriander sativum L. extracted (100, 200 mg/kg). The animals were observed for changes in locomotion and cognitive function as well as for vacuous chewing movements, tongue protrusions, and orofacial bursts for an hour after ingesting tacrine (2.5 mg/kg I.P.). After consuming plant seeds extract (100, 200mg/kg P.O.) for 15 days, tacrine-induced VMC, TP, and OB considerably decrease, whereas cognition and locomotor activity dramatically increase[79]. When given to wistar albino rats, the methanolic extract of Coriander sativum L exhibits neuroprotective action at a dose of 200 mg/kg p.o.The carotid arteries were blocked for 30 minutes in this investigation, and the brain was then reperfused for 45 minutes to induce cerebral ischemia. The study showed that pre-treatment with a methanolic extract of Coriandrumsativum

for 15 days increased endogenous enzyme levels (catalase, SOD, Glutathione, and protein level), while lowering lipid peroxidation and calcium level [80]. The anaesthetics scopolamine (0.4 mg/kg i.p.) and diazepam (1 mg/kg i.p.) have been shown to cause memory deficits in both young and old mice, however Coriandrumsativum leaves have also been shown to improve memory in both species in a dose-dependent manner[81].

1.7***Shankhpushpi(Convolvuluspluricaulis)***

Convolvulus pluricaulisis is the member of a memory booster that belongs to the *Convolvulaceae* family. Convolvulus pluricaulis aqueous extract and ethyl acetate are said to boost memory and enhance the abilities to learn.This plant's use has been shown to help maintain calm by regulating the body's production of stress chemicals including cortisol andadrenaline. The experiments revealed that giving ratsethanolic extract increases their capacity for learning and memory.The hippocampus CA1 and CA3 areas, which are involved in memory and learning, showed enhanced acetylcholinesterase activity after administration of Convolvulus pluricaulis[82].Anthocyanins,steroids, flavonol glycosides, and tri terpenoids are just a few of the secondary metabolites that have been found and may be responsible for the nootropic and memory-improving properties of shankhpushpi as well as its other pharmacological benefits[83,84].When mice were given CP extracts, their memory function improved in a dose-dependent manner. Similar improvements in memory were seen in aged mice when given CP extracts for seven days. Acetylcholine esterase activity in the hippocampus regions associated with learning and memory, CA1 and CA3, increased after receiving CP in a dose-dependent manner[85].Young adult rats that had been intubated with CT aqueous root extract showed a considerable improvement in passive avoidance learning and memory. CT-treated rats demonstrated a considerable compared to age-matched saline controls, the amygdale area of neurons had more dendritic junctions, branching sites, and dendritic processes coming from the soma [86].

1.8***GotuKola* (*CentellaAsiatica*)**

A plant called Centellaasiatica that may be found inside India, Sri Lanka,Bangladesh and belongsto the *Apiaceae* family.Asiaticoside,glycosides,madecassic acid vellarintriterpenes,Asiatic acid,adecassoside,sapogenins, one of the bioactive substances found in the Centellaasiatica plant is centelloside.Asiatic acid and asiaticoside may play a role in the prevention of toxicity and therapy of Alzheimer's disease since they suppressed amyloid cell death, reduced hydrogen peroxide-induced cell death, and free radical concentrations in vitro. Amyloid disease have being reduced and components of the reaction to oxidative stress were altered in mice brains after Centellaasiatica extracts.It is essential for nerve brain cells to have this plant in order for them to function properly, increase in intelligence and memory, and live longer[87].Asiatic acid is one among the phytochemicals present in Gotu Kola, and some of its derivatives dramatically enhanced cognitive performance in a scopolamine-induced memory impairment mouse.Temporary memory issues similar to those from early AD are caused by scopolamine. According to experiments measuring passive avoidance and Morris water maze

performance, researchers discovered that pre-treatment with three different asiatic acid derivatives significantly improved memory in mice compared to mice treated with scopolamine and not given any medicine These compounds had a cognitive-improving effect because they had higher choline acetyltransferase activity, which led to better Ach production[88].

