



**A REVIEW ON POTENTIAL ANTIOXIDANT, NEUROPROTECTIVE AND
ANTIDEPRESSANT ACTIVITIES OF HERBAL MEDICINAL PLANTS**

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ABSTRACT

Exposure to several chemical and environmental pollutants has risen due to the increased influence of western diets and modern lifestyle among peoples. It is playing a key role in chances of developing a neurodegenerative disorders and depression in this 21st century. Neurodegeneration, it is death of neurons in Central Nervous System and it is becoming the most growing cause of mortality. Depression, a mood disorder, leading to severe mental illness due to decrease in brain monoamines, becoming 2nd most devastating cause of death in a very early age. Despite of having plenty of standard drugs, limitations of pharmacotherapy make it urgent to shift towards an herbal source. Drugs from herbal matter can be more effective, as it has been used from ancient time, are cheaper, show less adverse effects and work for a longer time in body. These are rich source of several phytochemicals as flavonoids, polyphenols, terpenoids, saponins and many essential oils, which provide a source of antioxidants that work also as neuroprotective agents and some other which may raise the brain monoamines, thus can work as antidepressant too. This review compiles the list of medicinal plants exhibiting neuroprotective, antioxidative and antidepressant activities with their botanical name, common name and basic phytochemical constituents.

KEYWORDS: Medicinal plants, neuroprotection, antidepressant, antioxidant, radicals.

INTRODUCTION

Human dependency on western diets and modern lifestyle has increased their exposure to several environmental and chemicals pollutants worldwide, results in mood disorders and mental illness like depression, neurodegeneration and anxiety. NDs, affecting millions of people globally every year (44% elevation in mental, neurological and substance use disorder pressure from 1990-2013 has found which estimated to increase further by 23% by 2025 in India) cause locomotory dysfunctions, psychological impairments, reduction in memory, cognitive defects and many other devastating effects on body.^[1] NDs are rapidly growing cause of death, so it becomes extremely important to prevent these diseases at early stages.^[2] The pathological signs include aging, dysfunction and mortality.^[3] As human life expectancy is increasing, so too has the chances of getting these age-related ailments.^[4] Some biological mechanisms also affect neuronal health as degradation of neurotransmitters in synaptic cleft, cell death, mitochondrial dysfunction or any damage in BBB.^[5] Most commonly known NDs are as, Alzheimer's disease, a consequence of diffuse cerebral atrophy; in Parkinson's disease loss of dopaminergic neurons occurs and whereas in

Huntington's disease loss of medium sized striatal neurons occurs, some other are Multiple Sclerosis, dementia etc.^[6] Inflammation has also been recognized as an important mediator for the cause of CNS related pathologies.^[7] Oxidative stress may also results in pathological conditions, which may result in lipid per oxidation in organs like brain, formation of ROS as a result may cause, chronic and acute neurodegeneration in neurons of brain.^[8] Despite remarkable drug research, presently available synthetic therapeutic options ease symptoms but with more adverse effects and cannot stop disease progression, so, a better alternative is needed. Medicinal plants play a key role to treat such disorders.^[9] The global economy in medicinal plants and their derivatives is currently estimated to be worth US\$100 billion, growing at an annual rate of 15%.^[10]

Natural products are a potent source of many medicinally active constituents. According to the World Health Organization (WHO), more than 80% of the world's population depends on medicinal plant-based systems for primary health care.^[11]

Medicinal plants have polyphenolic alkaloids compound and flavonoids as resveratrol, curcumin, ginsenoside,

triptolide etc., which shows neuroprotective effects, delay neurodegeneration and also improve memory and cognitive functions.^[12] Natural Antioxidants can work at different steps, they can bind with iron, so can prevent radical formation and by inhibiting damage caused by ROS.^[13] Herbal matters are considered as the leading source of antioxidants because of high reducing power of secondary metabolites.^[14] These significance of herbal products to treat many illness and for a healthy lifestyle has increased in past years.^[15]

Like NDs, another most common affective disorder is depression, a heterogeneous mood disorder or disturbances of thoughts, it may be initiating from mild condition to moderate and even can worsen the condition with severe hallucinations and even premature death.^[16] The psychological consequences of COVID-19 pandemic and quarantine period are also associated with depression and anxiety.^[17] Symptoms include feeling sadness, worthlessness, not able to experience happiness, loss of libido, change in biological clock and sleep patterns, suicidal thoughts, Tachycardia, sweating, respiratory dysfunction, insomnia and aggression etc.^[18,19] Two types of depression are known named as unipolar and bipolar depression, in unipolar, mood swings are continuously in one way, common (75%), non-familial, linked with traumatic life events, another is bipolar (endogenous) (25%) shows a familiar pattern, not associated with outer stress but usually appears early in adult life.^[20] Various factors can cause depression including biological, inherited, and psychological but the key enzyme that has been suggested to be the most susceptible to trauma is monoaminoxidase-A[MAOA] and amongst the most accepted hypothesis, patient with major depression have symptoms which are expressed because of change in neurotransmitters, particularly Nor-epinephrine (NE), dopamine (DA) and serotonin (5-HT).^[21,22]

There are many drugs available for depression but they show severe adverse effects, drug-drug interaction and probability of relapse.^[23] These conditions provide an opportunity to herbal medicine and natural products as an alternative strategy to treat depression and anxiety in a better way using natural components.

Plants exhibiting Neuroprotective and Antioxidant activities (Table-1)

Eugenia dysenterica

Common name - "Cagaita" (Brazilian plant), a rich source of antioxidants such as quercetin and catechin. In AlCl₃ induced neurotoxicity, CHE of leaves showed same behavior as of a standard antioxidant compound quercetin for oxidative stress markers as CAT, SOD and lipid peroxidation. Thus, may work for neuroprotection by minimizing memory loss.^[24]

Salvia officinalis

Commonly known as "Common Garden sage" occurs in Middle East and Mediterranean areas. Ethanolic extract

of leaves contains flavonoids have antioxidative properties, decrease MDA levels and increase the activity of AChE and GSH result in neuroprotective effects.^[25]

Hypericum perforatum

Commonly called as "St. John's wart", Grows in open areas mostly in world's temperate regions, contains compound as flavonoids, rutin, quercetin and kaempferol. Alcoholic extract of this whole plant has potent effects on depression, lipid peroxidation and cell protection against amyloid β induced toxicity. Work in regulation of neurotransmitters receptors, so protect neuronal disorders.^[26]

Lavandula angustifolia

Commonly known as "English lavender", found in Europe-Mediterranean range, it contains essential oil, anthocyanin, phytosterols, sugars, minerals, coumaric acid, glycolic acid, valeric acid, ursoilic acid and tannins. Decrease the glutamate induced neurotoxicity by inhibiting cholinesterase, so it helps in prevention of cognitive dysfunction and provide neuroprotection.^[76, 27]

Curculigo orchioides

Commonly known as "Golden eye grass", native to Nepal, China, Japan, India and Micronesia, contains flavonoids and polyphenols. It tends to increased restoration of CAT, SOD and GSH levels and decreased MDA levels. Studies also showed that it has cell protective effect against cisplatin induced cell damage, so it can work as a neuroprotector.^[28]

Ficus sycomorus

Popular as "Fig", native of Africa. Phytoconstituents as alkaloids, carbohydrate, flavonoids, saponins, steroids, tannins, phenols, anthocyanin and coumarin are present. Methanolic extracts of figs or fruits represent inhibitory effect on seizures, contains good amounts of amino acids and 5-HT, which is useful for neuroprotection. Studies also showed, this plant has also been used in treatment of epilepsy, because of its anticonvulsant properties.^[29,30]

Panax ginseng

Also known as "Korean ginseng", found in China, South Korea and Japan. Contains bioactive compounds as ginsenosides, polysaccharides, amino acids, volatile oils and polyacetylenes. EA fraction of plant showed inhibitory properties over AChE and decreases MDA levels in brain tissue of mice. Ginseng suppress the formation of ROS, NO and TNF- α , provide protection of dopaminergic neurons and neuroinflammatory suppression.^[31]

Angelica sinensis

Commonly known as "Dong quai", is indigenous to China. It contains β sitosterol, uracil, daucosterol, hyperoside, caffeic acid, sucrose, D-glucose. Previous studies indicated that it has compounds as ferulic acid and phthalates which action in improvement of memory

impairment in amyloid β induced neurotoxicity, promotes scavenging of intracellular ROS, it also promotes expression of protective genes like heme oxygenase-1 and HSP72 (heat shock protein 72), thus shows antioxidant and neuroprotection.^[32]

Tecomella undulata

Commonly known as “Rohida” and “Desert teak”, state flower of Rajasthan, is native of Oman and from southwest Iran to northwest India. A rich source of biological active compounds as tecomellosides, tecomine, tecosides lapachol, β -sitosterols, undulosides, chromones glycosides, veratric acid, tannins and saponins. Antioxidant effects were reviewed on STZ induced diabetic rats, MDA levels of plasma have been decreased by treating them with leaves ethanolic extract. The level of plasma GSH back tonear normal range.^[33,34]