Conclusion

There are numerous unwanted adverse effects associated with synthetic drugs. Herbal medicines are becoming more popular as they are more effective and have fewadverse consequences. A variety of potentially bioactive compounds found in medicinal plants could be used to treat a number of neurodegenerative illnesses. Therefore, there is an alternative for patients to opt the herbal medicines instead of synthetic product in order to treat these diseases. The main objective of this article is to explainapplication and scope of many medicinal plants that can be used to treat these diseases.In today's world, scientists face significant challenges in discovering the specific mechanisms of action of herbal plants so that the representation of efficacy on plant medicines can be placed in a concrete manner. Although preliminary studies on small animals were conducted, more research on a larger population is needed to establish Drugs for the treatment of neurodegenerative illnesses derived from medicinal plants.

References

1 Gitler, AD.;Dhillon, P.; Shorter, J. Neurodegenerative disease: models, mechanisms, and a new hope, Dis Model Mech, 2017, 10(5). 499-502.

2 Roy,S.;Awasthi, HI. Herbal medicines as neuroprotective agent: A mechanistic approach, Int J Pharm PharmSci, 2017, 9(11). 1-7

3 Alexander, GE.; An emerging role for imaging white matter in the preclinical risk for Alzheimer Disease: linking β-Amyloid to myelin, JAMA Neurol, 2017, 74(1). 17-19.

4 Johannes, Brettschneider. J.;Tredici, KD.; Lee, VMY.; Trojanowski,JQ.; Spreading of pathology in neurodegenerative diseases: a focus on human studies, Nat Rev Neurosci, 2015; 16: 109–120

5 Mohebbatia, R.;Khazdairb, MR.; Hedayatia, M.Neuroprotective effects of medicinal plants and their constituents on different induced neurotoxicity methods, J Rep PharmaSci, 2017; 6(1): 34-50

6 Balaban, H.; Nazıro ˘glu, M.; Demirci, K.; Övey, ˙I.S. The protective role of selenium on scopolamine-induced memory impairment, oxidative stress, and apoptosis in aged rats: The involvement of TRPM2 and TRPV1 channels. Mol. Neurobiol. 2017, 54, 2852–2868.

7 Andersen, J.K.; Oxidative stress in neurodegeneration: Cause or consequence? Nat. Med. 2004, 10, S18.

8 Alzheimer's Association: 2010 Alzheimer's disease facts and figures. Alzheimers Dement 6:158-194.

9 Bredesen, DE.;Neurodegeneration in Alzheimer's disease: caspases and synaptic element interdependence. MolNeurodegener 2009, 4:27.

10 Perry, EK.; Pickering, AT.; Wang, WW.; Houghton, PJ.; Perry, NS.; Medicinal plants and Alzheimer's disease: from ethnobotany to phytotherapy. J Pharm Pharmacol 1999, 51:527-534.

11 Howes, MJ.; Perry NS, Houghton PJ: Plants with traditional uses and activities, relevant to the management of Alzheimer's disease and other cognitive disorders. Phytother Res 2003, 17:1-18.

12 Wagner, H.; Ulrich-Merzenich, G. Synergy research: Approaching a new generation of phytopharmaceuticals. Phytomedicine 2009,16, 97–110.

13 D, J. Selkoe―Alzheimer‘s disease: Genes, proteins, and therapy,‘‘ Physiological Reviews, 2001; 81(2): 741–766.

14 Francis, PT.; Palmer, AM.;Snape, M.; Wilcock, GK. The cholinergic hypothesis of Alzheimer‘s disease: a review of progress, J NeurolNeurosurg Psychiatry, 1999; 66(2): 137-147.

15 Bredesen, D.E.; Sharlin, K.; Jenkins, D.; Okuno, M.; Youngberg, W.; Cohen, S.H.; Stefani, A.; Brown, R.L.; Conger, S.; Tanio, C.; et al.Reversal of Cognitive Decline: 100 Patients. J. Alzheimer's Dis. Parkinsonism 2018, 8, 1–6.

16 Haass, C.;Selkoe, DJ. Soluble protein oligomers in neurodegeneration: lessons from the Alzheimer's amyloid beta-peptide. Nature Rev Mol Cell Biology 2007; 8: 101-12.

17 S,K. Van. Den. Eeden.; C,M. Tanner.; A,L. Bernstein, R.D. Fross.; A, Leimpeter.; D,A. Bloch, et al., Incidence of Parkinson's disease: variation by age, gender, and race/ethnicity, Am. J. Epidemiol. 157 (2003) 1015–1022

18 G,F. Wooten.; L,J. Currie.; V,E. Bovbjerg.; J,K. Lee.; J, Patrie. Are men at greater risk for Parkinson's disease than women? J. Neurol. Neurosurg. Psychiatry 75 (2004) 637–639

19 D, K. Simon.; C, M. Tanner.; P, Brundin. "Parkinson disease epidemiology, pathology, genetics, and pathophysiology," Clinics in Geriatric Medicine, vol. 36, no. 1, pp. 1–12, 2020.