Ginkgo biloba

Common name – “Maidenhair tree”, is native to China. Its constituents are flavonoids, terpenoids, bifalvones, organic acids other substances. Leaf Extract (EGb 761) contains two major constituents i.e., flavonoids and terpenoids, which are useful in treatment of neurodegenerative disorders like AD, EGb 761 shows potent antioxidation properties against A β fragments induced toxicity and protect hippocampal neurons.^[35]

Lycium barbarum

Common name - “Goji berry”, native to China, possess constituents like Carotenoids, flavonoids, alkaloids, amides, and terpenoids. Well known for its for its anti-aging property, in primary rat cortical neurons exposed to A β fragments, pretreatment with extract reduces the LDH, it also exhibits dose – dependent neuroprotective effects.^[36]

Crataegus pinnatifida

Also known as “Mountain hawthorn” or “Chinese hawberry”, found in Southeast and Native to China. Contains chemical composition of flavanols, triterpenoids, steroids etc. It was found to have high total phenolic compounds, in luminol H₂O₂ system, CPE shows the best H₂O₂ scavenging activity near to a standard compound Trolox, worked as antioxidant. It also provide neurogrowth effect and work as a potent neuroprotectant.^[37]

Pistacia lentiscus

Commonly known as “Mastic”, native to Mediterranean basin, it contains phytoconstituents Myrcene, β gurjunene, terpinene, α pinene, murolene. Have high reducing power, in chloroform and hexane aqueous extract than that of standard, BHA and α -tocopherol. also exhibited high DPPH scavenging activity in different extracts, except its chloroform extract. H₂O₂ scavenging activity of extracts also been high, suggest that it can eliminate radicals.^[15]

Curcuma longa

Commonly known as “Turmeric”, native to tropical South Asia, a popular spice in India and other Asian countries. *Curcuma longa* have several medicinal values, as it contains polyphenols and non-flavonoid compound known as curcumin. Curcumin possess highly neuroprotective activity. Water soluble extract of curcumin was able to increases dopamine, nor-epinephrine and 5-HT levels in CNS.^[38]

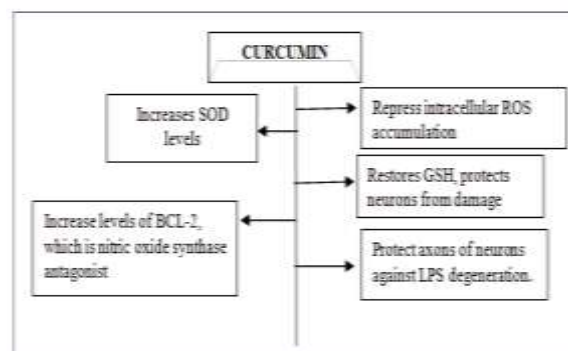


Fig. 1: Mode of action of Curcumin at different levels.

Plumbago zeylanica

It is also known as “Ceylon leadwort” or “Doctor bush”, is native of South Africa, and contains non-phenolic (plumbagin- naphthoquinone), phenolic compounds and flavonoids. Plumbagin is soluble in hot water and ethanol, ethanolic extract of root this plant has shown, effective DPPH and FRAPS assays, while boiled aqueous root extract was efficient in scavenging ABTS radicals. Root extract of the plant inhibit lipid peroxidation in mitochondria of rat liver.^[13]

Terminalia chebula

Commonly known as “Black or chebulic myrobalan”, is native to South Asia from India, Nepal east to Southwest China, Sri Lanka, Malaysia and Vietnam, Its phytoconstituents are tannins (Punicalagin, Terflavin, terchebulin, punicalin, gallic acid, casuarinin, ellagic acid, methyl gallate), phenols, terpenoids, saponins, sterols, flavonoids etc, acetone extract of bark showed excellent ferrous reducing power, high inhibition of lipid peroxidation because of their hydrophilic polyphenolic compounds and also able to scavenge hydroxyl radicals. EA and water extracts have antiradical potential. Thus, work as potential antioxidant.^[39]

Melaleuca alternifolia

Commonly known as “tea tree”, is native to Australia’s Bungawalbin valley, in Northern New South Wales, rich in phytoconstituents as terpinen-4-ol, terpinolene and 1, 8-cineole chemotypes, essential oil of plant has shown the hydroxyl radical scavenging activity more similar of DPPH, but lesser than quercetin, higher than α tocopherol. The essential oil also shows anti lipid peroxidation activity.^[40]

Bacopa monnieri

Popular as “Brahmi”, is best known for its medical properties in ayurveda. Found in wetlands of Southern and Eastern India, Australia, Europe, Africa, Asia and North and South America. Phytoconstituents are saponins (Bacosides), glycosides, jujubogenin, lutein and apigenin. It consist potential to renew nerve cell and possess great activity to improve memory power. It is also found useful for its anti-oxidant, anti-stress, anti-inflammatory properties. Effective in treatment of HD.^[41]

Withania somnifera

Also known as “Ashwagandha”, grows in India and the Middle East parts of Africa. Contains many pharmacologically active steroidal lactones named as withanolides compounds which showed anti-proliferative properties, inhibit formation of tumors in CNS and cancers, it also inhibits NADPH-d activity by releasing of corticosterone and enhancing choline acetyl transferase, as a result it boosts serotonin in hippocampus.^[42]

Opuntia ficus- indica

Commonly known as “the Indian fig opuntia or prickly pear”, is native to, Mexico and is widespread in Central America, Southern USA, Africa, Asia and Southern Europe. Phytochemicals as flavonoids, tannins, saponins and phenols are present. The methanolic extract of these fruits found to decrease neuronal damage occurred due to free radicles, hence work as an antioxidant. Butanol extract increased the restoration of some activities like–CAT, SOD and GSH levels and also decreased MDA levels in cyclophosmide induced neurotoxicity was proved in previous research.^[43]

Plants showing Antidepressant activities (Table-2)***Zinger officinale***

Popular as “Ginger”, It is native to Southeastern Asia, and contains phytoconstituents as phenols (gingerols and shogaols), terpenes, polysaccharides, lipids, organic acids and raw fibers. Ginger has been used in traditional medicine from decades, and also as health supplements, it express bio medicinal properties and treat various disease as asthma, diabetes, nausea, hypertension, dementia and also exhibit properties like antisedative and Antianxiety, previous research reported that in depression associated with diabetes ginger shows enhancing activities of 5-HT₃ receptors, and improve symptoms of depression.^[44]

Centella asiatica

It is also known as “Gotu kola or Indian penny wart”, found in the Southeast Asian countries as India, Sri Lanka, Indonesia and Madagascar, contains constituents like saponins, terpenoids, alkaloids and phenols, several researches have done which shows sedative, anxiolytic, antiepileptic, memory enhancing and immunomodulation activities of this plant.^[45]

Momordica charantia

Also called as “bitter-melon or ampalaya”, is native to tropical and subtropical parts of Asia and Africa. It has been used as both food and medicine, its phytochemicals compounds are alkaloids, flavonoids, glycosides, triterpenoids, steroids, phenols, tannins, oils and fats. The unripe fruit and leaves of this plant also been reviewed as potent antidepressant and anti-anxiety herbs.^[46]

Cucurbita pepo

Commonly popular as “Pumpkin”, found in United States, Canada, Europe, Asia and Mexico. Have number of phytochemical compounds as carotenoids, polyphenols, minerals and vitamin C. Aqueous and alcoholic extract of this plant has shown high antidepressant like effect in mice in FST and its effectively found to be similar as imipramine.^[47]

Aegle marmelos

Commonly known as “Bilwa or Bael”, is native across the Indian subcontinent and Southeast Asia, also cultivated throughout Sri Lanka, rich in phytochemical compounds as carotenoids, phenolic, alkaloids, pectin, tannins, coumarins, flavonoids and terpenoids. It is an ayurvedic medicinal plant, fruit of this plant is known as ‘Bael fruit’ is popular all over the India, methanol extract of leaves of this plant has shown anxiolytic and antidepressant activities by enhancing monoamines levels at post synaptic sites.^[48]

Rosmarinus officinalis

This plant is commonly known as “Rosemary”, it is native to the Mediterranean region, and cultivated in several European countries and in USA. contains phytochemicals as rosamarinic acid, camphor, caffeic acid, ursolic acid, betulinic acid, carnosic acid and carnosol. It is often use in perfume industry and as a flavoring agent and has been used in medicine because of its antioxidant properties, and also work to improve memory, it was also found to have antidepressant activity.^[49]

Papaver rhoeas

It is commonly known as “Wild poppy”, is native of China, Nepal, Pakistan, Africa, Europe; North America. This plant was found to have a variety of alkaloids as radin, radic acid, papaveric acid, macoic acid, mucilase and a very low amount of morphine and several other drug properties. Hydrochloric extract also showed improved depression in rats in a dose dependent manner. Alcoholic extract also shows low levels of anxiety and decreased corticosterone.^[50]

Glycyrrhiza uralensis

It is commonly known as “Mulethi”, is mainly cultivated in arid and semiarid areas in China. It contains triterpene, saponins, flavonoids etc. flavonoids from these plants have exerted antidepressant like effect in animal models, liquiritin a flavones part derived from

G.uralensis showed antioxidative and antidepressant properties in chronic stress induced depression model of rats.^[51]