20 A,Ascherio.; M, A. Schwarzschild. "The epidemiology of Parkinson's disease: risk factors and prevention," The Lancet Neurology, vol. 15, no. 12, pp. 1257–1272, 2016

21 Fu, W.;Zheng, Z.;Zhuang, W.; Chen, D.; Wang,X.; Sun, X.; Wang, X. Neural metabolite changes in corpus striatum after rat multipotentmesenchymal stem cells transplanted in hemiparkinsonian rats by magnetic resonance spectroscopy. IntNeurosci. 2013;123:883–891.

22 Buzhor, E.; Leshansky, L.; Blumenthal, J.;Barash, H.;Warshawsky, D.;Mazor, Y.; Shtrichman, R. Cell-based therapy approaches: the hope for incurable diseases. Regen Med. 2014;9:649–672.

23 Virmani, V.; Pinto, L.;Binienda, Z.; Ali, S. Food, nutrigenomics, and neurodegeneration--neuroprotection by what you eat! MolNeurobiol. 2013;48:353–362.]

24 Chen, LW.; Wang, YQ.; Wei, LC.; Shi, M.; Chan, YS. Chinese herbs and herbal extracts for neuroprotection of dopaminergic neurons and potential therapeutic treatment of Parkinson's disease. CNS NeurolDisord Drug Targets. 2007;6:273–281.

25 W, J. Szlachcic.; M. Switonski.; W, J. Krzyzosiak.; M, Figlerowicz.; M, Figiel. "Huntington disease iPSCs show early molecular changes in intracellular signaling, the expression of oxidative stress proteins and the p53 pathway," DMM Disease Models and Mechanisms, vol. 8, no. 9, pp. 1047–1057, 2015.

26 X, Li.; A,Valencia.; E, Sapp. "Aberrant Rab11-dependent trafficking of the neuronal glutamate transporter EAAC1 causes oxidative stress and cell death in Huntington's disease," Journal of Neuroscience, vol. 30, no. 13, pp. 4552–4561, 2010.

27 Reiner, A.;Albin, RL.; Anderson, KD.; D'Amato, CJ.; Penney, JB.; Young, AB. Differential loss of striatal projection neurons in Huntington disease. ProcNatlAcadSci USA 85: 5733–5737, 1988.

28 Y, Sari. "Huntington's disease: from mutant huntingtin protein to neurotrophic factor therapy," International Journal of Biomedical Science, vol. 7, no. 2, pp. 89–100, 2011

29 Wang, JQ.; Chen, Q.; Wang, X.; Wang, QC.; Wang, Y.; Cheng, HP.;Guo, C.; Sun, Q.; Chen, Q.; Tang, TS. (2012) Dysregulation of mitochondrial calcium signaling and superoxide flashes cause mitochondrial genomic DNA damage in Huntington's disease. J BiolChem 288:3070–3084.

30 S, Hodgins. "Mental disorder, intellectual deficiency, and crime: evidence from a birth cohort," Archives of General Psychiatry, vol. 49, no. 6, pp. 476–483, 1992.

31 S, Hodgins.; S, A. Mednick.; P, A. Brennan.; F, Schulsinger.; M, Engberg.; "Mental disorder and crime: evidence from a Danish birth cohort," Archives of General Psychiatry, vol. 53, no. 6, pp. 489–496, 1996.

32 American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (American Psychiatric Publishing, 2013).

33 Lo, C. Y. et al. Randomization and resilience of brain functional networks as systems-level endophenotypes of schizophrenia. Proc. Natl Acad. Sci. USA 112, 9123–9128 (2015)

34 Burns, T.; Patrick, D. Social functioning as an outcome measure in schizophrenia studies. Acta Psychiatr. Scand. 116, 403–418 (2007).

35 Fett, A. K. et al. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. Neurosci. Biobehav. Rev. 35, 573–588 (2011).

36 D, Babic.; R,Babi. ´ c. "Complementary and alternative ´ medicine in the treatment of schizophrenia," PsychiatriaDanubina, vol. 21, no. 3, pp. 376–381, 2009.