Echium amoenum

Commonly known as “Borage”, is native of Caucasus Mountains, grow North of Iran and also in Europe and Mediterranean regions. The effective phytoconstituents of this plant include anthocyanidins, flavonoid aglycone and gamma fatty acids and because of these its showed anticonvulsants and antidepressant activity and also found to regulate animal behavior and treatment of anxiety.^[52]

Matricaria chamomilla

Also known as “Chamomile”, it is native of Europe and Western Asia and found in Australia and North America. This plant has been reported to strengthen neurological functions and immune systems. Properties like hypnosis, sedation, analgesia, anti-colic and Antianxiety has also been shown due to flavonoids content of this plant. It also has been evident that flavonoids affect the binding of neurotransmitter GABA, NE, DA and serotonin to its receptors. Its different extracts function in improve of memory by preventing neuropathological processes.^[53]

Siphocampylus verticillatus

A Brazilian medicinal plant, found to exhibit antidepressant-like activity in its hydrochloric extract of aerial parts against synaptosomal uptake of serotonin, noradrenaline and dopamine. reduced immobility time in FST and TST test, it might work as a potent antidepressant by interacting with adrenergic, dopaminergic, glutamatergic and serotonergic system.^[54]

Curcuma longa

It is commonly known as “Turmeric”, is native to tropical South Asia, it contains phytochemicals as cyclocurcumin and curcumin. It shows various medicinal properties, according to some previewed literature the aqueous extract of this plant, showed dose dependent effect when administered orally to the mice model, causes reduction in immobility in TST, in higher concentration show enhanced effect than that of standard fluoxetine, it may action as an antidepressant by inhibiting MAOA in mouse brain.^[55]

Piper laetispicum

Also, popular as “Pepper”, is a native of China to Northern Thailand, Hainan, contains phytochemicals as stigmaterol, vitexin, β sitosterol, laetispicine, brachystamide A, D-glucoside etc. The effect of an amide alkaloid known as laetispicine isolated from stem of *P. laetispicum*, showed antidepressant and antinociceptive activity in forced swimming, acetic acid writhing and formalin test in a mice model, this activity in dose dependent manner, thus it is potentially useful in pain and depression.^[56]

Asparagus racemosus

Commonly known as “Satawar”, is common throughout the India and the Himalyas and northern Australia. Possesses phytochemicals as steroidal saponins, isoflavones, asparagamine, racemosol, mucilage, vitamins A, B1, B2, and folic acid. well-known anti stress ayurvedic remedy, by elevating nonspecific resistance of body. methanolic extract of roots has worked as an antidepressant, cause reduction in immobility and in LHT, it showed increase avoidance response in rats’ model, thus methanolic extract of this plant has shown potent antidepressant activity.^[57]

Aloystia polystachya

It commonly known as “Griseb”, it is native of South America, mainly in Argentina and Uruguay, contains several biochemical compounds as thujone and carvone, helpful for antidepressant properties, previous studies showed hydroalcoholic extracts of its leaves produced antidepressant action, in FST when applied in female rats, in a dose dependent manner.^[58]

Epimedium brevicornum

It is commonly known as “Barrenwort” or “Horny goat weed”, is native to China, with smaller numbers elsewhere in Asia and a few Mediterranean region, used in Chinese medicine, several researches confirmed that this plant action as an antidepressant by inhibiting MAOA, MAOB and also by reducing serum MDA levels. Flavonoids increase the neurotransmitters as 5-HT and 5-HIAA by increasing gene expression of receptors in pituitary. Carine is a key flavonoid compound which is able to cross the BBB, hence can work for reduction of neuroinflammation.^[59]

Berberis aristata

It is popular as “Daruharidra or Daruhaldi”, is native to Northern India and Nepal. It contains phytochemical as Berberine, oxyberberine, berbamine, aromoline, alkaloids, tannins, sugars etc., more often used for the treatment of inflammation, jaundice, diarrhea but many recent studies have antidepressant like activity in TST and also antioxidative nature of this plant has studied. It contains alkaloids berberine which helps in increased in brain serotonin, noradrenaline and dopamine levels.^[60]

Hypericum perforatum

It is commonly known as “St John’s Wort”, it can be found across temperate rea of Eurasia. Phytochemicals are Hypericin, hyperforin, pseudohypericin, quercetin, a well known part in the field of antidepressant medicine; Its extract WS 5570 is put up in Germany for acute treatment of mild to moderate depression, in vitro and in vivo studies had shown it might action by elevating serotonin level in brain, blocking the mechanism of reuptake and by activating serotonin 5-HT₂ receptors.^[61]