37 G, Elkins.; M, H. Rajab.; J, Marcus. "Complementary and alternative medicine use by psychiatric inpatients," Psychological Reports, vol. 96, no. 1, pp. 163–166, 2005.

38 Chang, D.; Liu ,J.; Bilinski, K. et al. Herbal medicine for the treatment of vascular dementia: an overview of scientific evidence. EvidBasedComplAlternMed. 2016;2016:1–15.

39 Tewari, D.; Stankiewicz, AM.; Mocan, A.; Sah, AN. Ethnopharmacological approaches for dementia therapy and significance of natural products and herbal drugs. FrontAgingNeurosci. 2018,10(3):1–24.

40 Rossor, MN.;Fox, NC.; Mummery, CJ.; Schott, JM.; Warren, JD. The diagnosis of young-onset dementia. LancetNeurol. 2010,9(8):793–806.

41 Tripathi, M.; Vibha, D. Reversible dementias. IndianJPsychiatry. 2009,51(Suppl1):S52

42 Iadecola C. The pathobiology of vascular dementia. Neuron. 2013,80(4):844–86

43 Rivas-Arancibia, S.; Hernández-Zimbrón, LF.; Rodríguez-Martínez, E.;Borgonio-Pérez, G.; Velumani, V.; Durán-Bedolla ,J. Chronic exposure to low doses of ozone produces a state of oxidative stress and blood-brain barrier damage in the hippocampus of rat. AdvBiosciBiotechnol. 2013,04(11):24–29.

44 Yan, D.; Zhang, Y.; Liu, L.; Yan, H. Pesticide exposure and risk of alzheimer's disease: a systematic review and meta-analysis. SciRep. 2016,6(1):1–9.

45 Van, Marum. RJ. Update on the use of memantine in alzheimer's disease. NeuropsychiatrDisTreat. 2009,5(1):237–247.

46 Mishra, L.C.; Singh, B.B.; Dagenais, S. Scientific basis for the therapeutic use of Withaniasomnifera (ashwagandha): A review.Altern. Med. Rev. 2000, 5, 334–346.

47 Russo, A.; Izzo, A.A.; Cardile, V.; Borrelli, F.; Vanella, A. Indian medicinal plants as antiradicals and DNA cleavage protectors.Phytomedicine 2001, 8, 125–132.

48 Matsuda, H.; Murakami, T.; Kishi, A.; Yoshikawa, M. Structures of withanosides I, II, III, IV, V, VI, and VII, new withanolideglycosides, from the roots of Indian Withaniasomnifera DUNAL. and inhibitory activity for tachyphylaxis to clonidine in isolatedguinea-pig ileum. Bioorg. Med. Chem. 2001, 9, 1499–1507.

49 Tohda, C.; Kuboyama, T.; Komatsu, K. Dendrite extension by methanol extract of Ashwagandha (roots of Withaniasomnifera) inSK-N-SH cells. Neuroreport 2000, 11, 1981–1985.

50 Kuboyama, T.; Tohda, C.; Komatsu, K. Neuritic regeneration and synaptic reconstruction induced by withanolide A. Br. J.Pharmacol. 2005, 144, 961–971.

51 Russo, A.;Izzo, AA.;Cardile, V.;Borrelli, F.;Vanella, A: Indian medicinal plants asantiradicals and DNA cleavage protectors. Phytomedicine 2001, 8:125-132.

52 Auddy, B.;Hazra, J.;Mitra, A.;Abedon, B.;Ghosal, S. A standardized Withaniasomnifera extract significantly reduces stress-related parameters inchronically stressed humans: a double-blind randomized, placebo-controlled study. J Am NutraAssoc 2008, 11:50-56.

53 Kuboyama, T.;Tohda, C.; Zhao, J.; Nakamura, N.; Hattori, M.; Komatsu, K. Axon-ordendrite-predominant outgrowth induced by constituents fromAshwagandha. Neuroreport 2002, 13:1715-1720

54 Pushkar, GK.;Pushkar, BK.; Sivabalan, R. A review on major bioactivities of Bacopamonnieri, Annals ApplBiosci, 2015, 2(2): 1-11.

55 Hofrichter, J.; Krohn, M.; Schumacher, T.; Lange, C.; Feistel, B.; Walbroel, B.; Pahnke, J. Sideritis spp. Extracts Enhance Memoryand Learning in Alzheimer's beta-Amyloidosis Mouse Models and Aged C57Bl/6 Mice. J. Alzheimers Dis. 2016, 53, 967–980.