Spirulina platensis

Commonly known as “Spirulina”, widely distributed in Africa, Asia, California, and Mexico. It contains

chemical compounds as tyrosol, catechine, coumaric, apigenin, protein, folic acid, pantothenic acid, phycocyanin etc. Spirulina has already been used as health supplement and animal food, considering it as rich source of minerals, essential fatty acids, amino acid, and vitamins such as B12 and antioxidative pigments, many studies has also been evident that this shows antidepressant activity, since it decreased the immobility in both FST and TST, increased the 5-HT, clonidine induced aggression and L-DOPA induced hyperactivity,

representing its action on serotonergic, noradrenergic, and dopaminergic systems respectively.^[62]

Eclipta alba

It is also known as “Bhringraj” or “false Daisy”, is widely distributed in China, India, Thailand and Brazil, contains phytoconstituents as comenstans, alkaloids, flavonoids, glycosides, triterpenoids, stigmasterol etc. Recent studies on leaf extract of the plant showed its antidepressant activity in TST and FST in animal model depression.^[63]

Table 1: List of plants reported antioxidative and neuroprotective activities.

Ser. No.	Botanical Name	Family	Activity	References	No
1.	<i>Cassia fistula</i>	Fabaceae	Neuroprotective	Mohebbati <i>et al</i> , 2017	3
2.	<i>Nigella sativa</i>	Ranunculaceae	Neuroprotective	Mohebbati <i>et al</i> , 2017	3
3.	<i>Juglans regia</i>	Juglandaceae	Neuroprotective	Mohebbati <i>et al</i> , 2017	3
4.	<i>Aerva lanata</i>	Amaranthaceae	Antioxidative	Mohebbati <i>et al</i> , 2017	3
5.	<i>Lycium chinense</i>	Solanaceae	Neuroprotective	Uddin <i>et al</i> , 2013	4
6.	<i>Smilacis chinae</i>	Smilacaceae	Neuroprotective	Uddin <i>et al</i> , 2013	4
7.	<i>Piper nigrum</i>	Piperaceae	Antioxidative	Rasool <i>et al</i> , 2014	5
8.	<i>Salvia tiliifolia</i>	Lamiaceae	Anticholinesterase	Rasool <i>et al</i> , 2014	5
9.	<i>Tussilago farfara</i>	Asteraceae	Neuroprotective	Cho <i>et al</i> , 2005	7
10.	<i>Plumbago zeylanica</i>	Plumbaginaceae	Antioxidative	Tilak <i>et al</i> , 2004	13
11.	<i>Pistacia lentiscus</i>	Anacardiaceae	Antioxidative	Atmani <i>et al</i> , 2007	15
12.	<i>Eugenia dysenterica</i>	Myrtaceae	Antioxidative, Neuroprotective	Thomaz <i>et al</i> , 2018	24
13.	<i>Salvia officinalis</i>	Lamiaceae	Antioxidative, Neuroprotective	Lima <i>et al</i> , 2004	25
14.	<i>Hypericum Perforatum</i>	Hypericaceae	Neuroprotective	Silva <i>et al</i> , 2005	26
15.	<i>Lavandula angustifolia</i>	Lamiaceae	Neuroprotective	Muruganandam <i>et al</i> , 1999	27
16.	<i>Curculigo orchioides</i>	Amaryllidaceae	Neuroprotective	Ramchandani <i>et al</i> , 2014	28
17.	<i>Ficussy comoros</i>	Moraceae	Neuroprotective, Antioxidative	Ratnasooriya <i>et al</i> 1998, Singh and Goel, 2009	29,30
18.	<i>Panax ginseng</i>	Araliaceae	Neuroprotective	Lee <i>et al</i> , 2012	31
19.	<i>Angelica sinensis</i>	Apiaceae	Neuroprotective	Kanski <i>et al</i> , 2002	32
20.	<i>Ginkgo biloba</i>	Ginkgoaceae	Neuroprotective	Bastianetto <i>et al</i> , 2000	35
21.	<i>Lycium barbarum</i>	Solanaceae	Neuroprotective	Yao <i>et al</i> , 2011	36
22.	<i>Crataegus pinnatifida</i>	Rosaceae	Antioxidative	Chang <i>et al</i> , 2012	37
23.	<i>Spatholobus suberectus</i>	Leguminosae	Antioxidative	Chang <i>et al</i> , 2012	37
24.	<i>Uncaria rhynchophylla</i>	Rubiaceae	Antioxidative	Chang <i>et al</i> , 2012	37
25.	<i>Alpinia officinarum</i>	Zingiberaceae	Neuroprotective Antioxidative	Chang <i>et al</i> , 2012	37
26.	<i>Drynaria fortune</i>	Caryophyllaceae	Antioxidative	Chang <i>et al</i> , 2012	37
27.	<i>Curcuma longa</i>	Zingiberaceae	Neuroprotective	Noor <i>et al</i> , 2012	39
28.	<i>Terminalia chebula</i>	Combretaceae	Antioxidative, Neuroprotective	Venkatesan <i>et al</i> , 2016	39
29.	<i>Melaleuca alternifolia</i>	Myrtaceae	Antioxidative	Zhang <i>et al</i> , 2018	40
30.	<i>Baccopa monnieri</i>	Plantaginaceae	Antioxidative, Antistress, Anticholinesterase	Ratheesh <i>et al</i> , 2017	41
31.	<i>Withania somnifera</i>	Solanaceae	Neuroprotective, Antistress	Jain <i>et al</i> , 2014	42
32.	<i>Glycyrrhiza glabra</i>	Leguminosae	Anticonvulsant	Abdolmaleki <i>et al</i> , 2020	64

33.	<i>Centella asiatica</i>	Apiaceae	Antioxidative	Gohil et al, 2010	65
34.	<i>Acorus calamus</i>	Acoraceae	Antioxidative, Anticholinesterase	Ahmed et al, 2009	66
35.	<i>Buddleja salviifolia</i>	Scrophulariaceae	Neuroprotective, Anticholinesterase	Adewusi et al, 2011	67
36.	<i>Crocus sativus</i>	Iridaceae	Neuroprotective	Khazdair et al, 2015	68
37.	<i>Polygala paniculate</i>	Polygalaceae	Neuroprotective	Braidy et al, 2013	69
38.	<i>Punica granatum</i>	Lythraceae	Neuroprotective	Celik et al, 2013	70
39.	<i>Citrus limon</i>	Rutaceae	Antioxidative	Moosavy et al, 2017	71
40.	<i>Syzygium aromaticum</i>	Myrtaceae	Antioxidative	Hosseini et al, 2019	72
41.	<i>Humulus lupulus</i>	Cannabaceae	Antioxidative	Arsene et al, 2015	73
42.	<i>Ocimum sanctum</i>	Lamiaceae	Neuroprotective	Kusindarta et al, 2016	77
43.	<i>Delonix regia</i>	Fabaceae	Antioxidative	Kumawat et al, 2017	78
44.	<i>Martynia annua</i>	Martyniaceae	Antioxidative, Anticonvulsant	Kumawat et al, 2017	78
45.	<i>Kigellia Africana</i>	Bignonias	Antioxidative	Kumawat et al, 2017	78
46.	<i>Cassia alata</i>	Leguminosae	Antioxidative	Igara et al, 2023	79
47.	<i>Cassia siamea</i>	Fabaceae	Antioxidative	Ghosh et al, 2023	80
48.	<i>Carthamus tinctorius</i>	Asteraceae	Antioxidative, Neuroprotective,	Alegiry et al, 2022	82
49.	<i>Anthocephalus cadamba</i>	Rubiaceae	Antioxidative	Priyanka et al, 2022	84

Table 2: List of plants reported antidepressant activities.