56 Dimpfel, W.; Schombert, L.; Biller, A. Psychophysiological Effects of Sideritis and Bacopa Extract and Three Combinations Thereof—A Quantitative EEG Study in Subjects Suffering from Mild Cognitive Impairment (MCI). Adv. Alzheimer's Dis. 2016, 5,1–22.

57 Limpeanchob, N.;Jaipan, S.;Rattanakaruna, S.;Phrompittayarat, W.; Ingkaninan K, Neuroprotective effect of Bacopamonnieri on beta-amyloid-induced cell death in primary cortical culture, J Ethnopharmacol, 2008, 120(1): 112-117

58 Shinomol, GK.;Mythri, RB,;SrinivasBharath, MM.; (2012)Muralidhara.Bacopamonnieri extract offsets rotenome-induced cytotoxicity in dopaminergic cells and oxidative impairments in mice brain. Cell MolNeurobiol 32:455–465

59 Mullaicharam, AR. A review on evidence based practice of Ginkgo biloba in brain health, Int J Pharm Chem Anal, 2013; 1: 24-30.

60 Kim, MS.; Lee, JI.; Lee, WY.; Kim, SE.Neuroprotective effect of Ginkgo biloba L. extract in a rat model of Parkinson's disease, Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 2004; 18(8): 663-666.

61 Singh, SK.;Srivastav, S.;Castellani, RJ.;Plascencia-Villa, G.; Perry, G.Neuroprotective and antioxidant effect of Ginkgo biloba extract against AD and other neurological disorders, Neurotherapeutics, 2019; 1-9.

62 Mahadevan, S.; Park, Y. Multifaceted therapeutic benefits of Ginkgo biloba L.: Chemistry, efficacy, safety, and uses. J. Food Sci.2008, 73, R14–R19.

63 Ramassamy, C.; Longpre, F.; Christen, Y. Ginkgo biloba extract (EGb 761) in Alzheimer's disease: Is there any evidence? Curr.Alzheimer Res. 2007, 4, 253–262.

64 Yao, Z.; Drieu, K.; Papadopoulos, V. The Ginkgo biloba extract EGb 761 rescues the PC12 neuronal cells from beta-amyloid-induced cell death by inhibiting the formation of beta-amyloid-derived diffusible neurotoxic ligands. Brain Res. 2001, 889,181–190.

65 Smith, PF.;Maclennan, K.; Darlington, CL. The neuroprotectiveproperties of the Ginkgo biloba leaf a review of the possible relationship to platelet-activating factor (PAF). J Ethnopharmacol1996,50:131–139.

66 Shi, C.; Zhao, L.; Zhu, B.; Li, Q.; Yew, DT.; Yao, Z.;Xu, J. Protective effects of Ginkgo biloba extract (EGb761) and its constituents quercetin and ginkgolide B against beta-amyloid peptideinduced toxicity in SH-SY5Y cells. ChemBiol Interact 2009,181:115–123.

67 Khazdair, MR.;Boskabady, MH.;Hosseini M, Rezaee, R.; Tsatsakis, AM.; The effects of Crocus sativus (saffron) and its constituents on nervous system: A review, Avicenna J Phytomed, 2015; 5(5): 376.

68 Nemati, H. BM.; Ahmad, zadefVostakolaei. H. Stimulatory effect of crocus sativus (saffron) on beta2-adrenoceptors of guinea pig tracheal chains, Phytomedicine, 2008; 15: 1038–1045 .

69 Akhondzadeh, S.; Sabet, M.S.; Harirchian, M.H.; Togha, M.; Cheraghmakani, H.; Razeghi, S.; Hejazi, S.S.; Yousefi, M.H.;Alimardani, R.; Jamshidi, A.; et al. Saffron in the treatment of patients with mild to moderate Alzheimer's disease: A 16-week,randomized and placebo-controlled trial. J. Clin. Pharm. Ther. 2010, 35, 581–588.

70 Farokhnia, M.; ShafieeSabet, M.; Iranpour, N.; Gougol, A.; Yekehtaz, H.; Alimardani, R.; Farsad, F.; Kamalipour, M.; Akhondzadeh,S. Comparing the efficacy and safety of Crocus sativus L. with memantine in patients with moderate to severe Alzheimer's diseaseA double-blind randomized clinical trial. Hum. Psychopharmacol. 2014, 29, 351–359.