Ser.No.	Botanical Name	Family	Activity	References	No
1.	<i>Cressa cretica</i>	Convolvulaceae	Antidepressant	Eloziia et al, 2017	16
2.	<i>Spirulina platensis</i>	Spirulinaceae	Antidepressant	Eloziia et al, 2017	16
3.	<i>Asparagus racemous</i>	Asparagaceae	Antistress, Antioxidative, Antidepressant	Jawaid et al, 2011	18
4.	<i>Passiflora caerulea</i>	Passifloraceae	Sedative, Antianxiety	Hosseini and Hosseini, 2018	19
5.	<i>Zinger officinale</i>	Zingiberaceae	Antidepressant	Hosseini and Hosseini, 2018	19
6.	<i>Tecoma stans</i>	Bignoniaceae	Antidepressant	Rahman et al, 2017	20
7.	<i>Melissa officinalis</i>	Lamiaceae	Antistress, Antisedative	Rahman et al, 2017	20
8.	<i>Passiflora foetida</i>	Passifloraceae	Antidepressant	Rahman et al, 2017	20
9.	<i>Magnolia officinalis</i>	Mangoliaceae	Antianxiety, Antisedative	Rabiei and Rabiei, 2017	21
10.	<i>Epimedium brevicornum</i>	Berberidaceae	Antidepressant	Rabiei and Rabiei, 2017	21
11.	<i>Uncaria lanosa wall. var. appendiculata</i>	Rubiaceae	Antidepressant, Antianxiety	Hsu et al, 2012	22
12.	<i>Zingiber officinale</i>	Zingiberaceae	Antidepressant	Farzin et al, 2013	44
13.	<i>Centella asiatica</i>	Umbellifere (Apiceae)	Antidepressant	Selvi et al, 2012	45
14.	<i>Momordica charantia</i>	Cucurbitaceae	Antidepressant, Antianxiety	Ganesan et al, 2008	46
15.	<i>Cucurbita pepo</i>	Cucurbitaceae	Antidepressant	Parvathi et al, 2013	47
16.	<i>Aegle marmelos</i>	Rutaceae	Anxiolytic, Antidepressant	Kothari et al, 2010	48
17.	<i>Rosmarinus officinalis</i>	Lamiaceae	Antioxidative, Antidepressant	Erkan et al, 2008	49
18.	<i>Papaver rhoeas</i>	Papaveraceae	Antianxiety, Antidepressant	Hosseini et al, 2019	50
19.	<i>Glycyrrhiza uralensis</i>	Fabaceae	Antidepressant, Antioxidative	Zhao et al, 2008	51
20.	<i>Echium amoenum</i>	Boraginaceae	Anticonvulsant, Antidepressant	Rabbani et al, 2004	52
21.	<i>Matricaria chamomilla</i>	Asteraceae	Antianxiety	Heidari et al, 2009	53
22.	<i>Siphocampylus verticillatus</i>	Campanulaceae	Antidepressant	Rodrigues et al, 2002	54
23.	<i>Curcuma longa</i>	Zingiberaceae	Antidepressant	Yu et al, 2002	55
24.	<i>Piper laetispicum</i>	Piperaceae	Antidepressant,	Yao et al, 2009	56
25.	<i>Aloysia polystachya</i>	Verbenaceae	Antidepressant	Kumari et al, 2016	58
26.	<i>Berberis aristate</i>	Berberidaceae	Antidepressant	Kumari et al, 2016	58
27.	<i>Hypericum perforatum</i>	Hypericaceae	Antidepressant	Kumari et al, 2016	58
28.	<i>Eclipta alba</i>	Asteraceae	Antidepressant	Swati et al, 2013	63

29.	<i>Morinda officinalis</i>	Rubiaceae	Antidepressant	Zhongqiet al, 2000	74
30.	<i>Tinospora cordifolia</i>	Menispermaceae	Antioxidant, Antistress	Mutalik and Mutalik, 2011	75
31.	<i>Areca catechu</i>	Arecaceae	Antidepressant	Haque et al, 2023	81
32.	<i>Sceletium tortuosum</i>	Aizoaceae	Antiantianxiety	Bonokwane et al,2022	83

DISCUSSION

At the end by studying various parameters, we can conclude that herbal matters are rich source of several phytochemicals as flavonoids, polyphenols, terpenoids, saponins and many essential oils, which provide a source of antioxidants, that work also as neuroprotective agents, previous findings also suggest that there are plenty of herbal drugs may function in a potent manner to treat disease as NDs and depression at a better level, with lesser adverse effect and at a cheaper cost.

CONFLICT OF INTERSET

The authors find no conflicts of interest regarding this survey of literature.

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ABBREVIATIONS	
α	Alpha
β	Beta
NDs	Neurodegenerative disorders
CNS	Central Nervous System
BBB	Blood Brain Barrier
AD	Alzheimer's disease
MS	Multiple Sclerosis
HD	Huntington's disease
ROS	Reactive Oxygen Species
WHO	World Health Organization
MAOA	Monoaminoxidase-A
NE	Norepinephrine
DA	Dopamine
Serotonin/5- HT	5-Hydroxy tryptamine
SOD	Superoxide dismutase
AlCl ₃	Aluminum chloride
MDA	Malondialdehyde
GSH	Glutathione
AChE	Acetylcholinesterase
CAT	Catalase
NO	Nitric oxide
TNF	Tumor necrosis factor
HSP	Heat shock protein
STZ	Streptozotocin
EGb	Extract of <i>Ginkgo biloba</i>
LDH	lactate dehydrogenase
EA	Ethyl acetate
DPPH	2,2-Diphenyl-1-picrylhydrazyl
CPE	<i>C. pinnatifida</i> extract
H ₂ O ₂	Hydrogen peroxide
BHA	Butylated hydroxyanisole
LPS	Lipopolysaccharides
FRAP	Ferric reducing antioxidant power
ABTS	(2,2' azino-bis (3- ethylbenzenothiazoline-6-sulfonic acid)
FST	Forced swimming test
GABA	Gamma aminobutanic acid
TST	Tail suspension test
LHT	Learned helplessness test
HIAA	5- Hydroxyindoleacetic acid
L- DOPA	Levodopa

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