71 Chainani-Wu, N. Safety and anti-inflammatory activity of curcumin: A component of tumeric (Curcuma longa). J. Altern.Complement Med. 2003, 9, 161–168. [CrossRef].

72 Aggarwal, B.B.; Sundaram, C.; Malani, N.; Ichikawa, H. Curcumin: The Indian solid gold. Adv. Exp. Med. Biol. 2007, 595, 1–75.

73 Breitner, J.C.; Welsh, K.A.; Helms, M.J.; Gaskell, P.C.; Gau, B.A.; Roses, A.D.; Pericak-Vance, M.A.; Saunders, A.M. Delayed onsetof Alzheimer's disease with nonsteroidal anti-inflammatory and histamine H2 blocking drugs. Neurobiol. Aging 1995, 16, 523–530.

74 Butterfield, D.; Castegna, A.; Pocernich, C.; Drake, J.; Scapagnini, G.; Calabrese, V. Nutritional approaches to combat oxidativestress in Alzheimer's disease. J.Nutr. Biochem. 2002, 13, 444.

75 Hewlings, S.J.; Kalman, D.S. Curcumin: A Review of Its Effects on Human Health. Foods 2017, 6, 92.

76 Bala, K.; Tripathy, BC.; Sharma, D.Neuroprotective and anti-ageing effects of curcumin in aged rat brain regions, Biogerontology, 2006, 7(2): 81-89.

77 Lawrence, BM. A planning scheme to evaluate new aromatic plants for the flavor and fragrance industries, New crops, 1993, 620-627.

78 Sahib, NG.; Anwar, F.;Gilani, AH.; Hamid, AA.;Saari, N. et al., Coriander (Coriandrumsativum L.): A potential source of high-value components for functional foods and nutraceuticals-A review, Phytother Res, 2013, 27(10): 1439-1456.

79 Mohan, M.;Yarlagadda, S.; Chintala. S. Effect of ethanolic extract of Coriandrumsativum L on tacrine induced orofacial dyskinesia, Indian J ExpBiol, 2015, 53(3): 292-296 .

80 Vekaria, RH.; Patel, MN.;Bhalodiya, PN.; Patel, V.; Desai, TR. et al., Evaluation of neuroprotective effect of coriandrumsativumlinn. Againstischemicreperfusion insult in brain, Int J Pharmacol, 2012, 2: 186-93.

81 Mani, V.; Parle, M.;Ramasamy, K.; Abdul,Majeed. AB. Reversal of memory deficits by Coriandrumsativum leaves in mice, J Sci Food Agric, 2011, 91(1): 186-192.

82 Nahata, A.;Patil, UK.; Dixit, VK. Effect of Convolvulus pluricaulischoisy on learning behavior and memory enhancement activity in rodents. Nat. Prod. Res. 2008,22/(16):1472–1482.

83 Malik, J.; Karan, M.;Vasisht, K.Noo tropic, anxiolytic and CNS-depressantstudies on diff erent plant sources of shankhpushpi. Pharm Biol 2011,49:1234-1242.

84 Jain, NN.;Ohal, CC.;Shroff, SK.;Bhutada, RH.;Somani, RS.;Kasture, VS.KastureSB:Clitoriaternatea and the CNS. PharmacolBiochemBehav 2003, 75:529-536.

85 Sharma, K.;Bhatnagar, M.;Kulkarni, SK.Effect of Convolvulus pluricaulisChoisy and Asparagus racemosusWilld on learning and memory in young and old mice: a comparative evaluation. Indian J ExpBiol 2010, 48:479-485.

86 Rai, KS.; Murthy, KD.;Rao, MS.; Karan KS. Altered dendritic arborization of amygdala neurons in young adult rats orally intubated with Clitoreaternatea aqueous root extract. Phytother Res 2005, 19:592-598.

87 Dikalov, S.;Losik, T.;Arbiser, J. Honokiol is a potent scavenger of superoxide and peroxyl radicals. Biochem. Pharmacol.2008;76/(5):589–596.

88 Kim, S.R.; Koo, K.A.; Lee, M.K.; Park, H.-G.; Jew, S.-S.; Cha, K.-H.; Kim, Y.C. Asiatic acid derivatives enhance cognitiveperformance partly by improving acetylcholine synthesis. J. Pharm. Pharmacol. 2004, 56, 1275–1282.

.